Report from the Fifth Great Lakes Ballast Water Collaborative Meeting: Baltimore

The Pier 5 Hotel

711 Eastern Avenue

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Prepared for: The Great Lakes Ballast Water Collaborative

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Great Lakes Ballast Water Collaborative Meeting: Baltimore

INTRODUCTION/CONTEXT

The goals of this meeting were for participants to:
1. Gain a better understanding of the research being done on ballast water movement and treatment in the Great Lakes.
2. Continue discussions about ballast water treatment system (BWTS) technology, research, and policies.

Approximately 70 representatives from the shipping industry, ballast water treatment technology industry, state and federal governments, and academia attended the daylong (8 a.m. – 5 p.m.) meeting of the Great Lakes Ballast Water Collaborative on September 27, 2011, in Baltimore, Maryland. This was the fifth meeting of the Collaborative, which formed to facilitate the exchange of information and cultivate relationships among academia, the shipping industry, policy makers, and other stakeholders in the ongoing challenge to maintain a cost-effective modern shipping industry while also preventing invasive species from entering North American waters, specifically the waters of the Great Lakes.

The Collaborative met in Baltimore to support the dedication of the Maritime Environmental Research Center's (MERC) barge-based Mobile Test Platform. The 155-foot $2.7 million floating laboratory is part of the research fleet operated by the University of Maryland Center for Environmental Science. Scientists will use the platform to test the efficacy of ballast water treatment systems over a range of salinities and other conditions. Media stories related to the dedication ceremony can be found at: http://mpa.maryland.gov/_media/client/News-Publications/2011/media/09272011press.pdf.

This meeting followed publication of two important reports:

1. **SAB report.** The Environmental Protection Agency's Science Advisory Board Report (July 12, 2011). **Efficacy of Ballast Water Treatment Systems: a Report by the EPA Science Advisory Board.** (154 pp, 1.26MB). http://yosemite.epa.gov/sab/sabproduct.nsf/fedrgstr_activites/6FFF1BFB6F4E09FD852578CB006E0149/$File/EPA-SAB-11-009-unsigned.pdf

2. **NRC report**. The National Academies' National Research Council Report (2011). **Assessing the Relationship Between Propagule Pressure and Invasion Risk in Ballast Water.** (156 pages). http://www.nap.edu/catalog.php?record_id=13184

The **Science Advisory Board (SAB)** concluded that treatment system performance to the IMO D-2 standards can be measured with existing methods, but presently available methods (and associated detection limits) prevent testing of BWMS to any standard more stringent than IMO D-2 and make it impracticable to verify a standard 100 or 1000 times more stringent. New or improved methods will be

required to increase detection limits sufficiently to statistically evaluate a standard 10 times more stringent than IMO D-2/(US Coast Guard proposed Phase 1), although such methods may be available in the near future.

Nine systems were found to have demonstrated the ability to comply with the IMO/Phase 1 discharge standard. However, based on the available testing data, it was also clear that none of these systems performed at 100 times or 1000 times the IMO standard.

The SAB concluded that moderate adjustments or changes to existing technologies can be expected to result in only incremental improvements. Reaching the 1000X standard, or even 100X standard would require entirely redesigned treatment systems and approaches.
(http://cfpub.epa.gov/npdes/vessels/programdevelopment.cfm).

Dr. James Carlton, Chair of the National Academies' Committee on Assessing Numeric Limits for Living Organisms in Ballast Water, made a statement regarding the **National Research Council (NRC)** report before several subcommittees of the U.S. House of Representatives on July 13, 2011 (http://www7.nationalacademies.org/ocga/testimony/Living_Organisms_in_Ballast_Water.asp). He offered the following five conclusions:

> *"First, the methods for determining an exact numeric standard for ballast water discharge are limited by a profound lack of data by which to develop and validate the necessary models that relate organism release to the probability of invasion.*
>
> *Second, while the number of released organisms is important, it is only one of many variables that determine when, why, and where species will invade. Any method that attempts to predict invasions based on only one factor is likely to suffer from a high level of uncertainty.*
>
> *Third, that said, there is evidence that significantly reducing the number of released organisms reduces invasion probability. Therefore a benchmark discharge standard that reduces the concentration of organisms below the levels achieved by open-sea ballast water exchange is an important first step.*
>
> *Fourth, we urge the development of robust statistical models, experimental studies, and field investigations that are focused on the relationship between the quantity, quality and frequency of released organisms and invasion risk. This research could be focused on the types of species that have the highest probability of being good invaders and that are likely to pose the greatest threats to our economy and health. This focus on the "best-case-for-invasion scenarios" sets the regulatory bar high—noting that by "best-case-for-invasion" we mean of course the worst-case for our society; and*
>
> *Fifth, our databases on what invasive species are now becoming established in American waters and our knowledge of the details of many vectors that bring these species to the United States—including ballast water, vessel fouling, the aquarium industry, and the live sea food and bait trades—are patchy and substantially mismatched. For example, we*

have anecdotal accounts that there are now fewer invasions since extensive open-ocean ballast water exchange has been in place for ships arriving from foreign shores. On the other hand, there is no – no – national survey program to determine if invasions have in fact decreased."

At the time of the fifth meeting of the Great Lakes Ballast Water Collaborative, the U.S. Coast Guard was still in the process of issuing a Final (Ballast Water Discharge Standard) Rulemaking, which is now expected in early 2012. The Coast Guard published a Notice of Proposed Rulemaking (NPRM) in August 2009 which proposed a two-phase ballast discharge performance standard: a Phase 1 standard similar to the IMO D-2 standard (http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships'-Ballast-Water-and-Sediments-(BWM).aspx) , and a Phase 2 standard, which, if implemented, would be based on the most stringent quantitative discharge limits proposed in U.S. state regulations, and would provide a target to encourage the development of more effective ballast water management systems. The USCG regulates ballast water discharges under authority of the National Invasive Species Act (NISA).

The EPA regulates ballast water discharges under authority of the Clean Water Act (CWA). The Environmental Protection Agency's (EPA) existing Vessel General Permit (VGP) for discharges incidental to the normal operation of commercial vessels, including ballast water discharges, will expire in December 2013 (http://cfpub.epa.gov/npdes/home.cfm?program_id=350). The EPA is expected to publish the draft of the next iteration of the VGP before the end of 2011.

THE MEETING

Craig Middlebrook, Deputy Administrator of the Saint Lawrence Seaway Development Corporation (SLSDC), served as the meeting's facilitator. He welcomed everyone briefly and said that one of the greatest benefits of Collaborative meetings is the relationships formed through them.

Middlebrook said, "About two years ago in Detroit, when this started … we didn't really know what to expect." He noted that in two years the Collaborative inspired meaningful relationships that are coming up with promising approaches for preventing species that might be in the ballast tanks of Great Lakes ships from invading new ports. Of particular merit are activities of the Canadian Shipowners Association (CSA), Canada Steamship Lines (CSL), the American Steamship Company (ASC), and the National Park Service.

The Collaborative reports are used to inform policy. They have been used by the Wisconsin Department of Natural Resources to reassess WI ballast water discharge

permit regulations, and cited in the EPA's Science Advisory Board report, the National Academies' report, and by the California State Lands Commission.

Middlebrook speculated that the role of the Collaborative in the future might be in helping move from understanding standards to facilitating compliance as the USCG Final Rule and the new VGP are enacted. "We all know there will be a different world by the end of the year," he said.

Terry Johnson, Administrator of the SLSDC, spoke next, thanking the International Joint Commission (IJC), and its U.S. co-chair Lana Pollack (who was in attendance), for supporting the meeting. He also congratulated the U.S. Maritime Administration (MARAD) and Dr. Mario Tamburri (MERC) for the launch of their floating ballast water treatment testing facility, which he said will be "very helpful in our work."

Johnson acknowledged the representatives from six states, USCG, EPA, and a variety of industry leaders from Canada and the U.S who were at the meeting. He thanked the Canadian Steamship Lines for sponsoring the evening reception and praised the IJC for its support of the Great Lakes Ballast Water Collaborative.

Lana Pollack, co-chair of the IJC, stepped to the podium next. Referencing the IJC's Boundary Water Treaty she said, "I think they had this day and this group in mind when they signed [the treaty] over 100 years ago." She said the Collaborative was a clear example of Canada and the U.S. working together on issues concerning international water. Pollack explained that the Treaty was designed to resolve boundary water issues between the U.S. and Canada and that its initial focus was the use of water for power, transport, agriculture, and to protect the environment.

"Every time society has a success in creating a workable strategy to a problem, we all win," said Pollack. "This is an example of what cooperative and collaborative work can achieve. … Thank you, your success will impact not just the interests in this room but the millions of people who rely on the Seaway. It's an example of working through a contentious issue."

Pollack ended by saying, "We live within a dynamic ecology, industry, and climate so we need to continue to see things as evolving. Prepare to learn from the application of this. We'll leave some work for the people who come after us."

UPDATES

Global Oceans

Chris Wiley, representing Transport Canada as well as Fisheries and Oceans Canada, and Chair of the IMO Ballast Water Working Group, attended recent IMO meetings and reported, "After we have solved ballast water, we have biofouling to deal with." To make his point, Wiley used the example of a 177,000 tonne vessel (290m long) in transit to Sept Iles in 2010 that was so badly biofouled after a two year lay-up in Singapore (according to the owner's communication, "fouling extends to all of the

vsl's bottom up to draft of 8m"), that speed was significantly reduced and fuel consumption was significantly increased. The owner wanted permission to clean the hull in Sept Isles, but logistics, timing, and costs ultimately sent the ship to dry dock in Africa. Wiley warned "There are many ships similarly laid-up due to current fiscal reality. The same situation could occur anywhere along the North American coast, with potential for harm to the environment" and added "I see this group as a useful forum for tackling biofouling." Wiley also mentioned that the handling guidelines being developed for bulk liquid gas is a current IMO global-scale issue, but not a big one in the Great Lakes.

Wiley said the IMO is looking at innovative ways to treat ballast, especially with leadership from the European Maritime Safety Organization (EMSO), part of the European Union. The EMSO provides information when available and coordinates activities to help move more countries toward ratifying the IMO Convention on the Management of Ships' Ballast Water and Sediments (see http://www.emsa.europa.eu/main/ballast-water/involvement.html). EMSO has developed guidance on ballast discharge sampling for enforcement based on research and liaison with global experts in the fields of ballast water sampling, water analysis, statistical analysis, port State control (PSC) and plankton biology. Some Flag States don't want to sign the Convention because of the variations in enforcement methodology across the globe. As of last week Wiley said the Port State control, sampling, and analysis were in alignment.

When queried, Wiley speculated that the Convention might be ratified by the end of this year (if countries representing sufficient tonnage sign on) or certainly sometime next year.

Ballast water technology is available, but getting it on ships is frustratingly slow and there are only few technologies that appear to be useful in the freshwater conditions of the Great Lakes (only 2 of 20 currently available systems are type-tested for fresh water, and one of those is currently off the market). See Lloyds of London's newest review of systems (http://www.lr.org/sectors/marine/News/227220-ballast-water-treatment-technology-update-september-2011.aspx).

When asked about global news on freshwater ballast treatment systems, Wiley responded that the Chinese are very interested in developing systems since Shanghai is the world's largest freshwater port.

CANADA

Sarah Bailey of Fisheries and Oceans Canada reported that science-based policy is the Canadian Government's goal. She spoke of a five year funding renewal for the Canadian Aquatic Invasive Species research network (CAISN II). The Network is undertaking a variety of studies, including assessment of exchange plus treatment for management of ballast water and development of DNA methods which might be used for compliance testing. Additionally, she referenced a

completed risk assessment for ship-mediated invasions to the Great Lakes, which includes domestic shipping that should be published by the end of the year. (This is a different risk-assessment than the one the CSA has spearheaded for the Great Lakes fleet; Bailey participated in both projects). Results of an earlier study which sampled the ballast water of domestic ships on the Great Lakes should be out in the next year.

Colin Henein (Transport Canada) discussed Canada's regulatory program. The Canada Shipping Act will be updated and realigned to reflect policy changes in three phases. The first phase moves Canada's existing requirements for ballast water exchange and flushing into the modernized *Canada Shipping Act 2001*. Phase 2 involves implementing the IMO ballast water treatment standards by the end of 2012; the coming-into-force provisions of these regulations will be coordinated with those of the IMO convention. During Phase 3, the Canadian Government plans to use the latest ballast water research to consider what regulations are appropriate for the domestic fleet.

Wiley added, "Currently the regulations are under domestic control but after the IMO Convention is ratified, they will be under Port State control. Either way, the Seaway expects to continue evaluating the ballast water conditions of 100% of the vessels entering the St. Lawrence River from the Atlantic Ocean."

When asked for a comment on how Canada views the BWTSs currently approved, Wiley said, "Our experience is that systems currently on vessels have not been effective in terms of protecting the Great Lakes." He said that the government would consider going aboard and making sure BWTSs work before letting a vessel into the Great Lakes.

Rich Everett wondered if additional testing would lead toward a "type approval" and type-testing requirements for freshwater conditions. Then he asked if the Canadian Government would expect the BWTS developers to do additional testing (land-based, etc.) and how the government would deal with evaluation of systems not type approved for freshwater. Wiley responded that if vessels do a mid-ocean ballast water exchange then they would have saltwater in their tanks. Saltwater would meet the conditions that the BWTS is type-tested to. The ships would be doing exchange plus treatment.

UNITED STATES

<u>EPA</u>

Ryan Albert of the EPA reported that the EPA is working closely with USCG on their mutual ballast water interests. He anticipates that the VGP will be available for review toward the end of Nov. 2011 on the EPA Web site. He said the EPA would like to sign the new VGP by end of 2012. "We want to give people a year to comply," he said. The existing VGP expires Dec. 2013.

The EPA agreed to set numerical limits for ballast water treatment compliance and plans to require monthly self-monitoring. Albert said that the EPA is working with the states and industry (and providing adequate time to respond) to achieve regionally consistent limits.

Albert said, "When developing the Clean Water Act permits, the EPA looks at the technology and science available." He said the EPA looked for data, provided it to the Science Advisory Board and that the board sought public input. He said that the independent evaluation of BWTS will need to continue and that the EPA remains obliged to look at other available information. The EPA Web page related to ballast water management will be updated regularly (http://cfpub.epa.gov/npdes/vessels/vgpermit.cfm).

U.S. Coast Guard

Rich Everett of the USCG thanked Dale Bergeron (Sea Grant) and Middlebrook for creating a tone that makes the Collaborative a "nice venue for communication." He then introduced the USCG's new Chief of the Environmental Standards Division, Commander Ryan Allain (replacing Commander Gary Croot, who retired).

Allain said, "Since I'm new, I guess this is my one free pass to say that I don't have any news at this time." He commented that he is looking forward to managing the ballast water program with the great staff that's in place. He then introduced Rodney Wirth, who was recently assigned to "work on the type approval process" and oversee shipboard testing strategies.

Bill Lind, with the classification society American Bureau of Shipping (ABS), asked if there were components of the USCG Shipboard Technology Evaluation Program (STEP) that could be streamlined so that the results could be reviewed in conjunction with the type-approval process. "Can more land-based testing get us beyond shipboard testing?" he asked.

Allain responded that the USCG is working on incorporating STEP information into the type-approval process.

Lind commented that the genesis of the program was to inspire shipboard testing, but that shipboard testing is proving difficult to accomplish.

Everett explained that STEP was and is focused on shipboard testing, but not for type-approval. STEP was created facilitate research and design where the BWTS developers defined testing goals and strategies. STEP provides a way for vendors to access ships for testing prototype BWTSs. He said the USCG wants to see the vendors' testing methods and reminded the group that the USCG does not have a formal type-approval policy yet.

Through the shipboard trials, the BWTS developers and the USCG learned a great deal about testing issues and how to work around hurdles. When the USCG's Final Ruling is published, it should reflect the STEP experience in its shipboard testing requirements.

Everett said that the USCG Final Rule will incorporate the EPA's Environmental Technology Verification (ETV) procedures that, for now, are land-based. He expects to see rapid ETV protocol development for shipboard testing because of the experience in developing the land-based protocols.

When asked how BWTS that were type-approved by foreign governments will be handled, Everett said that the USCG has made provisions to minimize redundant testing but that he could not give specifics at this time. He remarked, "We don't want to set everyone back to square one, but that being said, we don't know what other administrations are doing to ensure their testing is accurate. We need to see what information is actually presented."

Dave Adams from New York asked if the EPA and USCG were expecting to become involved in hull fouling issues. Both Albert and Allain said their agencies were working toward addressing hull fouling, especially after the major ballast water regulations are in place.

GREAT LAKES SEAWAY

Nancy Alcalde, the St. Lawrence Seaway Development Corporation's Director of Congressional and Public Relations, reported two summer developments:

1. In July, a Congressman from Ohio (Rep. Steven LaTourette) proposed an amendment that would discourage states from setting standards more stringent than the EPA. If they did so, the states would be prohibited from receiving any further EPA funding. The bill went to the House floor but the new provision concerned a New York representative enough to keep the amendment from being voted upon. The outcome was a pledge to work together to fashion a joint response to protect the Great Lakes and the economy while paying attention to the issue of patchwork ballast water legislation. LaTourette did say his aim was to call attention to this issue. "The intention wasn't to deny them funds, but to get their attention."

Alcalde thought it was unlikely that the discussion will move ahead, although the bill is still open. The Senate hasn't moved on the FY2012 Interior-Environment Appropriations bill either.

2. Representatives LoBiondo, Mica, and Gibbs forwarded HR 2840, a new bill titled "Commercial Vessel Discharges Reform Act of 2011," on September 2. HR 2840 is based on a previous hearing held in July and the recent SAB and NRC reports. It calls for uniform ballast water discharge standards aligned with IMO standards. The

prospect that the Senate will pass the Bill is minimal and it may not even go to a markup session.

Alcalde made it clear that like industry, the Federal government is eagerly awaiting the USCG Final Ruling.

---------- MERC BREAK ----------9:10 A.M. - 11:30 A.M.-----
Collaborative participants walked to a pier adjacent to the conference facility to join the University of Maryland Maritime Environmental Research Center (MERC) at the dedication ceremony of their mobile platform for testing ballast water treatment systems. Platform tours and a reception followed.
---------- MERC BREAK ----------9:10 A.M. - 11:30 A.M.-----

STATE UPDATES

--Accompanied by a PowerPoint presentation---

Jeff Stollenwerk of **Minnesota** thanked the IJC and Mark Burrows for making it possible for state agency staff to travel to the Collaborative meetings.

He said the Great Lakes states have been using either the best available science or an arbitrary target to generate ballast water discharge standards. The two methods have created state ballast water regulations that are inconsistent across the Great Lakes (see table below).

Great Lakes States Biological Ballast Water Discharge Standards. (slide 2 of the presentation).

State	***BW Discharge Standard for New***	***BW Discharge Standard for Existing***	
Michigan	Treatment Technology	Treatment Technology	
Illinois, Minnesota, Ohio	IMO in 2012	IMO by 2016	
Pennsylvania	Withdrawn	Withdrawn	
New York	1000x IMO in 2013	100x IMO by 2013	
Wisconsin	IMO by 2012	IMO by 2014	

In addition to consistency issues with regard to discharge standards, the states face scheduling challenges (are ballast water treatment systems required based on launch date, construction date, or keel-laid date?). There is also disparity about whether or not lakers are subject to the regulations.

He said, like most people in the room, the states desire a consistent federal or regional approach or standard. Stollenwerk said that states needed much more data and analysis on whether or not the regulations are achieving their goal of improving the odds that aquatic invasive species are NOT being spread to and around the Great Lakes. States would like BWTSs to be installed on ships as soon as possible and acknowledge that ballast water exchange is an interim step that should be retained when feasible. He said the states would like a mechanism to advance ballast water treatment technologies beyond the IMO standards and that whatever is happening now is a "next step," not the "final step."

Michigan Department of Environmental Quality's Sarah LeSage spoke about Michigan's litigation settlement with the EPA. In March, Michigan and a number of environmental organizations agreed not to sue the EPA over the imminent Vessel General Permit (VGP) with the understanding that the EPA would issue the newest VGP by Nov. 30, 2012. The EPA agreed to have a draft of the newest VGP available for public review by the end of November, 2011, and to meet with state representatives three times before the publication of the Final VGP in December 2012. Additionally, the EPA agreed to:

- Provide states with at least 6 months to deny, waive, or issue Section 401 Water Quality Certifications after the draft VGP is published.
- Include numeric concentration-based limits for live organisms in ballast water discharge in the draft VGP, or explain why such limits are infeasible to calculate.
- Expire the next VGP 4 years after its effective date.

During the first Michigan/EPA meeting, Michigan called for the EPA to establish an effective endpoint for ballast water discharge that is protective of water quality. LeSage said the state would like the EPA to use a risk-based approach. By 2014, Michigan is asking the EPA to require interim ballast water discharge standards 10X more restrictive than IMO's. By 2016, the state is pushing for even higher standards (100X or 1000X IMO).

LeSage said that Michigan understands the EPA's discharge standards need to ensure covered vessels are not penalized if they install and properly operate acceptable ballast water treatment technology. She also said the Michigan expects to require ballast water exchange at least until the end of 2013.

Michigan's current Ballast Water Control General Permit expires on January 1st of 2012. The state proposes to reissue the General Permit, with minimal changes in December 2011. If the EPA's next VGP is considered environmentally protective, then Michigan will rescind its General Permit, otherwise, Michigan's permit will likely be modified again in early 2013.

According to LeSage, by late August the EPA outlined information for drafting the next VGP and it seems they are basing their rules on technology-based limits.

New York State Department of Environmental Conservation's Dave Adams reported New York's continued commitment to a 100X IMO discharge standard for vessels (extensions were granted until August 2013 for those carriers who requested them). This commitment also includes the continued best management practice of coastal exchange and flushing. He said if the state is dissatisfied with the EPA's VGP, the 100X standard would apply to new vessels after 2016. In the meantime, the state would push for 10X IMO plus exchange for existing vessels by 2014. Adams said that New York believes that at least 10 viable technologies for treating ballast water currently exist and that at least one of these is able to meet the 100X IMO discharge standards.

Ocean-going vessels are not permitted to discharge graywater or bilgewater in New York waters starting in 2012, according to Adams.

Responding to a question about Michigan's General Permit for discharging ballast water, LeSage said it only applies to ocean-going vessels at this time. In New York, the current effort to achieve EPA 401 Water Quality Certification requires a 100X IMO ballast water discharge standard for all carriers in New York water by 2013. While New York is in the interim between the state's plan and the EPA's VGP, Adams said the state's next step would depend on how the VGP language plays out. "The new VGP would not be effective until after our implementation dates," he said.

LeSage commented that Michigan doesn't have the resources to enforce its ballast water regulations, but the state keeps track of who applies for and who gets permits. Adams said New York expects the EPA and the U.S. Coast Guard to conduct the compliance testing. "We don't have this responsibility," he said.

California State Land Commission's Lynn Takata explained that California has regulated ballast water since 1999 and is now also working on hull fouling regulations. In 2005, the state began crafting performance standards for ballast water treatment technologies as directed by the 2003 Marine Invasive Species Act. Working with technology advisors, the California Coastal Ecosystems Protection Act was adopted in 2006. It included performance standards for ballast water discharge as expressed in the table below. For ships greater than 5000 metric tons, the standards apply in 2012 for new ships for which construction began on or after 2012, and to all ships by 2016.

Takata made it clear that the greater than 50 micron "no detectable" standard for California was not the same as zero or even 1000X IMO. No detectable is defined by the sampling methodology(ies) used. She said some of the challenges to treatment technology evaluation include the small range of shipboard and environmental conditions in which BWTS are tested and that existing testing programs are not tailored to California standards. Because of these challenges, state employees evaluate BWTS for their POTENTIAL to comply based on the best available data. A system was considered to have potential if it met all of California's in at least one full scale land-based or shipboard test.

In a January 2009 review, California staff found that two BWTS showed potential for compliance. By August 2010, the number was up to eight systems, with three of those showing greater promise compared to the others (meeting California's standards in over 50% in 3 or more tests). About a year later (September 2011), 10 BWTS were identified as having the potential and five were able to show the potential to meet California standards more than 50% of the time over multiple tests (3 or more) during either land-based or shipboard testing. The 2011 Update Report, including a summary table of BWTSs with efficacy data (page 32) is available at: http://www.slc.ca.gov/Spec_Pub/MFD/Ballast_Water/Ballast_Water_Default.html.

State of California Performance Standards Compared to IMO Standards for Ballast Water Discharge.

Organism Size Class	California	IMO Regulation D-2
Organisms greater than 50 µm in minimum dimension	No detectable living organisms	< 10 viable organisms per cubic meter
Organisms 10 – 50 µm in minimum dimension	< 0.01 living organisms per ml	< 10 viable organisms per ml
Living organisms less than 10 µm in minimum dimension	< 10^3 bacteria/100 ml < 10^4 viruses/100 ml	
Escherichia coli	< 126 cfu/100 ml	< 250 cfu/100 ml
Intestinal enterococci	< 33 cfu/100 ml	< 100 cfu/100 ml
Toxicogenic *Vibrio cholerae* (O1 & O139)	< 1cfu/100 ml or < 1cfu/gram wet weight zoological samples	< 1 cfu/100 ml or < 1 cfu/gram wet weight zooplankton samples

Moving forward, Takata said that in light of discussions about the accuracy of testing methods and "best available technology," changing the California ballast water discharge standard was considered. However, this option is not being pursued because this would require new legislation and the political will to do so is minimal at this time. Instead, she said her agency is working to establish compliance verification protocols so that BWTS vendors can be "self-certified." They will specify methods for collecting ballast water samples and conducting analyses to assess vessel discharge compliance. While still meeting 2012 expectations for implementation, the compliance verification protocols will allow for revisions as detection limits improve, and will allow for grandfathering clauses.

Switching to California's concerns about biofouling, Takata cited Ruiz et al., 2011, (http://www.slc.ca.gov/spec_pub/mfd/ballast_water/Documents/Ruiz%20et%20al%202011.pdf) as suggesting that biofouling could account for the arrival of many invasive species in California and that California is a center for first introduction of aquatic invasive species on the Pacific Coast.

Vessel characteristic that increase the chances of hull fouling include slow speeds, long layups, many "nooks and crannies", and old antifouling paint or unpainted areas. Takata said there was little fouling on the laminar hull of vessels, except areas that had lost paint. Hot spots for fouling include ports, propeller shafts, thrusters, grates, and doors. Marine growth prevention systems work well … if they are turned on.

To regulate cleanliness standards for laminar hull and niche areas, California recently (Sept. 2011) proposed "Amendment to Article 4.8: Biofouling Regulations for Vessels Operating in California Waters." The proposal to regulate biofouling can be accessed online at:
http://www.slc.ca.gov/Spec_Pub/MFD/Ballast_Water/Laws_Regulations.html.

During a discussion following the state presentations, Takata was asked if biofouling species are different from those that travel through ballast water. Takata said it depends on the organism but that about 18% of existing invasive species were likely transported through bio-fouling, and California's performance standards have made ballast water treatment system efficacy a non-issue.

When asked if California has set specific methods for testing BWTSs that will be reviewed as new approaches in sampling and additional BWTSs become available, Takata answered that California will continue to update its reports and protocols to reflect new information. She also said that "potential" means the BWTS has met the California standards at least once in different salinity regimes (brackish, fresh, salt). IMO type-approval testing requires results from two salinity regimes. Regarding analyzing compliance testing, Takata said that the agency is working with a Poisson sampling design and intends to inform shippers about the expectations so they can factor them into their existing plans. "We want them to use the same protocols we use," she said.

BALLAST WATER TREATMENT TESTING FACILITIES UPDATE

For publicly available findings, see:
Great Ships Initiative (GSI), http://www.nemw.org/GSI/index.htm
Cal Maritime's Ballast Water Treatment Systems Test Facility (*Golden Bear*), http://www.csum.edu/web/industry/golden-bear-facility
Maritime Environmental Resource Center (MERC), http://www.maritime-enviro.org/index.html

Allegra Cangelosi of the Northeast-Midwest Institute/Great Ships Initiative gave an update about the type-approval methods work being done through the GSI and other BWTS testing facilities. She said, "We're involved in "test-driving" the final ETV protocol." The U.S. facilities are involved in refining the detailed land-based testing protocol so that the government can verify BWTS vendor claims and provide a solid basis for type-approval (final ETV Protocol—IMO standards). She noted that important opportunities for research and design exist since ballast water treatment systems are still in development stages for Great Lakes ships and conditions. This includes plans for ship discharge monitoring apparatus being discussed by the U.S. Maritime Administration (MARAD) and a Minnesota citizens group working in conjunction with ship owners.

Cangelosi said the GSI is gearing up to explore the risk and relationships between propagule pressure and invasions, which she speculates are probably unique to each environmental system. The GSI will conduct experiments in microcosms inoculated with live organisms to determine how they fare over time. Researchers are also surveying live propagule density on ships. The GSI is investigating efficient ways to monitor ships, conduct ballast water discharge sampling, and cooperate with U.S. and Canadian Great Lakes carriers and with ocean-going vessels. "The problem with salties is their irregular schedules," she said. Part of this work involves collaborating with the US. Geological Survey, the National Park Service, and the American Steamship Company to count the live organisms remaining after ballast water aboard the *Indiana Harbor* was treated with CO_2 in a preliminary test this summer.

The GSI recently ran a set of ballast water tests that were identical to tests run on the *Golden Bear*. Cangelosi said the USCG and EPA would be getting the results of these tests within a week. The identical tests were comparing the performance of a particular treatment system between the two facilities and between a freshwater and saltwater environment. In addition to its new mobile platform testing facility, MERC can use the *Cape Washington* for shipboard BWTS tests.

After examining datasets, Cangelosi said those in the BWTS testing world have overarching "meta" observations to report:

1. **Differences in the outcome of validation tests depend on the assemblage of organisms confronting the treatment system.** BWTS performance results appear to be dependent on whether the testing involved contrived assemblages of organisms (those cultured in a lab) or native ones, which could be hardier. For example the Norwegian Institute of Water Research (NIVA; http://www.ballasttech-niva.no/index.html) tested a ballast water filter using a specific organism. The NIVA results indicated the filter performed VERY differently from tests that were conducted in the United States.

2. **When it comes to lethal agents (biocides), what constitutes environmental soundness is nuanced relative to residual toxicity.** Once the neutralization process has played out, will sensitive organisms react poorly? In toxicity tests, researchers measure the response of organisms to incremental dilutions in order to determine when toxicity sets in. The question becomes, "At what dilution do we care?" Cangelosi said that it would be useful for state regulators to understand the biocides used in ballast water treatments and toxicity.

Responding to a question about the different kill rates between cultured organisms and wild assemblages, Cangelosi brought up the example, of brine shrimp, a laboratory favorite. She said, "Brine shrimp are easy to kill through filtration, but people think they are very tough in other situations. What constitutes a tough organism depends on what you're subjecting it to. Nature supplies us with a large range, labs don't." She reiterated that system performance changes in relation to "spiked" or "natural" assemblages. Cangelosi suggested that natural assemblages are more difficult to kill than cultivated assemblages.

Lind said ABS's Ballast Water Guide is forthcoming. (*Note: it was released on November 7, 2011;* http://www.eagle.org/eagleExternalPortalWEB/). He said that having the input of experts is important to class-societies such as ABS. Lind emphasized that:

1. ABS views BWTSs as a figurative "black box" that gets put on a ship.
2. ABS wants to ensure the "black box" won't hurt ship operations in any way and that it is an approved system.

To the regulators in the room, he said, "Shippers want to do the right thing…they will work with you if you give them things that they can actually do. Don't make it a maze. It MUST BE DOABLE. It must be possible."

ASSESSING THE RISK OF SECONDARY SPREAD: RESULTS

The Canadian Shipping Association (CSA) has invested considerable effort into developing an understanding of how ballast water is moved around the Great Lakes. Bruce Bowie, the president of CSA, introduced the session by thanking the Collaborative and active project participants like Sarah Bailey, Lindsay Chadderton, Noel Bassett, David Reid, Dale Bergeron, and members of the Project Panel for the valuable insights the conversations have provided. He said, "We need access to the experts in the room. This project taps into the expertise of the Collaborative."

Bowie mentioned the uncertainty about whether lakers will be held to the same ballast water discharge standards to which salties are, but the bigger concern is helping Great Lakes carriers mitigate the risk of spreading invasive species and informing the regulatory process.

Bowie stated that there is only one readily available BWTS that might work in fresh water, and proceeded to list the hurdles making it difficult to find BWTSs that work in the Great Lakes. Among the hurdles were: freshwater organisms and conditions, cold water, high ballast flow and volume, short trips, and the retrofitting the huge lakers.

Given the hurdles and the need for action, the CSA began exploring the potential for an enhanced risk-based approach to mitigate the secondary spread of invasive species through ballast water. Bowie said that the CSA and its collaborators looked to Australia and New Zealand studies for guidance on applying a risk-based approach and were heartened that the SAB also supported a risk-based approach in their report.

Bowie said the CSA project objectives are to:
1. Improve the understanding of the risk of secondary spread by lakers.
2. Develop enhanced industry voluntary ballast water best management practices (BMPs).
3. Consider the role of additional measures and practices for addressing risk.

By examining what technologies and logistic tactics will work best in the Great Lakes the CSA project team intends to generate a "made in the Great Lakes" approach for addressing invasive species.

Bowie gave the podium to Azin Moradhassel (CSA), who told the group about the previous day's Workshop between the two panels involved in the risk-assessment project. One of the panels was composed of aquatic invasive species scientists who were asked to guide the risk assessment. The other panel included Great Lakes shipping industry leaders, scientists, and agency personnel who were charged with looking into technologies and practices that could minimize the risk of Great Lakes ships moving invasive species from port to port.

Moradhassel said the CSA developed a ballast water movement inventory with help of five of the biggest shipping companies operating on the Great Lakes. Representing a majority of the shipping activity on the Great Lakes, they used consistent reporting methods that revealed 86 ships moved 42 million metric tonnes of ballast water in the Great Lakes through 2645 vessel voyages in 2009. Ballast water stayed within the same body of water about 35% of the time; for example, 13% of total trips were between ports within the St. Lawrence River and 8% of total trips were between ports within Lake Erie (8%).

Hamilton, Ont., on the shores of Lake Ontario was identified as the top ballast water "donor" port; meaning Hamilton was a source for more ballast water than other ports recorded in the study. Hamilton was followed by Lake Superior's Thunder Bay, Ont., and Duluth, Minn. Conversely, the top three recipient ports (those ports receiving more ballast water than other ports) were Duluth (MN)+Superior (WI) (Lake Superior), Gary (Lake Michigan), and Goderich (Lake Ontario).

CSA also developed a data set on aquatic invasive species in the region and the likelihood ballast water discharge would spread them to new ports in the Great Lakes. For example, if a species was reported in both the donor and the recipient port, a ship releasing ballast water from the donor port into the recipient port would not pose much of a risk for spreading the species (it's already there). The data set incorporated information about the environmental impact of a species, and prioritized the species based on the time since its first sighting and number of water bodies in which it is currently established.

Moradhassel then demonstrated the risk assessment tool the study team developed. It is an EXCEL spreadsheet that allows the user to pick a body of water (one of the Great Lakes or the St. Lawrence River) where ballast water will be taken on, then pick a body of water where it is likely to be discharged. Within seconds, the tool indicates invasive species that could potentially be spread through this movement of ballast water and information about them.

Robert Lewis-Manning, also with the CSA, followed Moradhassel with a quick review of the mitigation measures the study team identified. He said the challenge was to develop an adaptive risk-based approach better than it was. "Hopefully the work opens doors to future solutions," he said.

Lewis-Manning said that the industry team and the two panels tried to keep the technical, operational, and economic discussions about BMPs separate. Their "Inventory of Measures" fell into three groups:

1. Practices within existing BMPs – this includes sediment management, sea chest screens, secondary strainers, ballast water pumps, etc. Almost always discussions indicated a need for more information.
2. Alternate measures – this includes filtration (50 micron), biocides, and vessel modifications.
3. Emergency measures – this includes biocide shock, re-routing, and temporarily avoiding ballast water uptake.

The benefits of approaching ballast water management with enhanced risk assessment and BMPs are that they can be implemented, the results are achievable and it would be proactive. Lewis-Manning said, "With all the different vessels on the Great Lakes, it makes sense to have a range of options for approaching ballast management. We cannot be naive that we're only dealing with aquatic invasive species. There are other things, like ship design, to consider." He said the CSA work is aligned with the expert opinion expressed in the EPA's Science Advisory Board report.

Before segueing to questions, two carriers reported on studies they were involved with over the summer. Noel Bassett of the American Steamship Company (ASC) thanked all who visited his ship since issuing the invitation at the first Collaborative meeting two years ago. "Our problems are ones of volume," he said, mentioning that

ballast pumps on a 1,000-footer pump 13-16 thousand gallons of water per minute each.

The ASC has been partnering with the National Park Service (Isle Royale) and the U.S. Geological Survey by providing a platform for tests of biocide mixing and use of sodium hydroxide as a treatment. Prior tests confirmed the efficiency of biocide applications using Rhodamine dye to indicate how mixing occurred in a ballast tank using various mixing methods. This year the partners conducted treatment tests aboard the *Indiana Harbor* using a 4% concentration of sodium hydroxide as a biocide. The ballast water rapidly achieved a pH of 12 and the water was retained during a trip from Gary, IN, to Duluth, MN. The crew neutralized the pH by releasing liquid CO_2 through a vaporizer. Within 16 hours the pH was down to an acceptable level and could be discharged. The team drew inline ballast water samples coming in and out of the ship to get a before and after comparison. "This is beyond a theoretical project," said Bassett. "This was real. I'm eager to hear from [the GSI] about how the water samples actually compare." Bassett said he was "A little scared" of sodium hydroxide and "uncomfortable with keeping cryogenic carbon dioxide on our ship." Bassett speculated that maybe it would be possible to use waste CO_2 produced by the ships' generators to neutralize the biocide.

Kirk Jones of the Canada Steamship Lines commended the risk mitigation study team and their objectives, which helped sharpen the BMPs for ballast water in the Great Lakes. He offered to make one of his ships on which a Unitor Ballast Water Treatment System (Wilhelmsen Technical Solutions) is installed available for ballast water research. He said the company is committed to working with anyone wanting to pursue research on the risk mitigation project and that the CSL gave $750,000 in support of the project. He also observed, "Prevention will not look the same on each ship."

Rich Everett (USCG) asked if the CSA was planning to quantify the Unitor system's effectiveness under various conditions. Lewis-Manning said there is a need to look at efficacy and it would be good if such research could be done, but he couldn't say if there is an intention to do so. Jones said the results would certainly be relevant and might help illuminate how proposed "performance-based standards" compare to the things that are actually quantifiable.

Lewis-Manning responded to a question about immediate mitigation measures by saying that scientists and policy-makers need consistency and that managing sediments is challenging. He also said, "Minimizing ballast water uptake is not as simple as it sounds." He recommended developing a better understanding of how dangerous it is to leave harbor with not enough ballast.

Bergeron remarked that weighted expert evaluation is become a more popular way to make progress. He urged a continuing dialogue with the scientific community to create partnerships. "I hope you see this as an opportunity for science and for

broadening the learning base," he said. "This is opportunity and an invitation to get involved."

A Collaborative participant (Kevin Reynolds, Glosten Associates, Seattle, WA), acknowledging that commerce works best in competition, expressed concern that as shippers adopt additional voluntary measures, they could be putting themselves at a competitive disadvantage. Lewis-Manning said such competition is already happening, while Moradhassel said that good corporate citizenship is increasingly important to today's society.

Pollack was impressed by the expertise in the room but concerned about the multiplicity of management angles. She asked how there could be a technology-based standard when the technology is so dynamic. Middlebrook referenced the SAB report, which called for a risk-based adaptive approach. "This initiative is falling inline with what scientific experts are saying should be done," he said. Phyllis Green of the National Park Service added that technology standards should have a biological basis. "Technology standards require a big commitment early on," she said. "You decide that you are going to make sure a BWTS treats to a particular level."

Adams asked if the risk assessment tool was going to inform the way industry might focus on particular routes of particular vessels. Mira Hube of Algoma Central Corporation said, "We are looking for that to be an outcome of this model. We're not quite there, but we're getting there." Moradhassel added that it might influence emergency response measures and that additional information would take risk-assessment even further.

Collaborative participants praised the risk assessment tool with comments like:

- This model shows which species have become quickly common and those that haven't. (Jones)
- It has potential for indicating the risk of future invasions and what happens next. (Moradhassel)
- It offers an unbelievable capacity for the customization of ballast water management in the Great Lakes. (Bergeron)
- Generating this database allowed the scientists to tease out risk. (David Reid)
- It has the potential to become an alert system, which is a very applicable and exciting aspect of this research. Having these detailed lists will make progress much quicker. (Cangelosi)
- This work is key to setting the stage for making regulations. I know the CSA didn't have to do it, but I appreciate that you did. (Stollenwerk)

The conversation then turned to applying the risk assessment tool. One suggestion was that the next iteration of the species database could reflect the seasonal aspects of an organism's life instead of assuming that all species are available at all times. A mechanism for getting information out was also identified as a need. "Let's say you

have good data and good information, how would you get an alert out?" asked Middlebrook. A USCG representative (Lorne Thomas) suggested sending two alerts out as happens in the case of the fish-killing virus VHSv, which is episodic every 3 to 5 years. Information comes through state DNRs or the equivalent, and through the USCG.

Rick Harkins of Keystone Shipping said that the BMPs for ballast water came from the IMO. The procedures for the Lake Carriers Association are written in their laws, and in Michigan's law. He said the BMPs have been implemented on every ship since 2001. "It's not 'if BMPs can be improved,' but 'how,'" he said. Lewis-Manning agreed that the Lake Carriers Association and the CSA have been engaged in managing ballast water discharge since 2001. "From macro perspective, we're committed to making it better," he said. "We'd like to engage with the regulators. It's a complex dynamic problem that requires a dynamic approach."

THE NATIONAL ACADEMIES' NATIONAL RESEARCH COUNCIL REPORT

Cangelosi outlined the NRC report, **Assessing the Relationship Between Propagule Pressure and Invasion Risk in Ballast Water**, July 14, 2011, Washington. DC. She was a participant on panel and said their objective was to determine how much is known about the risks posed by different concentrations of organisms in the ballast water of ships. The NRC panel was NOT asked to assess ballast water treatment technologies and their ability to protect water and was NOT asked to recommend specific numeric standards for ballast water discharge.

Focusing on the relationships between propagule pressure and invasiveness, Cangelosi said Chapter 1 of the report deals with ballast water facts. Chapter 2 reviews the policy context for regulating ballast discharge, particularly the information and constraints faced by federal agencies. Important conclusions in this review are that the Clean Water Act and the National Invasive Species Act bring "a complementary set of teeth to potential standards." Cangelosi said, "Because of the long-term investment by the USCG & EPA in ballast water treatment research, we are better positioned to pursue a scientifically based standard for ballast water discharge in the Great Lakes."

Chapter 3 deals with propagule pressure and the sources of variation influencing the probability of invasion. Cangelosi said, "It would be nice if all organisms were equal in all environments, BUT… a particular ship doesn't pose the same range and risk that a different ship might." She said variables include propagule quality, species traits, environmental traits of receiving systems, and transient conditions like the time of year. A conclusion was that "inoculum density" (the number of organisms entering a system) is a key factor for a successful invasion, but is only one of many possible sources of variation.

Chapter 4 examines propagule pressure and establishment risk. The available models range in approaches from single species to statistical probabilities. Some are retrospective and employ proxy variables (i.e., amount of discharge). Cangelosi said the report suggests moving toward an approach that uses propagule characteristics but that single-species models are recommended for species most likely to invade new areas.

Chapter 5 reviewed other approaches to setting ballast water discharge standards. Cangelosi said that other approaches "come down to expert opinion and how well the questions have been defined and who is in the room." She said Chapter 6, a comment on the "path forward," was limited by a profound lack of data. As a first step, she said the report suggests that a benchmark discharge standard should be established that clearly reduces the concentration of organisms in ballast water currently discharged in the Great Lakes. When questioned, she said the report doesn't suggest the baseline standard because the authors would like to find a way to dampen the variability first. She said the NRC report recommends a two-track approach that implements experimental and field studies, including mesocosm experiments with a diverse range of taxa in different types of environments. At a mesocosm-scale, replicate trials would take place in 20 different one-cubic-meter containers. Ambient conditions would be kept as close to natural ones as possible and after about 10 weeks, researchers would look for the organisms they spiked. Cangelosi said the report recommends ground-truthing in the real world if possible and field studies that quantify what is ballast discharge, and the characteristics of the receiving system.

Bailey commented that scientists can't say at this time what the difference between adding ten organisms as opposed to one makes. "We won't know if setting an IMO standard or 100X IMO makes a meaningful difference until we learn more about the effect of propagule pressure," she said.

The USCG used a diagram comparing propagule risk in their notice of proposed rule making. Cangelosi acknowledged that the USCG chose the best model they could and populated it with the data that they had. She speculated that maybe significantly better data would be available in three to five years through the GSI and other ballast water treatment testing facilities.

Middlebrook asked Albert (EPA) and Everett (USCG) if the agencies intend to follow the NRC report recommendations. Albert said that, given the economic situation, this is a terrible time to launch a research initiative. He said the EPA would not be able to pursue every recommendation but maybe within five to ten years, some of the knowledge gaps the NRC report identified could be filled. Everett said the USCG budgets were tight, too. Their 5-year contract with National Ballast Information Clearinghouse includes several projects that will help assess the effectiveness of treatment systems. They are conducting experiments with specific vessels and intend to investigate how the rates of introduction change over time as management regimes are put in place. Everett said that the NRC report is far removed from the

USCG mission. "We see basic science as being more in the realm of environmental agencies," he said. "We're interested in focusing on particular "sentinel" harbors to look for changes in invasion rates."

THE EPA'S SCIENCE ADVISORY BOARD REPORT

Mario Tamburri of MERC thanked Collaborative participants for being part of the ballast water treatment system testing platform dedication ceremony. He said he wasn't speaking on behalf of the EPA or the Science Advisory Board, but that he was at the meetings as one of the consultants to the Board during the discussions.

The first question they sought to answer was: Are there treatment systems available? "We identified 51 different BWTSs," Tamburri said. "Of those 51 we identified 15 with reliable data sets." (This means that, at a minimum, the documentation provided methods and results.) Tamburri said that only nine of the 15 BWTS brands with credible data consistently met discharge standards. Those 9 fell into 5 treatment type categories. The SAB reported that five different types of BWTSs could meet IMO standards but none could achieve more than that.

The SAB's second question concerned whether existing BWTSs were based on reasonable engineering design and standard water treatment processes. The SAB recognized Great Lakes vessels present unique challenges. Many treatment systems may not be appropriate for those ships.

Regarding a third question, "Can current systems be modified to do any better?" the SAB concluded that existing BWTS could be improved incrementally but not enough to achieve 100X IMO any time soon.

The fourth question about developing better and more reliable data gave way to a conclusion that more standardized approaches are needed and that it might be worthwhile to use surrogate organisms to gage BWTS compliance with a discharge standard.

Beyond the SAB's "charge questions," the committee suggested adopting a risk-based approach for ballast water management, not just a numeric discharge standard approach. Tamburri said the SAB suggests looking at voyages and patterns and investigating ways to minimize ballast on board through ship designs. With available methods, researchers can achieve live organism detection limits needed for verifying performance against the IMO discharge standards. Tamburri said while zero living organisms might be a desirable ballast water discharge goal, it is not a statistically verifiable one.

The SAB reported that a broader suite of tools to minimize risk is needed. Tamburri said, "The point is to focus on a bunch of different options besides numeric standards."

Harkins said that important information is buried on page 75 of the SAB report. He said he and Chris Wiley just had a discussion about whether these BWTSs were qualified for a fish tank or a laker's ballast tank. In order for a BWTS to be functional, it needs to be approved based on the volume of water the BWTS could handle, said Harkins. Tamburri responded that the SAB discussed flow rate but that the topic was a bit beyond the report. Tamburri said the point is that there are some available systems that can treat ballast water.

Kevin Reynolds (The Glosten Associates, Seattle, WA),who was also a consultant to the SAB committee, commented that when the SAB attempted to evaluate availability of effective treatment systems, the resounding theme was, "Where's the data? Where are the samples? Where's the information?" He said most BWTS tests were done under ideal conditions specified for type-approval … not necessarily to test performance under the range of conditions found in natural environments. He said Great Lakes bulk carriers are a good example of a 'difficult to handle' fleet.

Middlebrook suggested that the implementation phase is the next challenge and that Collaborative members should read *Kick starting ballast treatment markets*, a Dec. 2010 blog post by Dennis King, Environmental Economics Professor, University of Maryland (http://www.sustainableshipping.com/forum/blogs/6/98981/Dennis-King/Kick-starting-ballast-water-treatment-markets).

When asked about California's reaction to the SAB report, Takata said the report reflects the reasons her agency called a technical advisory group together starting in 2010. "It's why we're moving forward with a compliance approach," she said.

Stollenwerk said, "If we had seen the SAB information right after [Takata's] presentation, it would make our heads spin!" He asked for an explanation of how the SAB and California landed in two different places. Tamburri said that he was also on the technical advisory group for California and the SAB only considered data that had methods associated with it. "If we didn't know how they sampled, we don't know what zero means," he said. "We also asked different questions than California." He said the SAB committee looked for BWTSs that "always make it" whereas California looked for systems that "sometimes make the (California) standard." When asked, he said that the SAB and California looked at many of the same BWTS but that they are not identified because the EPA didn't want to appear to endorse any particular systems.

Takata said that California's report came out a little later than the SAB's, giving the state time to gather a little bit more information. She said the state also went through a data and protocol discussion, but that California may have had a bit of different criteria and approach than the SAB.

IN CLOSING

Questions remain about what "zero" really means in a situation where present detection limits can only meet IMO discharge standards. Also, this observation was repeated throughout the discussion: **until research methods are standardized, it is very hard to compare data sets.**

Before the Collaborative meeting adjourned, Pollack said that it was obvious that more research is needed and called for the U.S. and Canada to work "as closely as we can together."

Closing comments recognized the work of Gary Croot, former USCG Commander and now a consultant to the shipping industry; and also the work of Middlebrook and Marvourneen Dolor, of the Seaway.

Middlebrook summarized the day's proceedings by saying he heard a lot that makes him hopeful about the future. He noted he (along with everyone else) is looking forward to more certainty in the regulatory environment. He talked about the exciting ways that MERC is aligning with GSI and the *Golden Bear* ballast water treatment system testing facilities and thanked everyone in the room for their focus. "I hope you feel like it was worth rolling up your sleeves for this long day," he said.

Continuing, he reminded the Collaborative that it was almost two years to the day when they first met and that two things are still true: "We have a serious challenge on our hands," and "No single entity has all the answers to these questions."

He said the Collaborative has leveled the playing field in the Great Lakes and elsewhere and that people are better informed because of this effort. He reminded attendees that the report and presentations associated with the meeting will be available online (http://www.greatlakes-seaway.com/en/environment/ballast_collaborative.html) and that they "have legs" (meaning they have become widely cited and respected by people working on ballast water challenges).

Pushing for the spirit of collaboration to continue, Middlebrook said the new EPA VGP and the USCG's final rule will have significant effects on state approaches without removing states from the game. He said, "If we've learned anything, we've learned that the process of responding to complex issues is as important as finding a solution."

Dr. Reid, putting perspective on the frustration with limited scientific answers, reminded attendees that before zebra mussels and Eurasian ruffe arrived in the Great Lakes, very few people had heard of ballast water or invasive species. He remarked that the science of invasion biology is very young compared to traditional sciences, which have been around for hundreds of years. "Ballast water research (related to invasive species) has only been going on for about 20 years," he said.

"Invasion biology more or less started in the late 1950s but only became mainstream as a research topic in the 1990s. It is good to keep this in perspective."

USEFUL RESOURCES

EPA's Science Advisory Board Report (July 12, 2011). **Efficacy of Ballast Water Treatment Systems: a Report by the EPA Science Advisory Board** (PDF) (154 pp, 1.26MB). http://yosemite.epa.gov/sab/sabproduct.nsf/fedrgstr_activites/6FFF1BFB6F4E09FD852578CB006E0149/$File/EPA-SAB-11-009-unsigned.pdf

National Academies' National Research Council Report (2011). **Assessing the Relationship Between Propagule Pressure and Invasion Risk in Ballast Water.** (156 pp). http://www.nap.edu/catalog.php?record_id=13184

Great Lakes Ballast Water Collaborative Reports. http://www.greatlakes-seaway.com/en/environment/ballast_collaborative.html

Kick starting ballast treatment markets, a Dec. 2010 blog post by Dennis King, Environmental Economics Professor, University of Maryland http://www.sustainableshipping.com/forum/blogs/6/98981/Dennis-King/Kick-starting-ballast-water-treatment-markets .

ABS's Ballast Water Guide, November 7, 2011. http://www.eagle.org/eagleExternalPortalWEB/.

Lloyds of London's newest review of BWTSs. (http://www.lr.org/sectors/marine/News/227220-ballast-water-treatment-technology-update-september-2011.aspx).

IMO's International Convention for the Control and Management of Ships' Ballast Water and Sediments, D-2. http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships'-Ballast-Water-and-Sediments-(BWM).aspx.

EPA's existing Vessel General Permit (VGP). http://cfpub.epa.gov/npdes/home.cfm?program_id=350.

California's 2011 Update Report, including a BWTS summary table (page 32): http://www.slc.ca.gov/Spec_Pub/MFD/Ballast_Water/Ballast_Water_Default.html

U.S. Coast Guard Ballast Water Management. http://www.uscg.mil/hq/cg5/cg522/cg5224/bwm.asp