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Environmental Dredging is an Important Part of USEPA's GLNPO Program Developed to Remediate Sites throughout the Great Lakes. Sevenson's Ryerson Creek Outfall Sediment Remediation 2021 using a Cable Arm Level-Cut Environmental Clamshell - 2.25 yd³ with Overlapping side Plates and Low Widrowing (See story pg. 6)

Environmental Remediation

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COVER: Environmental Dredging is an Important Part of USEPA's GLNPO Program Developed to Remediate Sites throughout the Great Lakes. Sevenson's Ryerson Creek Outfall Sediment Remediation 2021 using a Cable Arm Level-Cut Environmental Clamshell - 2.25 yd3 with Overlapping side Plates and Low Widrowing (See story pg. 6)

Ryerson Creek Outfall Sediment Remediation

Location: Muskegon, Michigan (MI)
Period of Performance: July 2020 – November 2020
Contract Value: $5,270,000
Sevenson's Role: Prime Contractor

SIGNIFICANT PROJECT FEATURES

Excavated and dredged a total of 10,758 yd3.
Treated 221,505 gallons of water.
Disposal off-site at Subtitle-D landfill.
Stabilized 7,595 yd3 of sediment using Portland cement.
Capped 88,261 SF.
Restored 6-acres of habitat.
Achieved over 17,700 safe work-hours without a lost-time incident.

INTRODUCTION

Located in Muskegon, Michigan, the Ryerson Creek Outfall (RCO) Sediment Remediation Project is a 12-acre portion of the Muskegon Lake AOC, which encompasses 4,179-crea of drowned river mouth lake that flows into the easter shore of Lake Michigan. The contaminated lake sediments were likely caused by historic storm sewer inputs and legacy industries including sawmills, automotive production, coal gasification operations, a foundry and other timer operations. The contaminants of concern include petroleum, lead, arsenic, cadmium, and PAHs.

SCOPE OF WORK

Site Preparation

As the prime contractor, Sevenson prepared USEPA- approved work plans; secured required permits; mobilized a company-owned dredge fleet, including a PC490 long- front excavator with a 2.25-yd3 bucket attachment positioned on a 40'x60' spud barge; 860 Sennebogen; Cat 336 Excavator; 100-yd3 hopper scows; 300-hp Tug; push boats; work boat; 2.25-yd3 level-cut environmental clamshell; and 2-yd3 clamshell. The project was staffed by field crews of 20 personnel, including Sevenson and craft labor/union. For the on-site WWTP, Sevenson mobilized a dewatering box with geobag; multi-media filters; a Organoclay filter; GAC filters; bag filter; frac tank; flow meter; and centrifugal pumps. Crews designed, constructed, and performed O&M of a 100-GPM WWTP to process sediment runoff with a geotextile filter bag (treated and discharged >221,000 gallons of water to Ryerson Creek).

Turbidity Controls

Prior to dredging, Sevenson installed a moon pool with turbidity curtain combination approach, which restricted suspended solids from migrating outside of the dredge work area. The assembled curtain was pulled into the water using push boats with mechanical assistance from the excavator. Moon pool floatation was achieved through the use of parallel sealed pipe, connected by a steel walking grate.

The piping and steel grating extended the entire length of the moon pool, providing the structure of the moon pool as well as access for Sevenson personnel to adjust the depth of the curtain. As a result, there were no exceedances as real-time turbidity monitors recorded data daily to meet water quality criteria.

Excavation and Dredging of Sediments and Debris

Sevenson removed sediments and debris from Ryerson Creek utilizing a PC450 long-front excavator at depths between 1–4 ft. Crews first removed 2,225 tons of debris from Ryerson


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Creek. Sevenson then mechanically dredged 10,758 yd3 of contaminated sediment. The hopper scows were moored to the excavator barge and oriented so that the excavator could swing 90-degrees and offload dredged material. The loaded scows were transported, via push boat, to the load-out area where they were unloaded by an 860 Sennebogen Telehandler (load-out excavator). Offloaded sediment was placed in the Dredged Material Management Area (DMMA) for subsequent dewatering and stabilization.

Sediment Dewatering and Stabilization/T+D

Upon arrival by scow to the DMMA, a small hose and pump was lowered into the scow to decant free water. Each scow hauled an average of 45-50 yd3 of sediment. The Portland cement dosage was determined per each scow. The material was removed from the scow and placed in the material mixing area by the 860 Sennebogen. The mixing area was located directly adjacent to the offloading excavator where the ratio of 10 percent (by wet weight) of Portland cement was added to the dredged material using a Cat 336 mixing excavator. The Portland cement acted as a stabilizing/dewatering agent. In all, Sevenson stabilized 7,595 yd3 of sediment.

As material began to increase workability, the mixing excavator removed the material from the mixing area and placed it on the ground within the DMMA, where a loader then collected the material and moved it into one of the six staging areas. Once material passed the paint filter test for transport, a PC360 was used to transfer material to dump trucks for disposal at an approved off-site landfill. Sevenson managed all T&D activities.

Capping Operations

Prior to placement of residual cover material between 8–10 ft., 33 post-dredging sediment confirmation samples and 13 quality control samples were collected and analyzed for TPH-ORO (total petroleum hydrocarbons-oil range organics). The sample results determined the required thickness of the residual cover material. Residual cover material was loaded into the 100-yd3 hopper scows at the load-out area and shuttled to the capping excavator for placement. Residual cover material, consisting of concrete sand, was placed in uniform thicknesses of 12 in. with a capping excavator using a conventional bucket to allow the slow release of materials in designated areas. Sevenson's operator utilized Best Management Practices and placed the residual cover materials by slowly releasing material from the bucket to disperse it evenly and limit resuspension of sediment. This process was repeated across all residual cover placement areas until the 88,261-sf area was capped.

Cost and Schedule Control

Sevenson used MIS and EVMS to track cost and performance daily and to forecast and control budget and schedule. The team executed the Ryerson Creek TO successfully on-time and within budget under the GLNPOCS II contract.…

"Shane [Reynolds, Project Mgr.] was able to capitalize on his experience working with a variety of partners (industry, State, Federal) to help bridge the project-management and contract management aspects of EPA to meet project objectives. … Shane's ability to manage schedule and cost, as well as developing efficient operations were a large part of why the project was able to be completed on-time and within budget." - Mark Loomis, PM USEPA.

Health and Safety

Developed/implemented site-specific H&S Plan 17,786 safe work-hours without a lost-time incident

Quality Control

Worked with subcontractor Foth to collect and analyze 25 paint filter tests, 25 pocket penetrometer tests and 33 grid verification tests with no resulting issues Eight 5-point composite samples were collected and analyzed from the former DMMA pad with zero issues Collected and examined 32 catch pans samples

Challenges and/or Unforeseen Issues

Upon completion of the before dredging survey, the USEPA and Sevenson discovered that the site bathymetry varied significantly from the preexisting condition survey provided in the contract plans. The difference in site conditions would have resulted in an estimated 4,000 yd3 under-run of sediment to be dredged. If this was not found, this would have led to a significant impact on the overall project cost to the USEPA. Sevenson's technical team offered multiple template revisions and redesigns for the USEPA's consideration which 1) re-established the dredge bid quantity (modified dredging depths and slopes), 2) provided additional navigable depth, and 3) provided a more natural dredging prism (removing berms between dredge areas and daylighting contours). Ultimately, through detailed conversations and Sevenson's redesign and modeling, a revised dredging prism was accepted and incorporated in a manner which had no schedule or production impact on the project.

Following T&D operations, the team biologist conducted a Floristic Quality Assessment (FQA) that encompassed 263,032 sf (6 acres) to assess the already established wetlands area. The FQA concluded that the wetlands area did not have to be disturbed. As a result, to finish habitat restoration successfully, it was determined that the invasive species (Phragmites and other woody species) needed to be removed, and three habitat structures (wood logs placed under water to create natural passageways for aquatic organisms) needed to be placed. The invasive species were eradicated by applying an herbicide to the Phragmites and select cut to all woody species that were considered invasive. Since there was no need for new plantings, Sevenson saved the USEPA >$161K.

REFERENCES

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Dredging Cycles

Robert Ramsdell

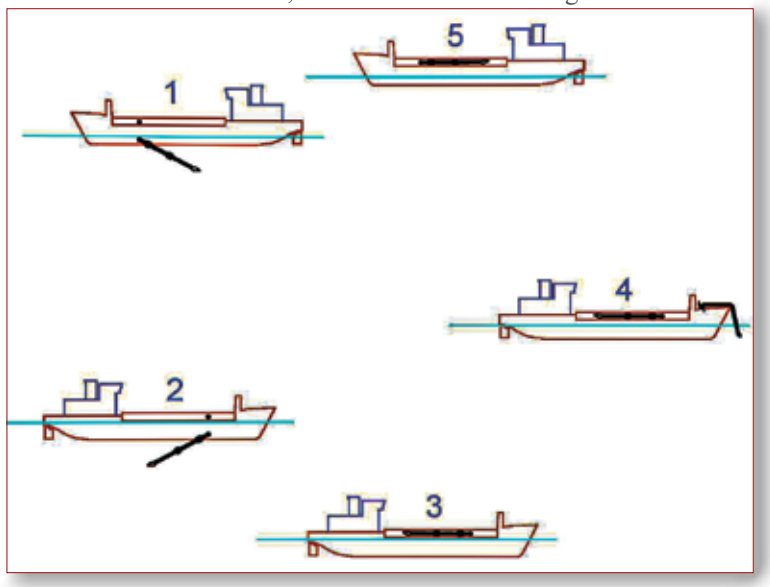
Welcome to a regular column discussing dredge production and dredging issues. I have been in dredging for 32 years, most of them with **Great Lakes Dredge & Dock Company (GLD&D)** and had a great career in the field and corporate office. I retired as Director of Production Engineering and R&D a year ago as I write this in mid-December.

This month I am going to start by discussing the cycles every dredge goes through as it digs. The cycles combine excavation, transport and repositioning the dredge for the next cycle. The cycles are great place to start talking dredge production, as it allows us to break the complexity of dredging into more easily understandable pieces. The cycle helps us understand the differences, strengths, and weakness of the various dredge types.

At GLD&D we spent lot of time developing precise definitions of the various cycle elements, which time applied to which element, and which time was delays we did not count as work.

The excavation phase of the cycle is when the dredge disturbs the material before it is transported. Most dredges do this by cutting the material, jetting it with water, or through erosion by flowing water.

The transport phase moves the material from the seafloor to the surface, then to its final discharge location. This generally done mechanically with a bucket or conveyor, hydraulically in a pipeline, or in the hopper of a dredge or scow. Dredges that load hoppers in fact have two transport phases, first putting the soil in the hopper, then moving it in the hopper to a final destination.

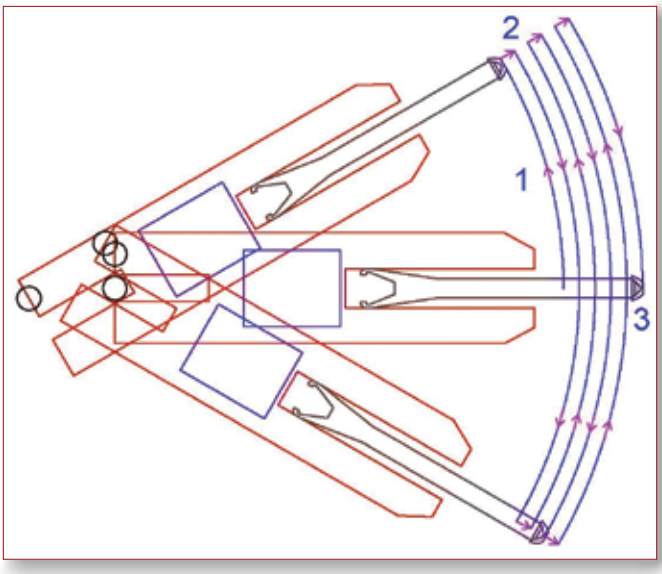


The repositioning phase prepares the dredge for the next cycle. It would be great (and very productive) if our dig areas were infinite but eventually the dredge reaches the end of the dig area and has to turn around or find new places to dig. In addition there is time spent preparing for the next element in the cycle.

For example a Cutter Suction Dredge (CS) has to move anchors every two or three dredge lengths, a hopper dredge (TH) takes a certain amount of time to connect to a discharge line on a beach project, and a clamshell dredge has to change scows.

The figure to the right shows the cycle of a Trailing Suction Hopper Dredge (TH). In phase 1 &2 the dredge is digging (excavation), with a turn (repositioning) between phases 1 and 2. Phase 3 is sailing to the pump-out location (transport). Phase 4 is hooking up to the pipeline and pumping out the dredge (transport). In phase 5 the dredge return light to the digging area (repositioning). The majority of the dredge time is spent in transport and repositioning, with as little as 25% of the time spent digging.

The relatively small portion of the cycle spent digging and the fact that the various cycle elements use different components of the dredge provides several advantages. Because the digging and pumping installation is used for only a small portion of the cycle, routine maintenance can be performed while the machinery is not in use. For example, most drag-head maintenance can be performed while the dredge is sailing to and from the disposal area. This means that hopper dredges can routinely work 20 – 22 hours per day. The nature of the cycle reduces production risk, as variations in conditions are unlikely to affect all elements of the cycle, reducing the impact. In addition, soil grain size affects the loading and pump-out phases in opposite directions. Coarse material that is difficult to pump out loads well, while fine materials that are slow to load are easy to pump out.



One more implication of the hopper dredge cycle is large returns to scale of the hopper size. Most of the cycle is invariant to the load size, so larger loads lead directly to better overall production.

The next figure is a diagram of the digging cycle of a Cutter Suction Dredge (CS). Starting with the spud carriage fully retracted, the dredge swings (1 - Excavating and transporting together) and steps (2 - repositioning) several times, until the carriage is fully extended, then must stop to retract the carriage

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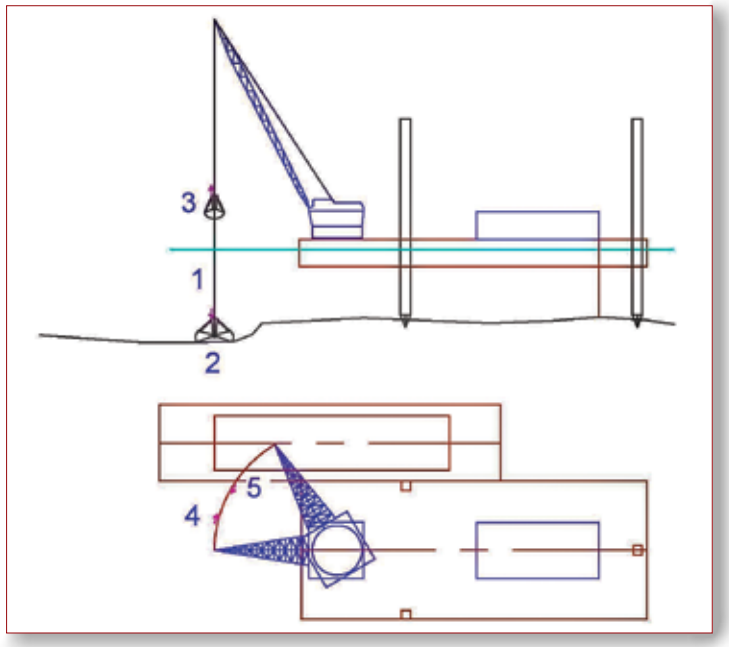
(3 - repositioning). When the dredge has moved several dredge lengths, the crew must reposition the anchors as well. In material that is difficult to excavate or pump, the dredge can spend as little as 10% of the time stepping and resetting. But in easy digging or narrow cuts the dredge may spend 40 – 50% of the time in the repositioning phases.

In contrast to the hopper dredge, the high percentage of combined excavation and transport time means that variations in the soil or digging conditions can have a large impact on overall productivity.

Mechanical dredges have two associated cycles. The diagram below shows the digging cycle for a clamshell dredge, (1) lowering (repositioning) the bucket, (2) closing the bucket (excavation), (3) raising the bucket (transport),(4) swinging to the scow and dumping (transport), (5) swinging back to the digging position (repositioning). Excavation is a small portion of the total cycle, the majority of the time is spent transporting the dredged soil into the scow.



As with the hopper dredge, the short dig time in the cycle, which is not a function of the bucket size, means that there are significant economies of scale with larger buckets. Of course there is a hoist limit for the crane, which limits the size of the bucket for a given soil, so dredge operators will have multiple different buckets of varying weight and size in order to maximize the payload across a large range of materials.

The second cycle associated with a mechanical dredge is the scow cycle, with the dredge filling the scow (excavation), changing out the scow (repositioning), towing to the dump and dumping (transport), then towing empty back to the dredge and changing out scows (repositioning). Here the proportion of time spent on each part of the cycle is a function of dredge production, tow speed, and towing distance. Since transport to the dump happens at the same time as digging, the dredge can stay productive as the transport distance increases, just by adding tugs and scows.

Production Engineers focus on each element of the cycle in turn, trying to optimize production by reducing the time taken, or increasing the quantity of material dredged in each cycle. For example, on a cutter suction dredge, often the lever-man will overswing one side of the cut to ensure that it is clear. However, this overswing adds to the corner time, so helping them reduce overswing as much as possible reduces the overall cycle time and improves production.

Robert Ramsdell has been dredging for 32 years, 31 of them with Great Lakes Dredge & Dock Company. He spent 10 years in the field,supporting, planning, and managing dredging projects. This time included hydrographic surveying, dredge operations planning, working closely with crews, working with clients, and dredge performance optimization. Robert then spent twenty-one years in the GLDD Production Department, advancing dredging knowledge at GLDD and industry wide. He developed tools (software) and procedures for estimating, operations analysis, research, optimization, and troubleshooting. Robert worked on US domestic and international projects (up to $500M in revenue) with all types and sizes of dredging plant.

Robert's final position at GLDD was as Director of Production Engineering and R&D, working closely with researchers in governmentand academia to support their work and advance dredging knowledge. Working with colleagues at GLD&D and in the dredging industry, he contributes to research of pipeline transport of solids, cutter suction dredge spillage, safety, the mechanical properties of clay, and more. After leaving GLDD, Robert started his own consulting company, DredgingResources.net, providing consultation and analysis of allthings dredging.

Mr. Ramsdell is also a member of World DREDGING's Board of Industry Advisors.

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At the Port of Baltimore

Dredged Material Benefits Neighboring Communities & the Environment

The Port of Baltimore is experiencing a season of rapid growth and surging cargo volumes. As massive backlogs at other ports are impacting the nation's supply chain, the Port of Baltimore is taking on diverted ships as traffic continues to flow smoothly at its many harbor facilities.

Ranked 11th among major U.S. ports for foreign cargo and 10th for total foreign cargo value, the Port of Baltimore's ability to accommodate increasing volumes of container shipments come from years of preparation and a large investment in Port

Dredged material blending evaluation study being performed at the Cox Creek Dredged Material Containment Facility in Anne Arundel County, Maryland (MD). Photo Credit: MDOT MPA

efficiency. With tens of millions of dollars in infrastructure improvements in the works, dredging to increase capacity is a key part of the strategic plan to keep commerce moving freely at the Port.

In April 2021, a 50-foot deep container berth at its Seagirt Terminal was completed, supporting business expansion at the Port and generating thousands of jobs. The expansion doubled the terminal's ability to receive ultra-large ships. This was critical to the accommodation of East Coast commerce, while bottlenecks stifled movement at other ports across the nation.

As Baltimore continues to invest in Port efficiency, it finds new and innovative ways that material dredged from the navigation channels can contribute to local environmental remediation needs to support surrounding communities.

There are 150 nautical miles of channels serving the Port of Baltimore and every year approximately 5 million cubic yards of sediment must be dredged to maintain them. Finding sustainable solutions for the large volume of dredged material that the Port generates is an ongoing challenge that also presents many opportunities. The Maryland Department of Transportation Maryland Port Administration (MDOT MPA) Dredged Material Management Program (DMMP) provides a rolling 20-year plan aimed at addressing sediment management challenges through the broad participation of citizens, scientific experts, regulatory agencies, and business partners.

The DMMP uses a mix of strategies for managing dredged material. Wetland restoration, island recreation, upland placement, and innovative reuse options are helping to re-imagine its practical uses. As the Port's commitment to sustainability meets the needs of Baltimore development, the value of dredged material continues to grow in use and potential. Today, dredging's impact extends far beyond the maintenance of shipping channels and into Maryland communities farther from the Port.

In 2019 MDOT MPA began partnering with Maryland Department of the Environment, Maryland Environmental Service, Baltimore City, Baltimore Development Corporation, and TopGolf to reuse 22,000 yd3 of blended dredged material. Sourced from the Cox Creek Dredged Material Containment Facility, the material was used for an innovative remedial capping project in the upland restoration of the Ridgley's Cove recreational park.

"Baltimore is world-renowned for its beneficial use of dredged material, and the Ridgley's Cove reconstruction is further proof of Maryland's ingenuity," said MDOT MPA Executive Director William P. Doyle. "Continuous dredging is critical to accommodate the ships that enter the Port of Baltimore to deliver high volumes of cargo and support tens of thousands of jobs. We can use this dredged material to restore, reclaim and rebuild property in surrounding communities."

Historical research of the Ridgley's Cove site indicates environmental impacts stemming from land-use activities dating

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At the Port of Baltimore

Dredged Material Benefits Neighboring Communities & the Environment

Continued

Dredged material being loaded for transport at the Cox Creek Dredged Material Containment Facility. Photo Credit: MDOT MPA

Historical research of the Ridgley's Cove site indicates environmental impacts stemming from land-use activities dating back to the late 1800s. Plans involve mediation of existing environmental impacts and establishing the site as a recreational asset. The underutilized property is being developed into a multi-use recreation area with walking trails adjacent to Horseshoe Casino in downtown Baltimore City.

Restoration of the upland and near-shore environment is part of a mitigation package associated with the future TopGolf facility. "This is truly a terrific example of how working across jurisdictions and areas of expertise can bring about projects that transform neglected and underutilized property to improve the quality of life in our communities," said Kim Clark, Executive Vice President of Baltimore Development Corporation.

Ridgely's Cove is just the latest example of MDOT MPA using dredged sediment in innovative ways. In the past year, more than 32,000 cubic yards of sediment have been dewatered and transported for other off-site restoration projects, which increases capacity in upland facilities receiving dredged sediment from Port shipping channels.

"The partnership at Ridgley's Cove between public, private, and nonprofit sectors demonstrates how we can make a difference in our communities when we work together," said MDOT Secretary Greg Slater. "The project also highlights, yet again, the environmental and economic benefits we can achieve through the creative use of dredged materials."

After dredged material is dried and stockpiled at the Cox Creek facility, blending options are evaluated for potential innovative use such as general fill and/or topsoil for an engineered cap in a recreational use scenario.

"Learning more about innovative and commercially-viable options to reuse dredged sediment will help us both recover capacity and extend the lifespan of sediment containment facilities such as Cox Creek," said MDOT MPA Chief of DMMP Strategy and Partnerships Kristen Keene.

Dredged material being delivered and consolidated at the Ridgley's Cove site in Baltimore City, Maryland (MD). Photo Credit: Arco

MDOT MPA has taken on other types of environmental restoration projects as well. For example, Masonville Cove in Baltimore is the former home of Kurt Iron and Metal and the Maryland Shipbuilding and Drydock Co. More than 61,000 tons of trash and debris dating back to the Great Baltimore Fire of 1904 were cleared by MDOT MPA upon Masonville's opening in 2008. In 2013, Masonville Cove was named the nation's first Urban Wildlife Refuge Partnership, and today the facility includes walking trails, a fishing pier, and an education center.

Dredging alone won't prevent shipping backlogs. The ability to move cargo quickly and efficiently to and from the Port facility is also part of MDOT MPA's coordinated infrastructure plan. But the innovative uses of dredged material continue to benefit communities in ways that Marylanders can see, touch, and feel.

MEETING CLEANUP GOALS

Cable Arm Clamshell

Overlapping Side-Plates
6' x 8' Footprint
Level-Cut
4200 lb

ENTACT, LLC performed remediation of mercury and lead contaminated sediments from an approximate 3,600 linear foot segment of the **Portage Canal** that flows northeast from the Wisconsin River to the Upper Fox River. Mechanical dredging was accomplished using **Cable Arm's Environmental Clamshell** bucket affixed to an excavator to successfully dredge 29,400 cubic yards of sediment from a floating barge assembly. **ENTACT is proud to have contributed to the City of Portage's Lake Management and Aquatic Plant Management Plan for Silver Lake.**

CA

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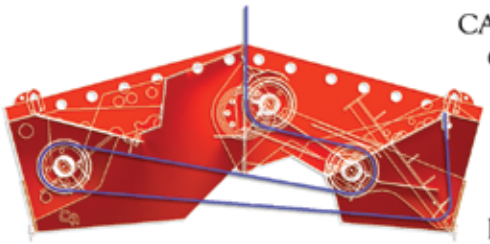
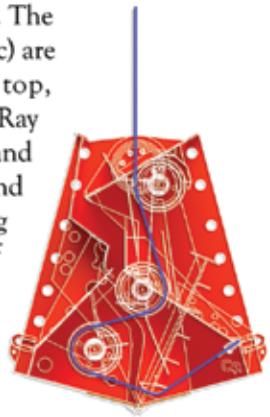
Inside Cable Arm...

"The Cable Arm Environmental Bucket is considered the most advanced in the world and one of the preferred options for environmental dredging" (Environmental Canada, 1998, p. 26)[1]. Since it's first demonstration in 1991, with it's innovative level-cut, the CA environment clamshell has continued to evolve.



CA clamshells are custom built to meet and exceed job specific goals. The CA environmental clamshells (available in mechanical or hydraulic) are specialized sediment removal buckets used to dredge the top, contaminated, layer of the water bed–efficently and effectively. "Ray Bergeron through his demonstrated knowledge of conventional and unconventional dredging, his outstanding problem solving skills and his ability to seek logical solutions to the needs of the dredging community has reflected greatly on his Company and the Western Dredging Association" (Dredger of the Year Award, Western Dredging Association, 2010). With over 30 years of custom designing environmental buckets to minimize resuspension, cut time, and reduce costs; Ray continues to develop new designs to tackle restrictions and/or needs unique to the job that can otherwise prohibit a successful and profitable operation.



Jobs in which CA environmental buckets excel: large volume sediment removal, precision dredging, remediation of difficult contaminants (e.g. mercury, lead, etc.), open-water disposal restrictions with high disposal/transportation costs (require high solid content), sites in which turbidity is an issue and silt curtains are prohibited (e.g. certified in Canada to remove sediment in front of nuclear power plants), etc.

CA clamshells are built in a modest shop in Southeast Michigan and shipped worldwide to work in various job applications.
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patent & patent pending

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75 yard³ | 22' x 29.5' footprint | 70k lb on 250k lb working load crane | 2-1/2" cable diameter

[1]https://publications.gc.ca/collections/collection_2019/eccc/En40-549-1998-eng.pdf

3+ Years on the Grasse River

Years of successful remediation work officially wraps in Massena, New York (NY)

Sam Crawford

This fall, J.F. Brennan Company, Inc. (Brennan) crews successfully completed the final phase of remediation after 3.5 years on the Grasse River. This project had a challenging scope with a demanding schedule but through a combination of great teamwork and outstanding production efficiencies, our team was able to complete the work and execute a safe demobilization prior to winter freeze up. Here's how we did it.

Floodplain backfill placement operations CLEAN UP

2018: Cap Pilot Test

In 2018, a small crew of Brennan operators and office staff mobilized to the site in Massena, NY, to lay the groundwork for the project. The primary goal of the cap pilot test was to install settlement monitoring equipment on the riverbed, followed by placing the components of a multi-layered armor cap that would allow

our client's engineers to assess how in-place cap material would settle on the river bottom.

2019: Dredge and Backfill

In 2019, Brennan began full-scale remediation operations on the Grasse River starting with mobilizing most of the equipment and barges that we would use throughout the project. From March through November, 64 office staff and crew worked on the project. The overall goal in 2019 was to dredge impacted areas along the north and south shorelines of the river to meet project criteria as agreed by the client and the Environmental Protection Agency (EPA).

To facilitate dredging operations, 2 dredge plants were utilized. We placed dredged material into Brennan's custom-built hopper barges and transported it via push-boat back to the Route 131 Staging Area, where we offloaded the material and processed it through a custom-built processing system. The processing system separated out larger boulders and other debris from the sediment and then dosed that sediment with Portland cement to help stabilize the material for off-site shipment.

Brennan's subcontractor, Infrastructure Alternatives Inc. (IAI), set up a mobile water treatment plant to pretreat the water that was collected on the sediment processing pad or that was pumped out of the dredge hopper barges. Once dredged areas were approved, 2 backfill plants followed the dredging operations placing clean material back into the dredged areas to meet pre-dredge elevations. A separate group of push-boats moved loaded barges of backfill material from the Route 131 Staging Area to the 2 backfill plants. Brennan also mobilized a long-reach amphibious excavator to the site to assist with dredging and backfilling near-shore areas and flood plains that could not be accessed with barge-based excavators.

2020: Snug Harbor, Dredge, Cap, Mussel Collection

The COVID-19 pandemic forced Brennan's crew to delay mobilization to the site for the 2020 season while we worked to obtain essential worker authorization from New York state. During that time, Brennan was awarded an extension to the original dredging contract, adding the removal of another 100,000 yd3 of dredge material from Snug Harbor, an area at the mouth of the river. Operations began back on the river in May, with approximately 73 office staff and crew.

Once on-site, dredging operations in Snug Harbor began using a process like our 2019 operations while a separate crew worked to reconfigure 2 backfill plants to create 2 Broadcast Capping System (BCS™) placement plants.

Our capping goal on the Grasse River in 2020 was to place a 3-layer armored cap across a 54 AC area, composed of a chemical isolation layer (CIL), gravel filter layer (GFL), and armor layer (AL). With the BCS and a hydraulic slurry plant fully assembled, crews

Steve Feenstra and Matt Wagner opening up a booster pump.

began placement of the CIL beginning at the uppermost extent of the project and working downstream covering approximately 54 AC of the main channel. Once we completed the CIL, a different plant was brought Online to place the GFL; this plant was configured to mechanically feed the BCS using a material handler.

Material barges were loaded at the Route 131 Staging Area with GFL material and then transported to the placement plant with a push-boat. With the GFL complete, both BCS placement plants were again reconfigured to create 2 mechanical placement plants outfitted with 130,000 LB long-reach excavators. The mechanical placement plants, fed by material barges and push-boats, were used to place a final layer of armor stone across the entire 54 AC area.

Haverstock Land Plant Operations

Placing Rootwad Tree in River.

On a downstream section of the river, Brennan's dive team mobilized to the site to conduct nighttime mussel collection and relocation as part of the New York State Department of Environmental Conservation (DEC) mussel protection initiative.

At this point, dredging operations were completed for the project. Crews ripped up the asphalt pad used for sediment processing operations and shipped it off-site. In late November, we began constructing a second staging area in preparation for the 2021 season. We'd use the staging area as a second capping land plant to facilitate capping operations on the downstream section of the river during 2021 operations.

2021: Dredge, Cap, Habitat Restoration

After a pause over the winter, in-river operations resumed on the Grasse River in March 2021 with an office staff and crew of 57. Crews worked to configure our 2 BCS™ capping plants, fuse approximately 20,000 FT of pipeline, and assemble a second hydraulic slurry plant at the newly developed Haverstock Staging Area.

Prior to mobilizing in March, the client identified a small section at the mouth of the river that required further dredging to provide additional draft for larger vessels operating near Snug Harbor. Brennan's team assembled a small-scale sediment processing system at the Route 131 Staging Area. Utilizing our ALLU amendment system inside a concrete bin, we stabilized the approximate 5,500 yd3 of dredge material that was removed in this area.

The scope of capping operations in 2021 required placing a 2-layered cap across 195 AC, starting at the terminus of the armored cap placed in 2020, stretching to the mouth of the river. Operations began working around the clock 24 HR per day, 6 days per week, placing a CIL similar to that placed in 2020. Once the CIL was verified complete, a second layer of non-amended sand termed a habitat layer was placed.

Upon completion of the habitat layer, crews transitioned to assembly and installation of several habitat features including rock clusters, anchored root-wads, and fish cribs.

Throughout the summer of 2021, crews conducted several mechanical placement operations: backfilling certain areas dredged in Snug Harbor, placement of high organic content topsoil in flood plain areas, and covering over 3.5 AC of the

river with a modified armor layer cap.

New and Custom-Built Assets

To help facilitate the execution of this project, Brennan acquired several new assets including 3 Hitachi ZX470 long-reach excavators; 1 Sennebogen 840E material handler; 1 Sennebogen 850E material handler; 3 truck-able push-boats, the James O'Neill, Robert Calvey, and Rodger Bean; a custom-built sediment processing system; and a BCS dewatering system.

A special shout-out to Brennan mechanics Matt Wagner and Kyle Vesbach for keeping these machines in prime operating condition. Thank you to the rest of the Asset Management group for helping to facilitate delivery and maintenance of these assets.

Grasse River by numbers:

Grasse River by numbers:	
Safe Man-Hours	360,000
Cubic Yards of Impacted Sediment Removed	210,000
Tons of Cement Used to Stabilize Dredge Sediment	37,000
Tons of Clean Capping Material Placed in River	1,600,000
Acres of Amended Cap Placed	260
Tons of GAC Used in Amendment Layer	2,200
Anchored Root-wad Trees Installed	17
Rock Clusters Installed	22
Large Fish Cribs Installed	276
Low-Profile Fish Cribs Installed	124

Sediment Processing Operations

Dredging up Affordable Precision

How real-time positioning from Trimble lowered pipeline dredging operations costs

Not all dredging operations require high precision, but to support the construction of offshore pipelines--like those connecting oil and gas platforms to onshore facilities--the final leg requires centimeter precision. And achieving that accuracy often comes at a time-consuming and costly price.

Singapore-based Offshore Construction Specialists (OCS) understands well the challenge in providing consistent high precision in offshore environments, particularly when they're closer to shore.

"For pipeline installation, near-shore construction needs more attention than when you are laying pipe, for instance, 100 kilometers away from land," says Keith Jackson, managing and technical director for OCS. "In near-shore construction you are concerned about fishing vessels, recreational folks, and other ship traffic—those might damage a pipeline—so you need to bury it. We need to dredge the seabed down, lay the pipe into the trench and backfill."

Typically, they've had to rely on conventional global navigation satellite system (GNSS) receivers and base stations—and risk theft or damage—or subscribe to pricey positioning services. But that changed when they sought and found a better option for real-time positioning for their dredging operations. They chose CenterPoint RTX from Trimble, a service that brings real-time, centimeter precision positioning over much of the globe. The solution has delivered not only the consistent centimeter precision they've needed, it's also provided it at a fraction of the cost of previous methods.

Precision Dredging

OCS operates dredges for projects spanning a wide region of Southeast Asia. Founded in 2007, OCS focuses on the installation of pipelines, platforms, tanker moorings and related facilities, and has teams that specialize in the crucial shore connections of pipelines.

Although OCS's primary services require precise positioning, the options for obtaining the required accuracy for their dredging vessels were proving to be cumbersome, time consuming and expensive. OCS was limited to either setting up GPS base receivers, contracting a surveying firm, or subscribing to costly maritime positioning services like RTK.

Legacy positioning solutions for the dredges were costly and time consuming. "Sometimes we used to put up a GNSS base on-

OCS adopted CenterPoint RTX for their near-shore pipeline dredging work. Source_ OCS

shore," says Keith. "And we would send RTK corrections to the GNSS receivers on the dredge via radios. We get curious locals; there can be theft; construction could disturb it; and some areas have piracy." These considerations added to costs including the need to own and maintain separate base receivers, spend time developing the coordinate reference for each location, and protecting the base by putting a fence around it or having someone watch it.

Another legacy option has been network real-time kinematic (RTK). There are many regions in the world that have real-time networks, or RTN. These networks work essentially the same way as base-rover RTK, with corrections delivered by cellular service. But most of the varied Southeast Asian environments that OCS works in—often austere locations—fall outside of existing RTN coverage.

OCS had also been contracting surveyors to tie to project control and set up RTK bases, or using an established maritime positioning subscription service. "Although the subscription service signal is good, it can be quite expensive," says Keith. "For a smaller contractor like us, every cent counts."

The New Service

OCS went in search of affordable precision and talked to Tan Siew Siong, regional sales manager at Trimble Singapore. Once they discussed the specifics of OCS's dredging workflows and precision requirements, Tan suggested Trimble's CenterPoint RTX. CenterPoint RTX is a global positioning service for marine and land-based applications like agriculture, construction, surveying, mapping, and vehicle autonomy. CenterPoint RTX service creates precise point positioning (PPP) corrections from Trimble's global tracking network of GNSS ground stations and delivers these via geostationary satellites.

"We started a two-week trial and found out quickly that after a short convergence time, it gave us centimeter accuracy, up to 5 to 10 kilometers from shore," says Keith. "We had vessels about to depart for Thailand for a job. We had everything integrated, tested, and operational details worked out within two weeks, ready for the work there."

Implementation

To meet the specifications for this kind of work, not only does the dredging barge need a constantly updated precise position and heading, the offsets to the dredging equipment need to tie to the GNSS positioning system. On each of OCS's dredges, there are two backhoes, one on the stern and one on the bow. Offsets were measured from the GPS antenna to each, and for the trailing suction system from big submersible sand pumps.

To utilize Trimble RTX, OCS acquired a Trimble BX982 GNSS receiver, commonly used for maritime applications. It has dual antennas to provide not only precise positions, but also heading. From the combination of the receiver and CenterPoint RTX corrections, OCS gets the precise horizontal (x-y) positioning they need. For the vertical component, they have multi-beam sonar, registered to the same positional reference as the Global Positioning System (GPS).

First implemented for the Thailand project, Trimble RTX rapidly became their standard positioning solution. "There was no question: we now use this on all projects," says Keith. "With CenterPoint RTX we don't have to set up a base and it provides consistent, centimeter positioning. Plug, play, and dredge… this represents quite a leap ahead for near-shore pipeline dredging operations.

OCS's utility barge "Miss Pennie" configured with for long-boom dredging with trailing suction, both referenced to real-time positions from CenterPoint RTX. Source_ OCS

Femern A/S - The tunnel across Fehmarnbelt

Liebherr's duty cycle crawler crane HS 8300.2 in dreding operation on the Baltic Sea for Europe's new shortcut between Germany and Denmark. The Fehmarnbelt tunnel. It will be the world world's longest of its type for both roadand rail.

The Fehmarn belt link – the world's longest immersed tunnel

The Fehmarnbelt link is one of Europe's most extensive construction projects to date. The 18 km Fehmarnbelt tunnel will connect Rødbyhavn on Lolland in Denmark with the island of Fehmarnin Germany.

In addition to the immersed tunnel Femern A/S is responsible for, the Fehmarnbelt link comprises land-works on the Danish and German sides. The railway - on both sides of the Fehmarnbelt - is being upgraded to two electrified tracks that can handle speeds of up to 200 km/hr. When the tunnel is completed, the train journey from Hamburg to Copenhagen will take well under three hours.

The tunnel will be user-financed – the same model that was used for the Storebælt and Øresund fixed links. The Fehmarnbelt tunnel's payback period is 28 years. The tunnel project funds the investments for upgrading the railway between Ringsted and Rødby.

https://femern.com/en ❍

WODCON XXIII Registrations Opens as Program Launches

Central Dredging Association (CEDA) announced today that the program for global summit, WODCON XXIII, is now available and registrations are open at **www.wodcon2022.org.**

CEDA is pleased to be hosting next year's global summit on behalf of the World Organization of Dredging Associations (WODA). The theme for WODCON XXIII is ***Dredging is Changing*** and it will be held in Copenhagen, Denmark from 16 to 20 May 2022 at the Tivoli Congress Center.

The World Dredging Congress, WODCON, is held every three years and is the biggest global event for professional involved in any activity related to dredging and dredged sediment management. WODCONs provide a unique platform for researchers and practitioners, from academia, government and business, to exchange knowledge and experiences, present research results, spark new ideas and explore collaborative opportunities.

Technical and business presentations in engaging formats

The organizing and papers committees have curated a typically comprehensive program of technical and business presentations, in plenary and parallel tracks, following dynamic and engaging formats, including keynotes and paper presentations. An exhibition, as well as technical visits and partner programs, will make the program complete. The full program, and details of how to register for the event, can be found at **www.wodcon2022.org.**

***Dredging is changing,* and this change is evident everywhere**

Dredging is changing – and today, this change is largely driven by the **sustainability** objectives as detailed in the UN's Sustainability Development Goals (SDGs). These challenges drive innovations in all segments from project proponents such as government agencies and ports, to regulators, contractors, consultants and shipyards.

Sustainability is manifested in the way water infrastructure projects are designed and implemented, and in the technology and processes used. Another remarkable change is that the use of dredging expertise is expanding beyond the traditional areas of port development, river deepening and land reclamation. Dredging is now also integral to offshore energy and deep-sea

mining expansion opportunities. WODCON XXIII's program reflects this rapidly changing field and the Congress will give superb opportunities to learn from each other and collaboratively design new tools for the future.

What can participant expect?

Participants at WODCON XXIII can expect to hear from the practitioners, academics and business thinkers, who are driving the change. More than 80 paper presentations from international experts, and panel discussions will cover areas including:

- Beneficial use of sediment
- Deep-sea mining
- Energy efficiency and decarbonization
- Equipment: history, development and innovation
- Flood risk and coastal protection
- Hydraulic transport
- Marine construction
- Ports and waterways: erosion, sedimentation and maintenance
- Renewables infrastructure including energy islands
- Sediment treatment
- The Fehmarnbelt Tunnel Link
- Turbidity modelling / monitoring

High-level keynotes will include: the Danish Minister of Transport, Benny Engelbrecht, who will address the conference theme: 'Dredging is changing'. Henrik Vincentsen, CEO Femern A/S, will cover some of the other large-scale projects in the pipeline for the region. There will also be a technical keynote on 'Offshore wind next level: the Danish Energy Islands', presented by Kristoffer Böttzauw, Director General of the Danish Energy Agency. The organizers expect to add further excellent keynotes to the program. Updates are available at **www.wodcon2022.org.**

The associated exhibition will showcase cutting-edge equipment and solutions from the pioneering companies leading the change.

Participants can choose from two technical visits: they can do a full-day tour to the construction site in the Fehmarnbelt - with a sail along the 18 km immersed tunnel alignment while enjoying the view of the dredging fleet at work or they can opt for the half-day tour to Lynetteholm, a 2.8 km^2 artificial island being built in the harbor of Copenhagen.

With the full program of technical and business presentations, exhibition, peer-networking and social activities, that make up the event, WODCON XXIII promises to be an engaging and memorable experience.

Participants can do a full-day tour to the construction site in the Fehmarnbelt - with a sail along the 18 km immersed tunnel alignment while enjoying the view of the dredging fleet at work.

Boskalis takes delivery of largest bio-fuel consignment to date

Boskalis has taken delivery of its largest-ever consignment of drop-in biofuel which will be used to power two hopper dredges on upcoming projects in northwestern Europe. The use of bio-fuel will result in a CO2 reduction of approximately 90% for the 12,000 m^3 hopper dredge Willem van Oranje and approximately 45% for the 4,500 m3 hopper dredge Strandway.

The delivery of approximately 1,000 m^3 of Hydrotreated Vegetable Oil (HVO), a sustainable bio-fuel derived from used cooking oil, was in collaboration with Boskalis' long-term partner and fuel supplier, GoodFuels.

Boskalis' own testing program with GoodFuels and engine manufacturer Wärtsilä that began in 2015 has demonstratedthat drop-in marine biofuels can reduce the CO2 emissions by up to 90% compared to fossil fuels. In 2019, as part of the 'Boskalis on Bio' program, the Willem van Oranje became the world's first dredging vessel to operate on 100% biofuel oil. Since then, Boskalis has successfully used various biofuel blends as an alternative to fossil fuels on both dredging and offshore installation vessels, as well as for dry earthmoving equipment, resulting in a considerable emissions reductions.

Through its agreement with GoodFuels, Boskalis enables its clients to opt for biofuel-powered vessels to reduce their carbon emissions on projects. Last year 80% of Boskalis' project tenders in The Netherlands included sustainability measures, including options to use biofuels. www.boskalis.com ❍

IHC Hytech under new ownership

Royal IHC announces that on the 24th of December it has sold IHC Hytech B.V. (Hytech) to anumber of private investors who have established Pommec Hytech Holding B.V. Buyers plan to merge the operations of Hytech with those of Pommec B.V. (Pommec).

Hytech specializes in the design and manufacturing of high quality, professional diving and hyperbaric equipment. Hytech designs, produces and delivers innovative, sustainable and integrated equipment for the diving, governmental, tunneling, life support and medical markets. Other than themedical market, Pommec is currently active in all markets that Hytech operates in. Pommec is currently located in Bergen op Zoom. Buyers plan to locate combined operations of Hytech and Pommec at Hytech's location in Raamsdonksveer.

IHC Hytech is a highly specialist company in the area of hyperbaric equipment. It is a highly reputableplayer for both new build as well as service. The company was originally acquired by Royal IHC because Royal IHC intended to build Dive Support Vessels. The changed market situation in the offshore market meant that this never materialized. Fortunately, the governmental market held up.On top, Hytech diversified its product offering into amongst others the market for medical hyperbaric chambers and the market for tunneling equipment. The company is successful in these markets. Through the planned merger with competitor Pommec, a leading 'go to' market player forhyperbaric equipment will be shaped.

Gerben Eggink, CEO of Royal IHC, stated, "We have always been proud to have such high-end technology in our product portfolio. Last year, during the reorganization of Royal IHC, Hytech was labeled as non-core for Royal IHC. I am happy that we found a good strategic home for Hytech. Thesale of Hytech successfully concludes the divestment of our non-core businesses."

Marcel Beckers, Owner Solyse Invest and representing Pommec Hytech Holding said, "The Pomme family and I are very proud that the merger of Pommec B.V. and IHC Hytech B.V., two companies with a joint existence of 75 years, results into a powerful enterprise with a top-3 position worldwide. Pommec Hytech is an innovative front-runner in the supply of high-end systems and services in specialized markets all over the world. A company that 'BV Nederland' can be proud of as well." www.royalihc.com ❍

Panama Canal – 2022

This month marks the end of another record-breaking year at the Panama Canal – no simple feat – given the challenges it faced, from global supply chain disruptions to the continued effects of the COVID-19 pandemic on the global economy. Behind the waterway's uninterrupted service stood a world-class team, who worked tirelessly to ensure the waterway remained safe and prepared for whatever the future may have instore for it next.

To celebrate the end of the year, Panama Canal leaders were asked to reflect on the waterway's top achievements from the past year, as well as what they have in store for 2022.

Operations

Although global trade began its resurgence in 2021, the Panama Canal kept its operations teams as agile as possible, given the pandemic's unpredictable impacts on traffic thus far. The team made prompt adjustments to accommodate the unprecedented surge in demand. In February, the Canal modified its transit reservation system and other maritime services to adapt its service and better manage its capacity in the face of fast-growing market conditions. The Canal also began offering an auction booking slot for the Panamax and Neopanamax Locks to help alleviate waiting times and offer additional booking optionsand flexibility for customers.

By October, the Panama Canal celebrated a record-breaking year of transits. "Our achievements in 2021 were made possible by our team's dedication to understanding our customer's shifting needs. As they shifted, we listened and evolved our service accordingly, while continuing to keep health and safety as a top priority," said Ilya Espino de Marotta, Deputy Administrator of the Panama Canal. "We look forward to accommodating even more transits for our customers in the New Year, with containership, liquefied natural gas and liquefied petroleum gas transits already expected to drive growth in 2022."

Sustainability

Accelerating the Panama Canal's transition to carbon neutrality will also be a key priority across the waterway's teams in the coming year, building off the waterway's fast-growing sustainability initiatives. In just the past year, the waterway launched its CO2 Emissions Savings Dashboard, a tool for calculating the carbon dioxide (CO2) emissions saved by vessels that transit the Panama Canal, compared to the most likely alternative route, which found that vessels saved more than 13 million tons of CO2 emissions by opting for the Panama Canal route in 2020.

This past year, the Panama Canal also signed the Call to Action for Shipping Decarbonization with 150 maritime organizations, contributed to the UN Global Compact's Charting a 1.5 C Trajectory for Maritime Transport, and gave a presentation on sustainable maritime routes at 2021 United Nations Climate Change Conference (COP26).

In 2022, the waterway will advance its pledge to becoming carbon neutral by 2030, with plans already underway to invest roughly $2.4 billion in modernizing its equipment and infrastructure to meet this commitment. For the operations team, initial next steps include adopting 10 hybrid tugboats, with the option of purchasing another 10, which will reduce tugboat operational carbon emissions by 20 percent. The Canal will also introduce a fleetof electric vehicles, among other measures.

"Our goal is to begin a series of investments that maximize the value we can offer our community, customers and world as a green route and corridor for world trade," said Victor Vial, Vice President of Finance. "By fortifying our infrastructure, technology and equipment,we can meet this challenge and ensure we continue to deliver the safe, efficient and reliable service we have been delivering for over 100 years."

Infrastructure & Engineering

Maintaining and modernizing the infrastructure of the Canal is no small mission. Over 100 maintenance projects are conducted in a typical year to preserve infrastructure and equipment.

To proactively plan, monitor and execute projects more efficiently, Miguel Lorenzo, Vice President of Infrastructure and Engineering and his team spent the past few monthsreviewing and optimizing the waterway's investment portfolio to determine new ways to carry out equipment acquisition, improvement and replacement projects. According to Mr. Lorenzo, 2021 marked the start of a series of organizational changes that will "fundamentally change" the way the Canal's physical assets are managed over the comingyears, with landmark investments planned for 2022 that will guarantee the long-termsustainability of the Canal.

"We are carrying out exhaustive evaluations of the conditions of our infrastructure, especially the oldest, to define the needs of attention in the short, medium and long term," he said. "In parallel with this, we will be evaluating and executing those projects that aim to maintain the Canal's social and environmental license, especially those aligned with our declaration of being a neutral entity in greenhouse gas emissions by 2030."

Digital Transformation

The design and implementation of the Panama Canal´s digital transformation vision and high-level roadmap was another strategic endeavor in 2021 that will continue into the coming years. According to Antonio Córdoba, Vice President of Digital Transformation, "going digital" is essential for the Canal as it will "evolve our organization to a new stage of innovation and will keep us relevant, transparent, and successful."

As part of this initial process, Mr. Córdoba and his team completed the following: priorities determination and digital breach analysis, new ways of working to be adopted, the dataand analytics roadmap, the people and cultural transformation journey, among other components of the overall Digital Transformation strategy. "We also defined, at high level, our internal IT evolution journey, which will allow us to support the organization in our acceleration towards the digital future."

Moving forward, the team anticipates a strong focus on scaling its organizational agility, as well as a move towards new digitalized and improved processes. These shifts will then bring increased operational efficiency at all levels. "An incremental usage of data in ways we had never before, thanks to new technologies we are implementing, will allow the organization to discover new business insights, improve precision in forecasting and predictability, and make better data driven decisions in 2022," said Mr. Cordoba. "We will prioritize updating our IT baseline infrastructure and systems, in a sustainable and consistent way, to be able to face the new era of transformation and technology changes."

Water

The Panama Canal is also advancing investments that will redefine its water use for the next 50 years, while making steady progress in the short-term.

A year after introducing water measures, the Panama Canal offered a maximum draft of 50feet at the Neopanamax Locks in 2021, the highest allowed at the waterway. Achieved through effective water management and an increase in rainfall, the higher draft ultimately increased the waterway's capacity to maneuver larger and heavier vessels, a trend expected to continue in 2022.

The Panama Canal, meanwhile, made progress on its search for a long-term water solution, reaching an agreement in November with the US Corps of Engineering (USACE) for developing an economically justified and environmentally sustainable integrated water resource management plan. John D. Langman, Vice President of Water Projects, confirmed that the plan will cover "specific measures to maximize the yield of waterresources within the Panama Canal watershed and potentially includes complementary solutions, resulting in increased operational reliability and resiliency of the system." He added that the agreement will also encompass "a recognition, feasibility studies, andtender support phases to prepare design build solicitations for the solutions selected, as well as capacity building throughout the process."

In 2022, Mr. Langman and his Panama Canal team will work alongside USACE experts to advance project management, engineering, hydrologic, water quality and other elements during the recognition and feasibility phases related to the reached agreement.

Strategic Vision

Measures to secure water in 2021 also offered invaluable lessons that will be applied in the coming year. "After implementing the freshwater surcharge and hearing from customers over the past few months, we recognized the value of offering a dynamic price, based on marketconditions that neither the Canal nor our customers have control," said the Panama Canal Administrator, Ricaurte Vásquez Morales. "We are working to develop a pricing strategy that provides them more visibility and certainty while also safe-guarding the competitiveness of our route."

According to the Administrator, "transparency and close communication with customers from across the Panama Canal's team proved essential to the waterway's overall success in 2021. At the end of the day, our legacy depends on our ability to sustainably create, capture, and render value for our customers, which we can only achieve together."

http://www.pancanal.com

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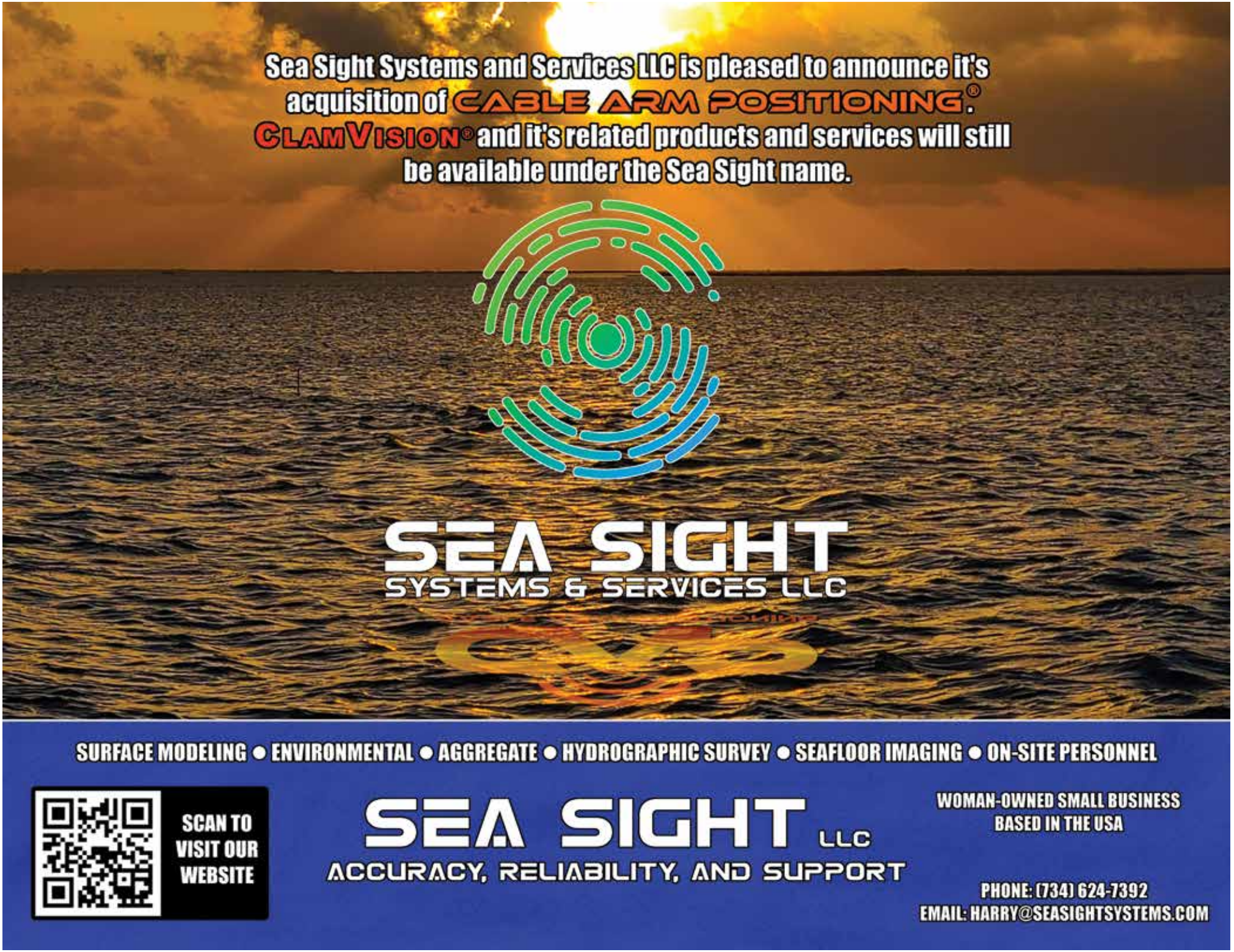
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