GREEN DYE ON THE WATER:
BUILDING AND INSTALLING THE NEW WEST HARBOR POND SIPHON

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1. A Little History

West Harbor Pond was created in 1880 when a dam was constructed across the mouth of Campbell Cove to create a freshwater pond for the production of natural ice for sale to the large urban centers of the Eastern Seaboard. Capt. E.D. Haley designed the dam and installed a passive siphon to evacuate sea water trapped behind the dam at the time of construction. This siphon continued to purge sea water that entered the Pond at extreme high tides.

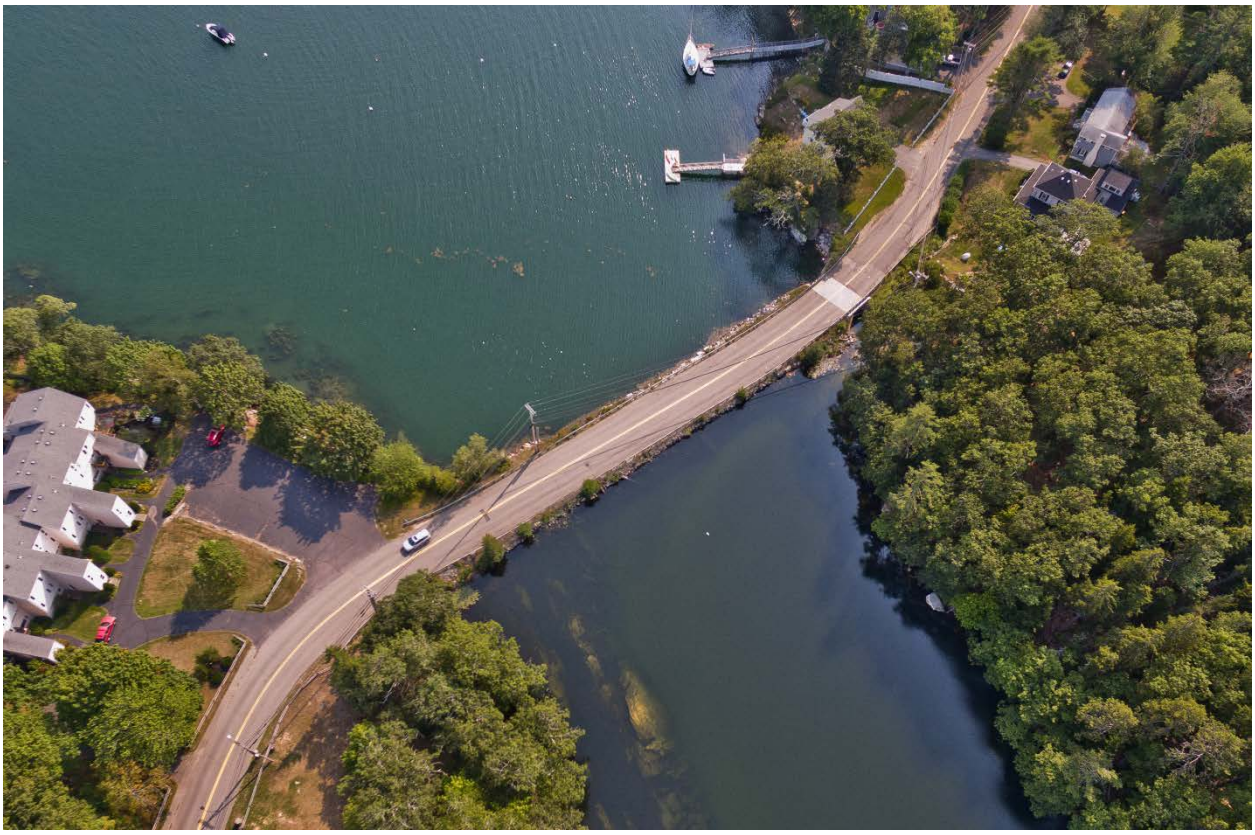
Because of its greater density, this salt water sinks to the pond bottom and, if not removed, prevents the seasonal turnover and reoxygenation of the Pond. While ice production ceased in the second decade of the Twentieth Century, the siphon continued to serve the crucial role of protecting the water quality of the Pond, until, after 130 years, it failed in about 2008.

In 2014, once it understood the damage that the broken siphon was degrading the Pond's water quality, the West Harbor Pond Watershed Association began seeking funds to repair or replace the old siphon. Grant applications submitted in 2014 and 2016 were unsuccessful; but in June 2017, the Maine Coastal Program of the Department of Agriculture, Forestry, and Conservation awarded the WHPWA ant the Town of Boothbay Harbor a $15,000 Coastal Communities Grant, enabling the WHPWA to hire Dirigo Engineering to prepare plans for a replacement siphon.

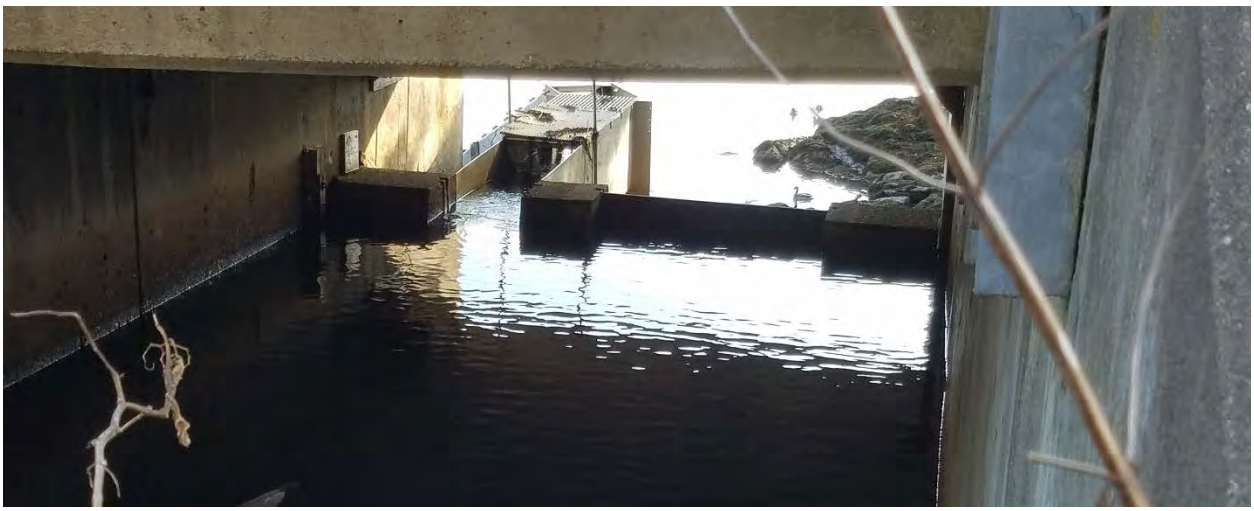
2. Location of the new WHP siphon

At the west end of the causeway that carries Highway 27 across the end of West Harbor Pond, there is a box culvert that permits water to drain from the Pond into the harbor. At the harbor end of the box culvert is a dam about two feet high and a fishway maintained by Maine Department of Marine Resources that permits the migration of alewives and eels in and out of

the Pond. The new siphon runs through the box culvert and through a hole at the base of the dam near the fishway.

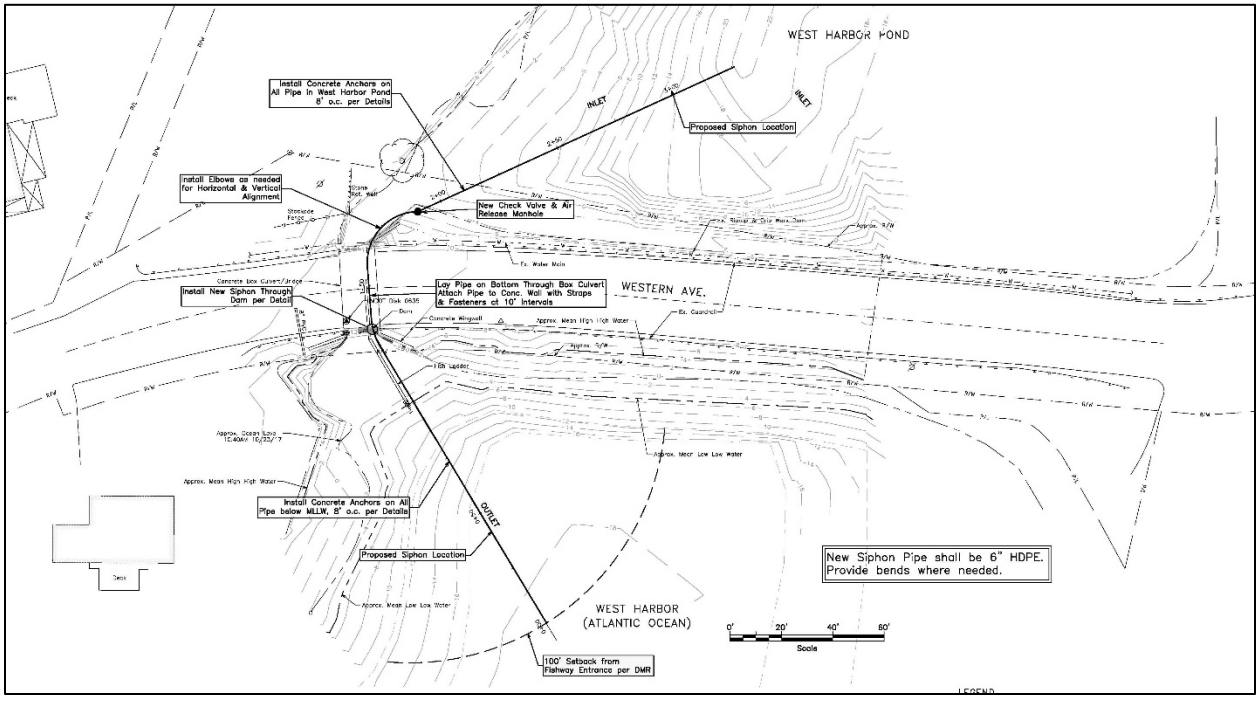


1: Aerial view of WHP causeway showing location of box culvert (white patch of concrete at r.)



2: View through box culvert from Pond showing dam and, at left, the opening of the fishway

3: Box culvert and fishway as seen from harbor



4: Engineering drawing of the siphon

3. Description of the New Siphon

The new siphon consists of three pieces:

1. a 100’ piece of six-inch plastic pipe running from the deepest point at the lower end of the Pond to a manhole cylinder located in the Pond at the mouth of the box culvert, weighted by a 300-lb. weight every 16’;

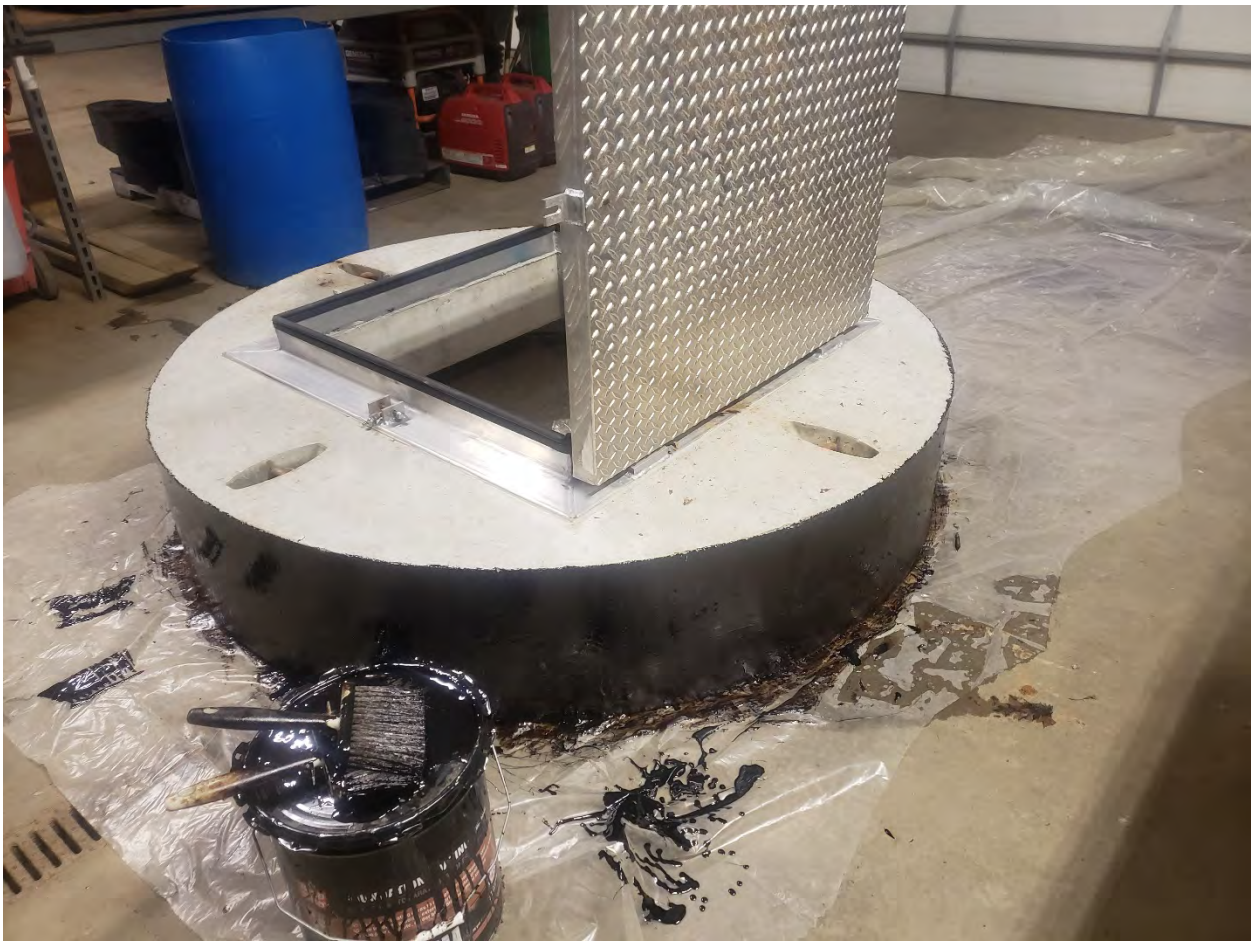
2. the manhole cylinder, closed by a locking hatch, houses the controls for the siphon: a check valve to prevent the siphon from operating in reverse to bring harbor water into the Pond, a large ball valve to open and close the flow of water through the siphon pipe, and two small ball valves (one on either side of the ball valve-check valve) to allow air to escape from the siphon and to permit air, water, or tracing dye to be introduced into the siphon; and

3. a 150’ piece of 6-inch plastic water pipe running from the manhole cylinder into the box culvert, through the face of the small dam in the box culvert, and out into the harbor, weighted by a 300-lb. weight every 8’.

4. Building the Siphon

The Boothbay Region Water District installed the control valves in the manhole cylinder and fused together lengths of 6” seasonal water pipe familiar to Boothbay and Boothbay Harbor residents to create the two lengths of siphon pipe that together will constitute the replacement siphon. The Water District donated the six-inch pipe and its labor to fuse the pipe.

5: Controls for siphon, showing check valve (blue); large ball valve (orange) and two small ball valves



6: Manhole cylinder top (with hatch installed) being waterproofed at Water District workshop

7: Dale Harmon, Operations Manager, Boothbay Region Water District, beside the manhole cylinder he and his crew assembled, after installation

8: The two halves of the siphon pipe fused and ready for installation (150' and 100' respectively)

9: Harbor-side siphon pipe during installation (no weights attached yet)

10: Pond-side siphon pipe with weights already attached

11: 300-lb. weight installed on test section of pipe

12: The Boothbay Region Water District crew: Taylor Timberlake, Shawn Simmons, Trevor Morin, and Weston Alley (l. to r.)

13: Taylor preparing the fusing apparatus

14: Shawn fusing two sections of pipe

5. Work Begins

On December 3, 2018, Pat and Kipp Farrin and their crew began work to install the new West Harbor Pond siphon that will once again remove saltwater from the Pond after the failure of the original 1880 siphon. The new siphon is being installed through an opening in the box culvert at the West end of the causeway adjacent to the fish ladder.

Prior to installation work, they had cored a hole through the small concrete dam in the box culvert to allow the siphon pipe to pass from the Pond to West Harbor. Installation began in freezing weather as Pat and his crew lowered the harbor-side siphon pipe into place and then painstakingly threaded it through the hole in the small dam in the box culvert under the Hwy 27 causeway and out onto the Pond side.

6. Pat Farrin and his crew

15: Pat Farrin at the controls of his backhoe

16: Pat calling instructions to his crew

17: Kipp Farrin (l.) and Mike Doyen (r.)

18: Josh Cook

19: Todd Hyson

7. Placing harbor-side pipe in water and threading it through hole in dam

20: December 3: Pat and Kipp maneuvering harbor-side siphon pipe into position in preparation for placing it in the harbor

21: Kipp and Josh positioning the harbor-side siphon pipe for placement in the harbor

22: Kipp and Josh preparing to thread the siphon pipe through the dam in the box culvert

23: Kipp and Josh threading the siphon pipe through the dam in the box culvert

24: Siphon pipe emerging on pond side after being threaded through dam in box culvert

25: Siphon pipe being pulled through dam in box culvert

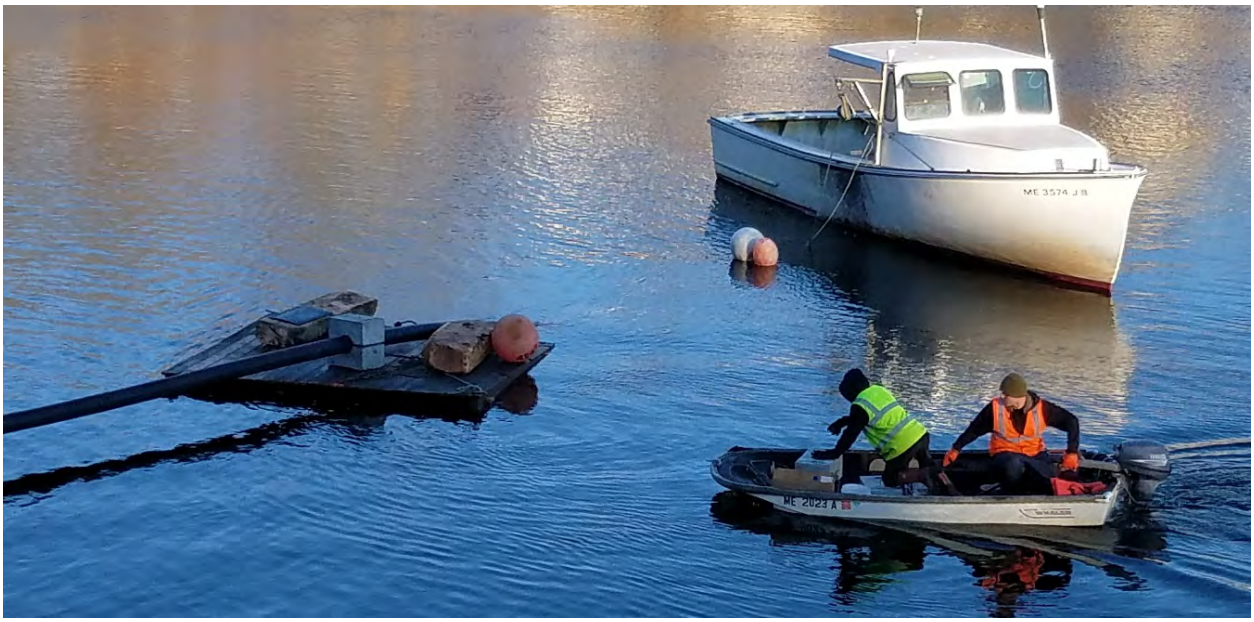
26: End of a long first day: the siphon pipe, filled with air, floating on surface of the harbor

8. December 4, 5, and 6: placing weighs on harbor-side siphon pipe

Once the harbor-side siphon was threaded through the face of the dam and was floating on the surface of the harbor, Pat's crew, assisted by Kent Berry and his lobster boat, installed 300-lb. concrete weights at 8-ft intervals to anchor the pipe to the bottom of the harbor. This work was carried out under brutal weather conditions. With the wind chill in the single digits, Mike, Kipp, and Josh worked from a small, tippy work platform, up to their knees and elbows in the frigid water, attaching the weights to the pipe, then wrestling weight and pipe off the platform.

27: Kent in his lobster boat and Mike on work platform getting ready to place first weight on harbor-side siphon pipe

28: Josh lowering pipe weight to Mike



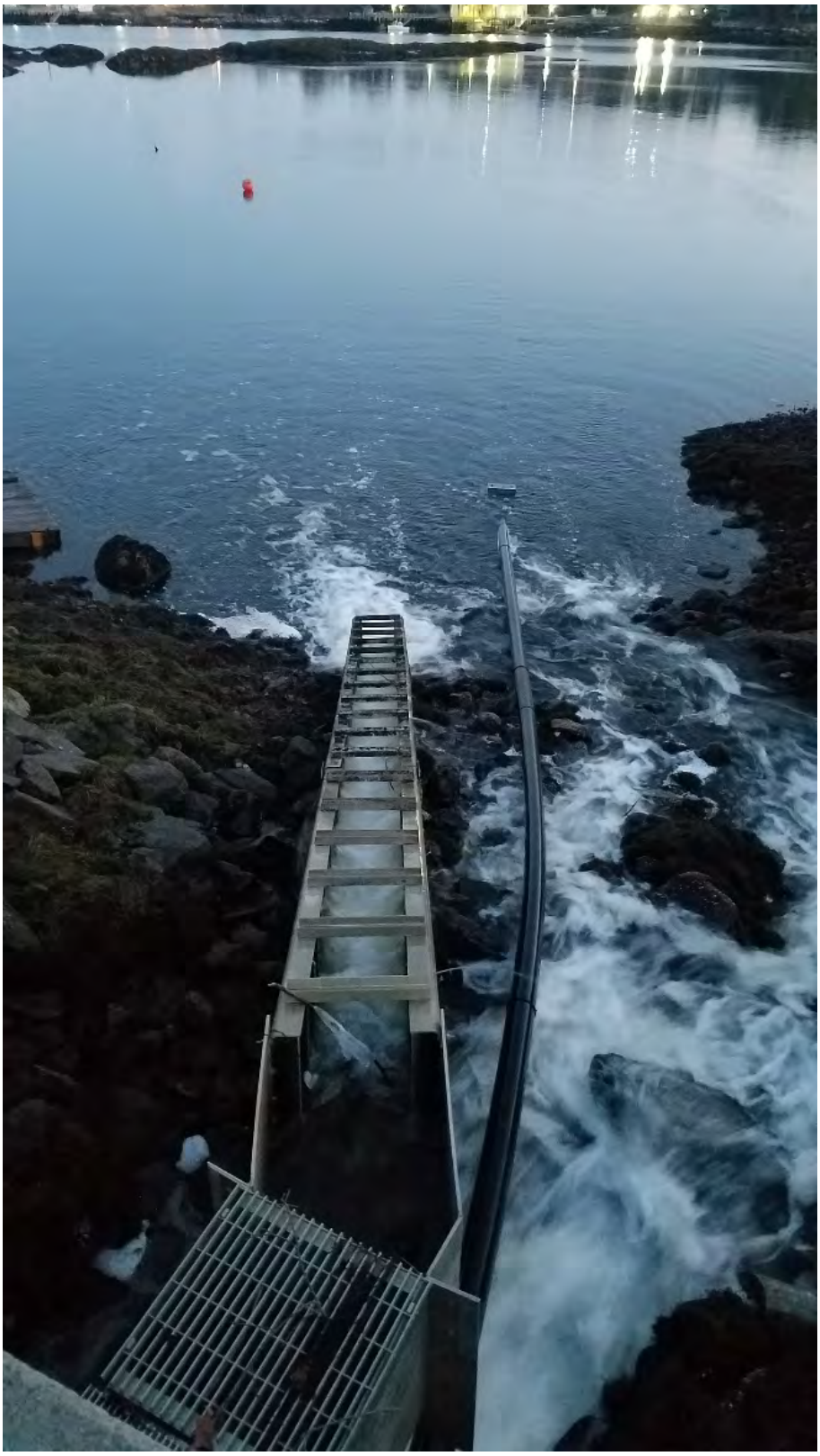
29: Ferrying the pipe weights to the work platform

30: Mike and Josh wrestling the weighted siphon pipe off the work platform

31: Mike, Josh, and Kent trying to move the weighted siphon pipe off the work platform

32: Installing weights on harbor-side siphon pipe continues

33: December 5 (end of the day): weights installed on half the length of the harbor-side siphon pipe



34: December 6: all weights installed and harbor-side siphon submerged and in place, with the end marked by an orange buoy

9. Installing manhole cylinder

During the week of December 10, Pat and his crew, assisted by Dale Harmon, prepared the site for the installation of the manhole cylinder in the Pond on the face of the dam just outside the box culvert. Once again, the weather was brutally cold. The crew soon discovered that the place whether the cylinder would be installed was not composed of fill and riprap, as they had believed, but solid ledge. In order to keep the water in the siphon from freezing, it was necessary to place the cylinder deep enough that the pipe would be submerged during the winter. Achieving the needed depth required the excavation of fully three feet of ledge, a task that could only be accomplished by a large, rented hoe ram. Finally, on December 13, the cylinder was set in place and later in the week the harbor-side siphon pipe was hooked up to it.

35: Manhole cylinder and top ready to be set in place

36: Preparing site for manhole cylinder

37: Greg Ireland, Dirigo Engineering (l.); Kipp; Dale Harmon, Operations Manager, BRWD; and Pat (r.) discussing placement of manhole cylinder

38: December 12: Hoe-ram removing ledge to gain the proper depth for the manhole cylinder

39: December 13: Crane lowering manhole cylinder into place

40: December 13: Crane lowering manhole cylinder into place

41: December 13: Manhole cylinder being lowered into place, Mike working hip-deep in frigid water

42: Manhole cylinder (without cover) in place

43: December 14: Manhole cylinder (with cover) in place; harbor-side siphon pipe awaiting attachment

10. Placing the Pond-side siphon pipe

Work on the siphon was suspended during January and February because of weather, health issues, and the Department of Transportation's work shoring up the outer face of the Highway 27 causeway. On March 1, Pat and his crew hauled the pond-side pipe out onto the ice, weights already attached, and, using chain saws to cut away the ice, dropped it into position. With the thickness of the ice running from 1" near the dam to 8" at the end of the siphon pipe, this was a difficult and somewhat dangerous task.

44: March 1: Pond-side pipe laid out on surface of Pond

45: Mike and Pat, assisted by Reef, determining proper location for siphon intake

46: Kipp levering the pipe into the proper alignment

47: Mike cutting through the ice supporting the siphon pipe

48: Kipp and Mike with chain saws

49: Even with the ice cut away beneath it, the siphon pipe was reluctant to take the plunge

50: With more cutting, it finally begins to sink

51: Finally, nothing remains but Pat and a large foam buoy

11. Hooking it up and making it work

On March 6, with the help of a hoe-ram provided *gratis* by the Water District, Pat and Kipp Farrin connected the pond-side siphon pipe to the manhole cylinder, completing the installation of the siphon. March 7 was spent riprapping and attempting to clear the ice that had

formed inside the pond-side pipe. That afternoon, Dale Harmon of the Water District put dye into the siphon at the manhole cylinder, hoping to see it appear at the harbor-side outlet. By the end of the day, no dye had appeared, indicating that portions of the siphon were still frozen. So on March 8, Dale Harmon placed a heater in the manhole cylinder to melt any ice obstructing the siphon mechanism, especially the check valve. Using a large air compressor, his crew then blew air first through the pond-side pipe, then through the harbor-side pipe creating dramatic effects. When the air from the pond-side pipe reached the surface, it carried with it the strong stench of hydrogen sulfide, the by-product of the decay of organic materials at the bottom of the pond. Dale then put more dye in the siphon, and at about 2 PM a green bloom of dye briefly appeared at the surface of the harbor before dissipating. The siphon was finally working!

52: March 8: Dale Harmon placing tracing dye in the siphon

53: The BRWD crew waiting for a glimpse of green dye

54: And here it is, the culmination of five years of hard work!