

DEFINING THE BEST NATURAL ENHANCEMENTS AND INNOVATIVE TECHNOLOGIES TO DELIVER ECOSYSTEM SERVICES TO HIGHLY URBANIZED WATERFRONTS

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Chesapeake Bay



Baltimore, MD Inner Harbor

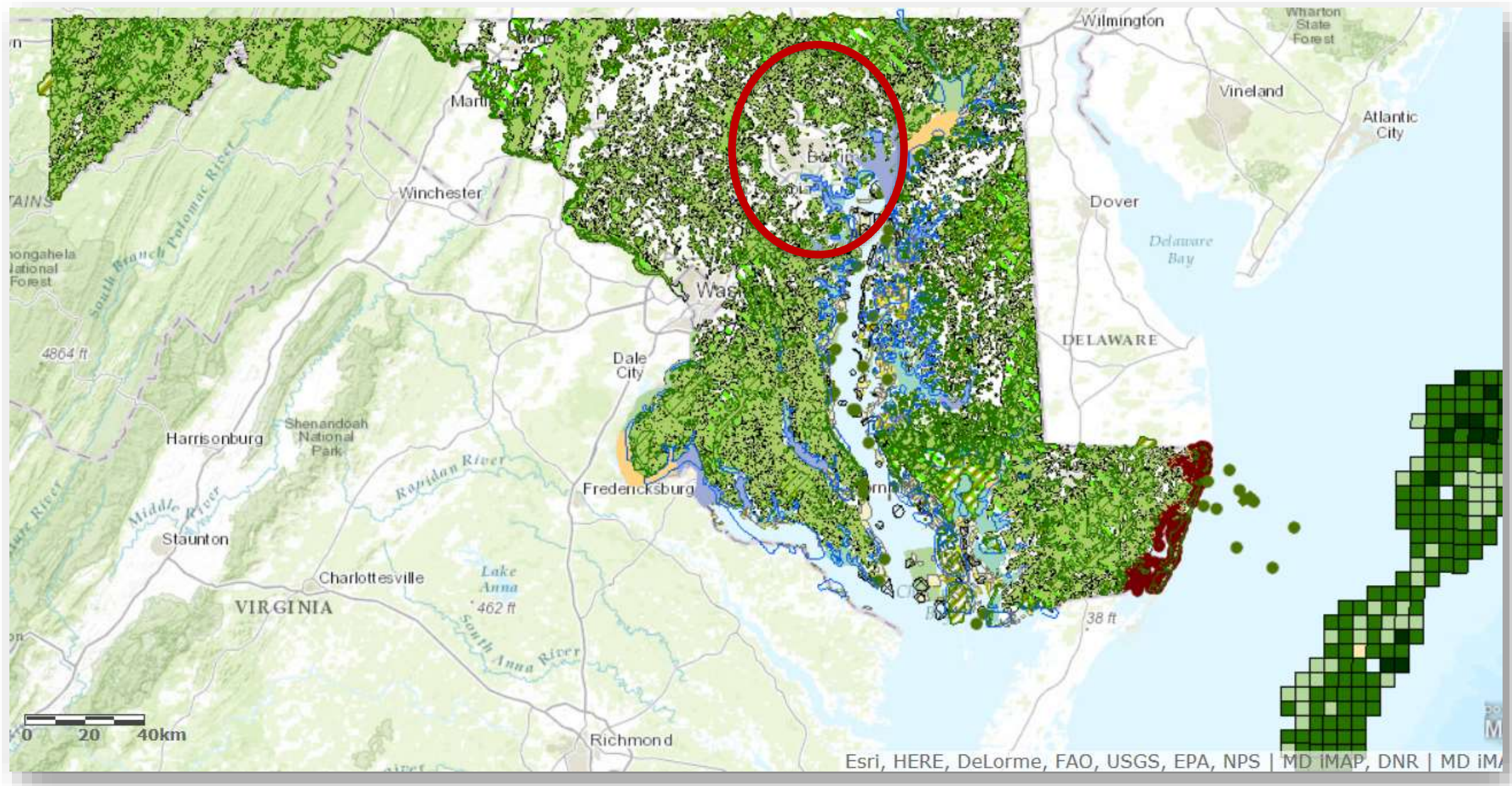




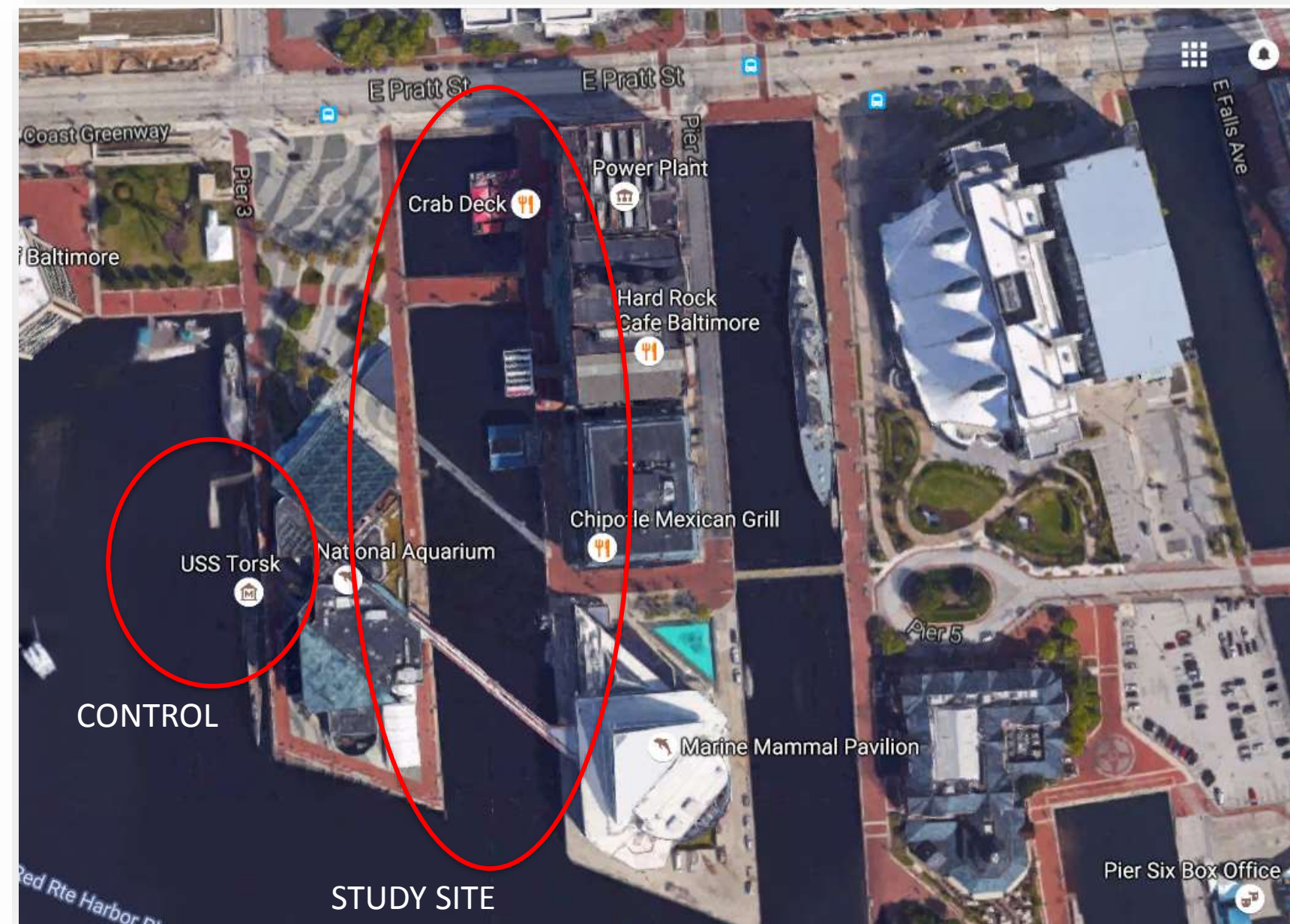
Waterfront Campus Plan

Baseline Monitoring to Identify Innovative Technologies

Watershed Resource Registry

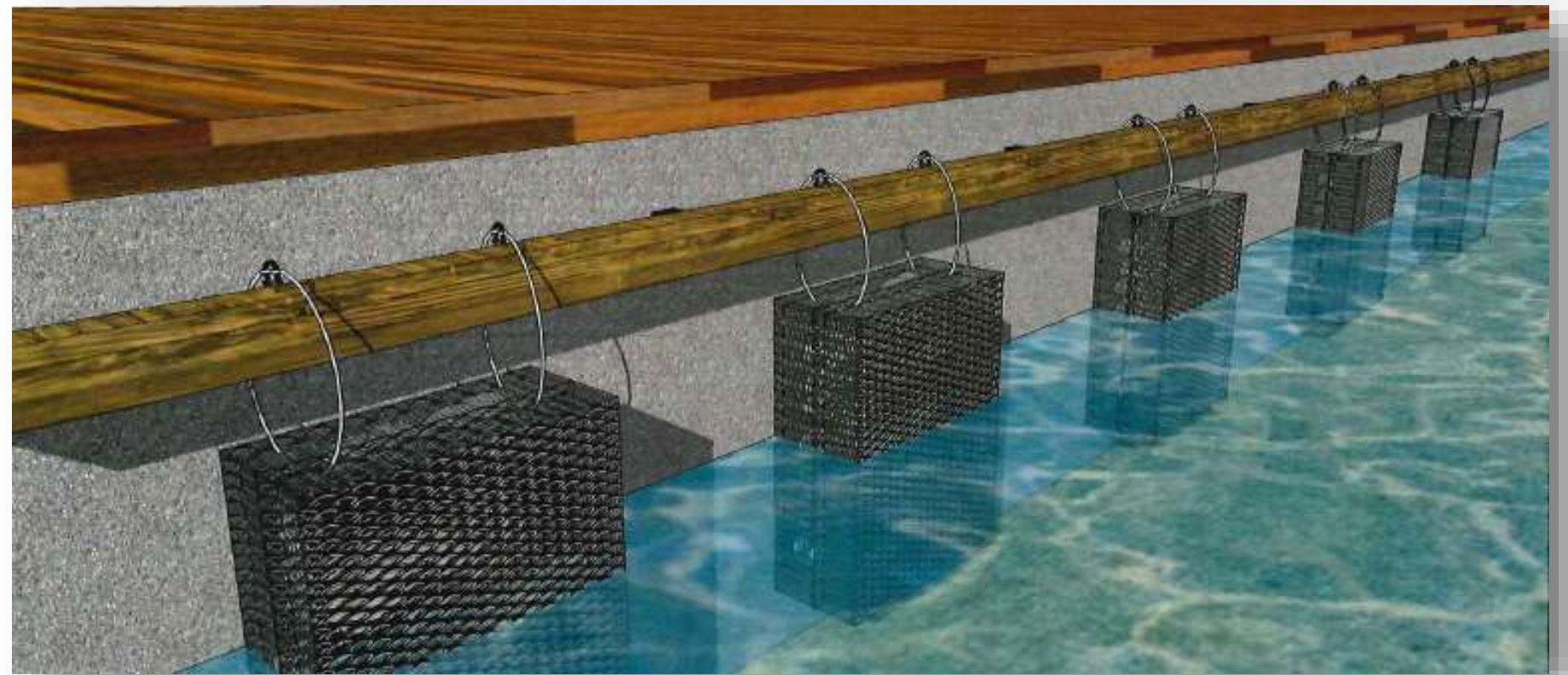
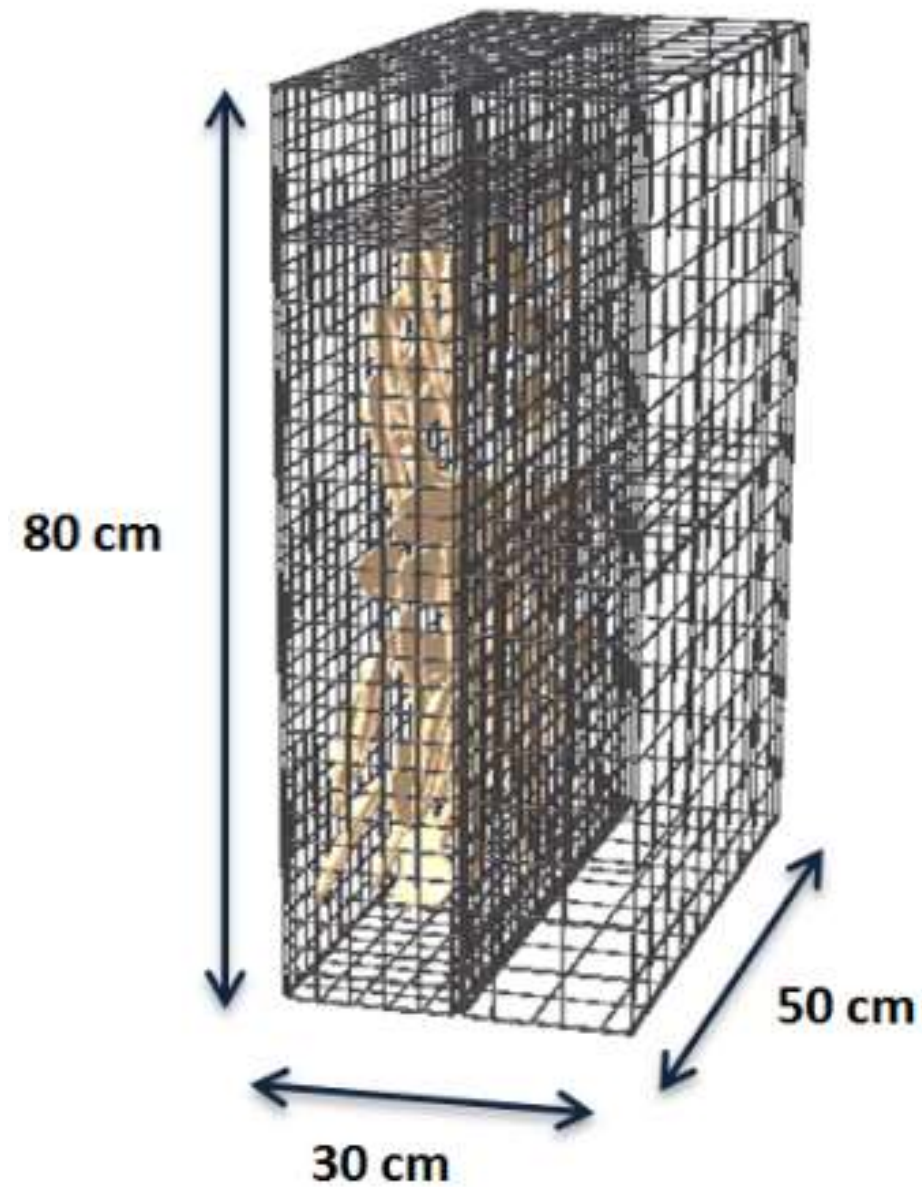


Baseline Monitoring to Identify Innovative Technologies



Aquatic Biodiversity

Biohut Pilot Project



Aquatic Biodiversity

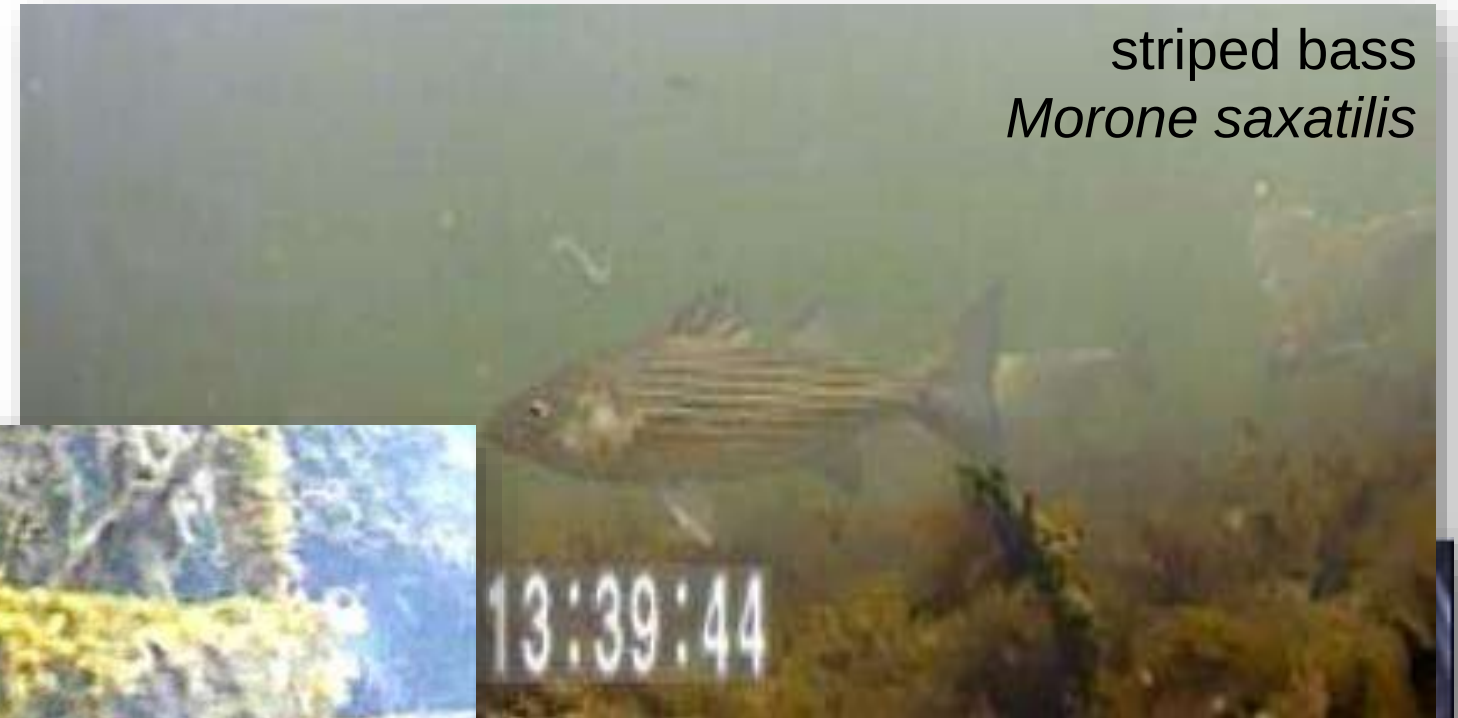
Biohut Pilot Project



pipefish
Syngnathus fuscus



Maryland blue crab
Callinectes sapidus



striped bass
Morone saxatilis



Aquatic Biodiversity



Photo credit: Pat Venturino



Photo credit: Pat Venturino

COMMON NAME	SPECIES
common grass shrimp	<i>Palaemonetes pugio</i>
mummichog	<i>Fundulus heteroclitus</i>
Northern pipefish	<i>Syngnathus fuscus</i>
MD blue crab	<i>Callinectes sapidus</i>
white-fingered mud crab	<i>Rhithropanopeus harrisii</i>
banded killifish	<i>Fundulus diaphanus</i>
American eel	<i>Anguilla rostrata</i>
dark falsemussels	<i>Mytilopsis leucophaeta</i>
white barnacles	<i>Balanus subalbidus</i>
Atlantic silverside	<i>Menidia menidia</i>
white perch	<i>Morone americana</i>
striped killifish	<i>Fundulus majalis</i>
naked goby	<i>Gobiosoma boscii</i>
gizzard shad	<i>Dorosoma cepedianum</i>
striped bass	<i>Morone saxatilis</i>
sea nettle	<i>Chrysaora quinquecirrha</i>
pink comb jelly	<i>Ctenophora Beroe ovata</i>
striped blenny	<i>Meiacanthus grammistes</i>

Aquatic Biodiversity

DNA Barcoding/Biofilm Study



May 2016



Aquatic Biodiversity

DNA Barcoding/Biofilm Study



June 2016

[7 11 16 clam worm](#)



Aquatic Biodiversity

DNA Barcoding/Biofilm Study

Sequence #2: 10 mM LCO 643 bases

```
CATCTATAAGACTCCTCATCCGAGCGGAACTCGGGCAGCCAGGAGCCTTGTTGGGCAGAGAT  
CAACTGTATAACACAATTGTAAGTCCCCACGCATTCCTAATAATTTTTTTCTTAGTTATACC  
GGTAATGATCGGGGGATTTGGAACTGACTAGTACCACTAATGCTTGGAGCCCCAGACATGG  
CATTTCCCCGTTTAAATAACATAAGATTCTGGCTACTCCCACCATCATTAATTTTATTACTC  
TCAAGTGCCGCAGTAGAAAAAGGAGTGGGTACAGGATGAACAGTATACCCCCACTATCAAG  
AAACATCGCCCATGCAGGACCATCAGTAGATTTAGCAATTTTTTCGCTTCATCTAGCAGGAG  
TATCTTCTATTATAGGAGCTCTAAACTTTATTACTACTGTCATTAATATACGATCTAAAGGC  
CTTCGACTAGAACGCGTCCCATTATTCGTGTGATCAGTAGTTATTACAGCAGTACTCTTACT  
ATTAAGACTACCAGTTCTCGCCGGAGCAATTACAATATTACTAACAGATCGAAATCTCAATA  
CAGCATTTTTTGGATCCCGCAGGAGGAGGGGACCCTATTTTATACCAACACCTATTTTGATTT  
TTTGGTCACCCTGAAAGTTTAAA
```

Blast Results:

Alitta succinea “clam worm”

voucher SERCINVERT0102

cytochrome oxidase subunit 1

(COI) gene, partial cds;

mitochondrial

Sequence ID:

[gb|KT959389.1|](https://www.ncbi.nlm.nih.gov/nuclot/gb|KT959389.1|)



August 2016

Aquatic Biodiversity

DNA Barcoding/Biofilm Study

Collected: July 7, 2016 from Baltimore Harbor

DNA Extration Method: Dneasy kit

PCR primers: LCO/HCO (JGLCO/HCO primers were used, but no amplification)

Sequence: 10 mM LCO 657 bases

```
TCCGCAATAGTTGGAACAGCTTTAAGAATACTAATTCGAGCTGAATTAGGACAACCCGGAAGTTTAATTG
GTGATGACCAAATTTACAATGTGATTGTTACAGCTCATGCCTTTATTATAATTTTCTTCATAGTAATGCC
TATTATAATTGGTGGATTTGGAACTGACTTTTACCTCTTATATTAGGAGCCCCTGATATGGCCTTCCCT
CGATTAAATAATATAAGTTTTTGA CT TCTTCCCCCAGCCTTAATACTTTTAATTAGAGGTTCTTTAGTAG
AAGCAGGAGCAGGAACAGGATGAACAGTTTATCCTCCTCTATCAAGTAATATTGCACATTCTGGTGCTTC
TG TAGATTTATCTATTTTTTTCTTTACACTTAGCCGGGGCATCTTCAATTTTAGGAGCAATTAAC TTTATA
TCAACAGTAATTAATATACGATCTGAACTCTTACTTTTGACCGACTTCCTTTATTTGTTTGAAGTGTAT
TTATTACCGTAATTTTACTTCTTTTATCATTACCTGTTTTAGCTGGTGCTATTACAATATTATTA ACTGA
CCGTAAC TTAACACTTCTTTTTTTTGACCCTACTGGTGGGGGAGACCCAATTTTATATCAACATTTATTC
TGATTTTTTTGGTCACCCTGAAGTTTAA
```

Blast Results:

Amphibalanus improvisus “Bay barnacle” isolate frag6 cytochrome oxidase subunit I (COI) gene, partial cds; mitochondrial

Sequence ID: [gb|FJ845844.1|](https://www.ncbi.nlm.nih.gov/nuclot/gb|FJ845844.1|)

Length: 686

Number of Matches: 1



Aquatic Biodiversity

DNA Barcoding/Biofilm Study



Study Site



Control Site

November 2016

SPECIES	STUDY SITE	CONTROL
colonial ciliates	27,200	112,900
hydroids	1	0
flatworms	14	56
stentor	16,053	21,729
amphipod	5	3
whip mudworm	935	989
lacy crust bryozoan	0	2
anenome	0	1
clam worm	8	8
tube bryozoan	532	1,640
dusky sea slug	2	1
hydra	1	2
copepod	1	2
dark false mussel	3	0
white barnacle	14	33

2016 biofilm summer results to date

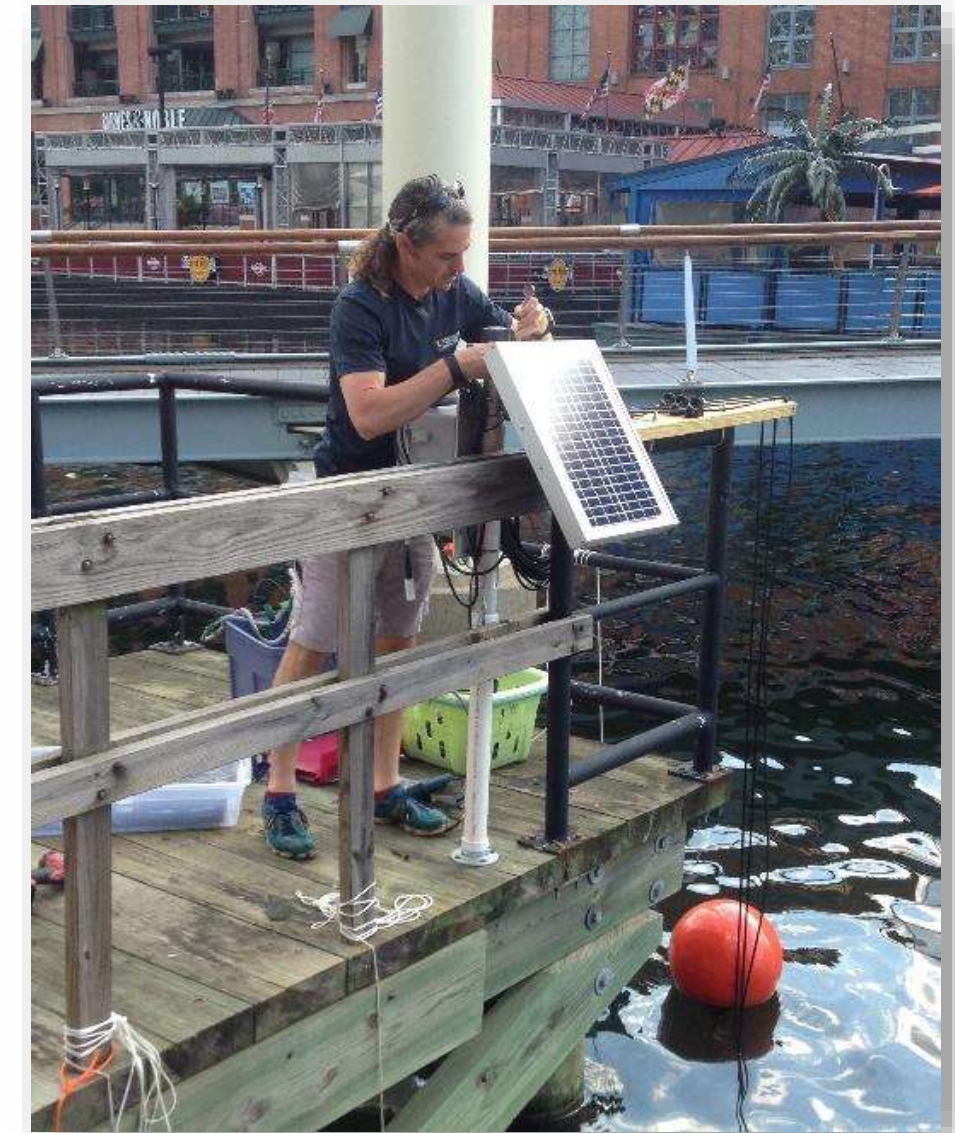
Water Quality Monitoring

Equipment

- Continuous Monitoring: 6 sensor EXO2 Sonde: temperature, salinity, DO, conductivity, pH, turbidity, algae (chlorophyll/blue green)
- Supplemental Readings: Handheld YSI: temperature, salinity, DO, conductivity

Additional Testing

- TN, TP, BOD



Water Quality Monitoring

2016 Water Quality Overview



Water Quality Monitoring

Preliminary 2016 Failure Threshold Analysis

Aquarium EAST (XIE7136) - Study Site		
Dissolved Oxygen	Surface	Bottom
Less than 5 mg/L	66%	97%
Less than 3.2 mg/L	41%	90%
Chlorophyll		
Greater than 15 ug/L	32%	0%
Greater than 50 ug/L	6%	0%
Turbidity		
Greater than 7 NTU	3%	11%

Aquarium WEST (XIE7135) - Control	
Dissolved Oxygen	Surface
Less than 5 mg/L	54%
Less than 3.2 mg/L	26%
Chlorophyll	
Greater than 15ug/L	53%
Greater than 50 ug/L	16%
Turbidity	
Greater than 7 NTU	4%

*observation results span May – October

Water Quality Monitoring

Common Blooms of the Inner Harbor

- Bacteria Sulfur Bloom
- “Mahogany” Tide
- *Karlodinium veneficum*



photo credit: Chesapeake Bay Program



photo credit: UMCES

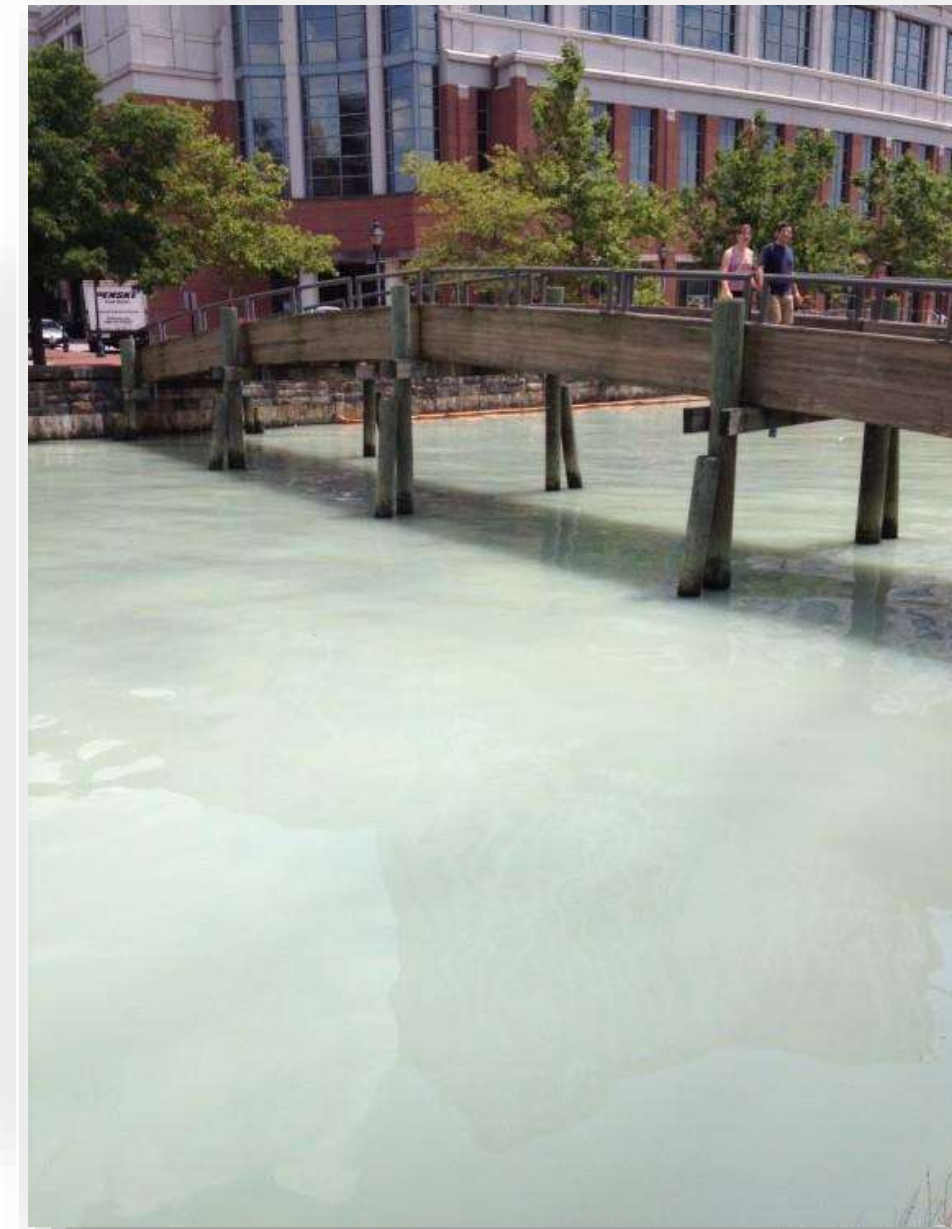


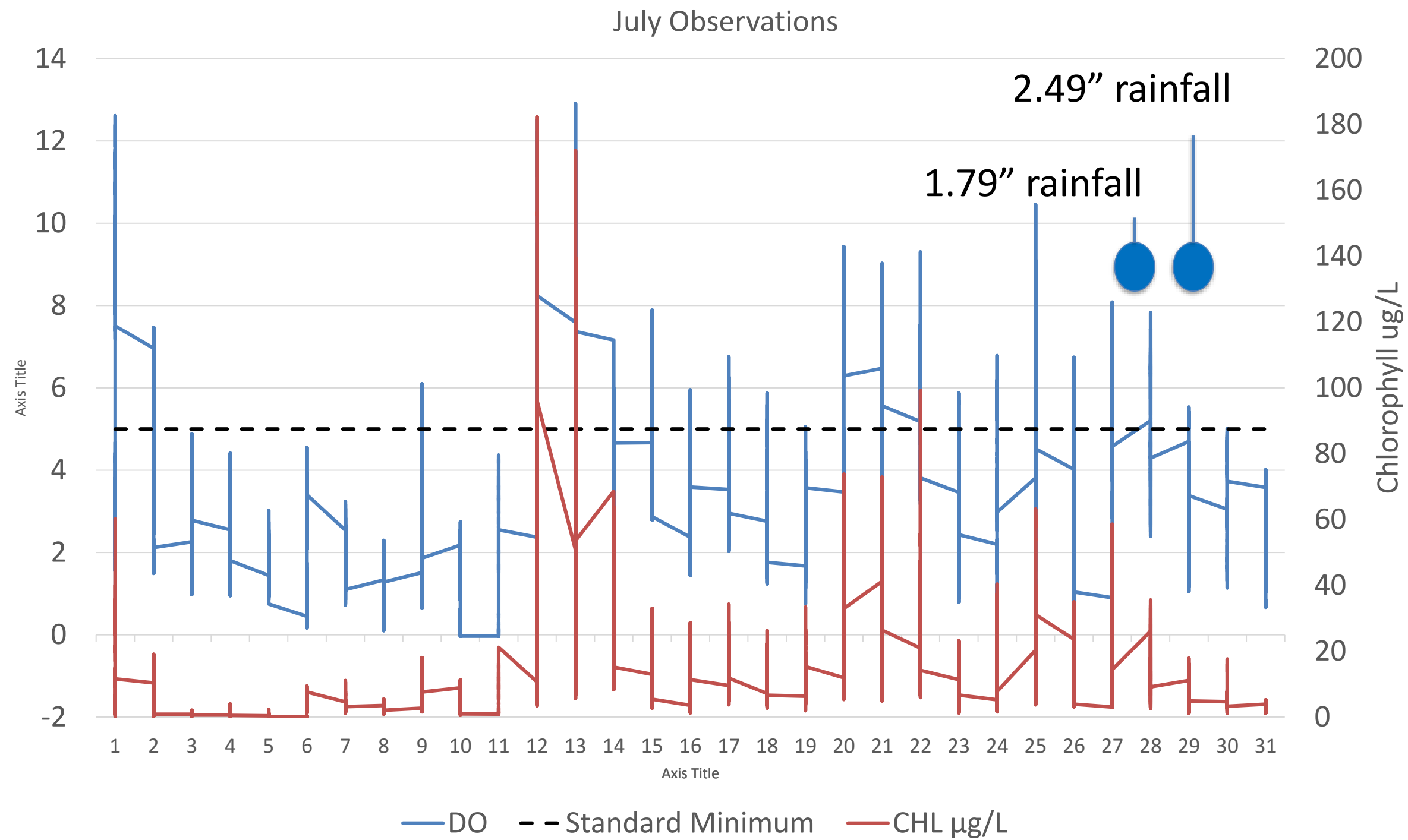
photo credit: Blue Water Baltimore



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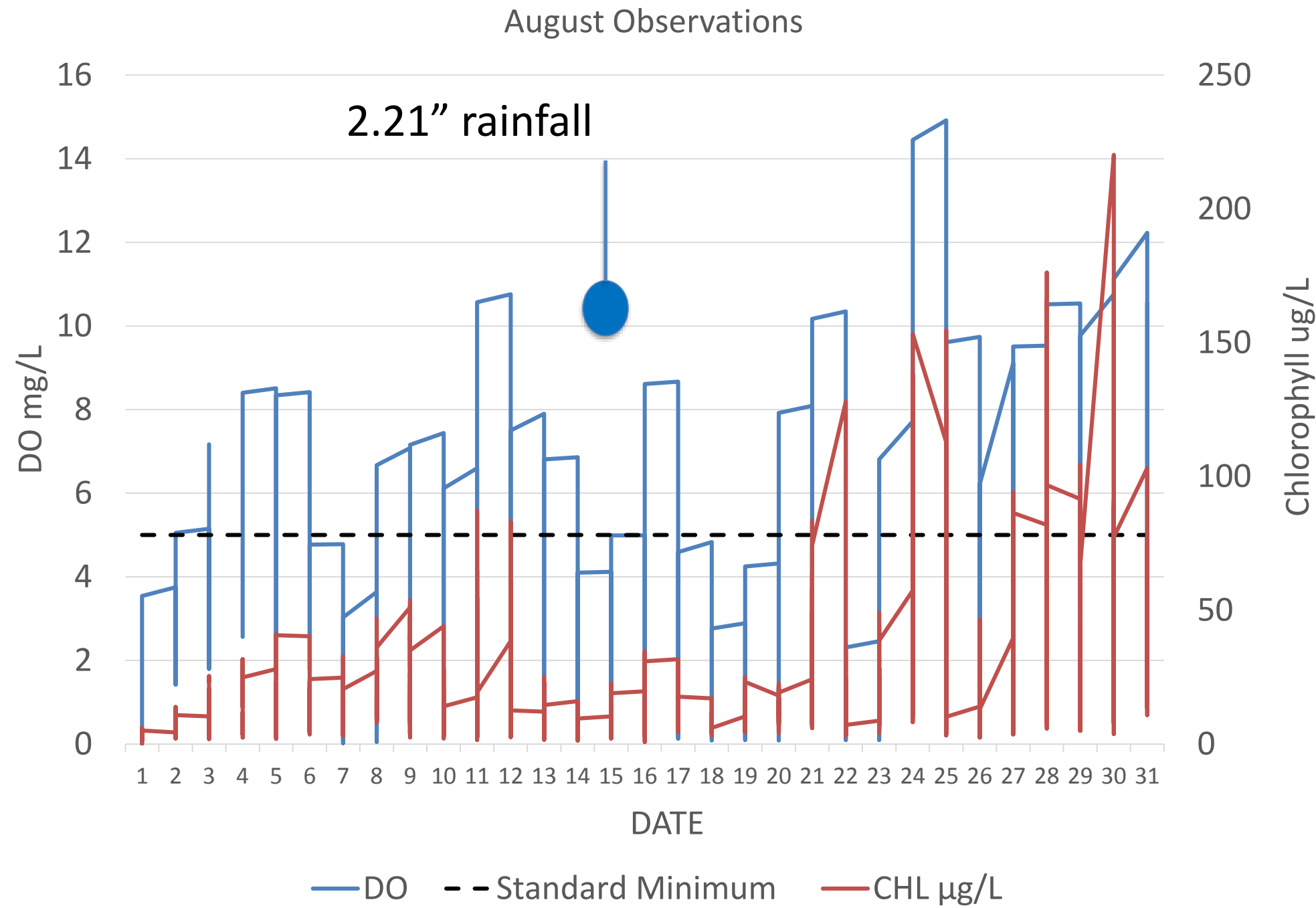
Water Quality Monitoring

Summer of 2016 - JULY



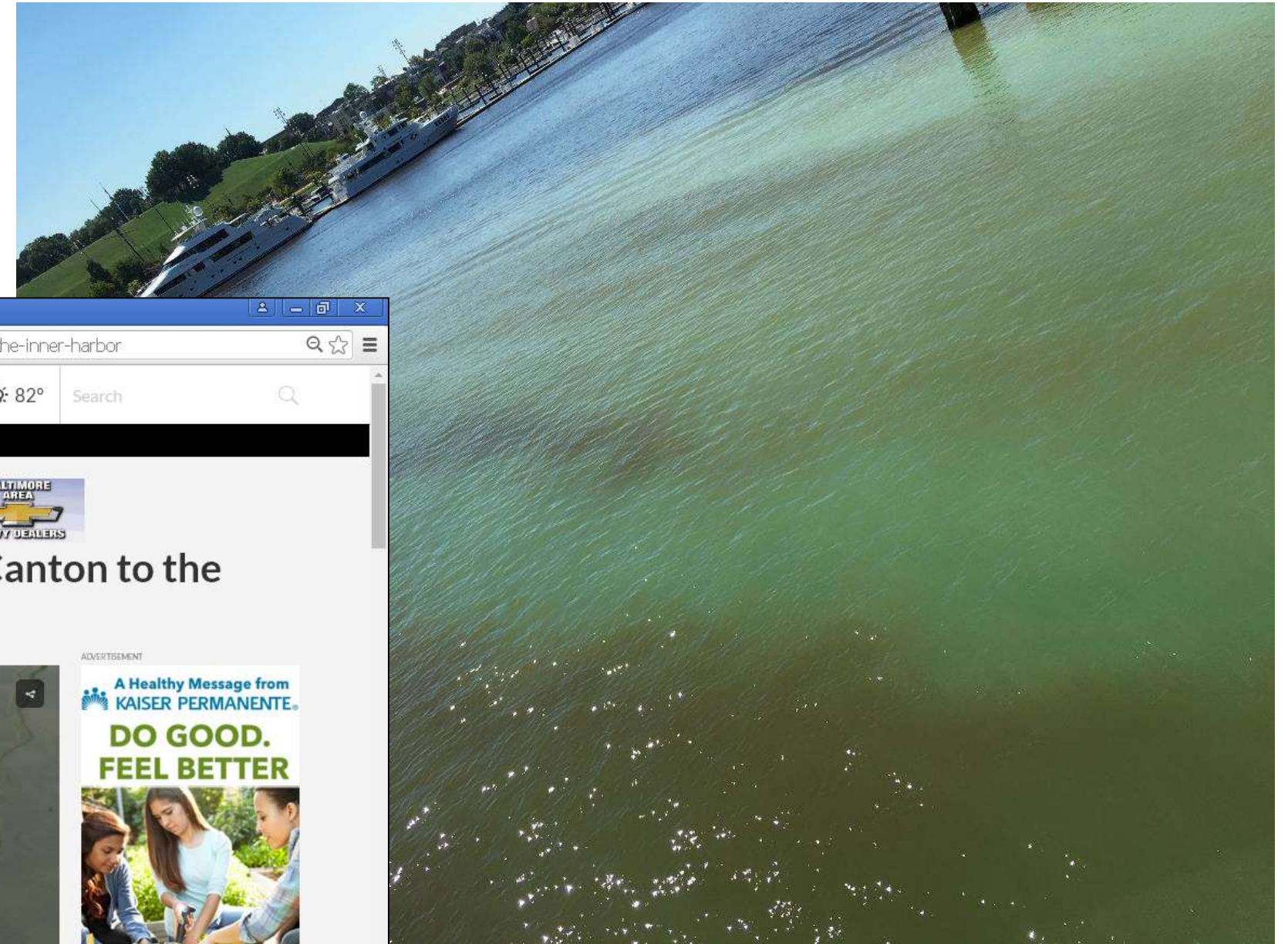
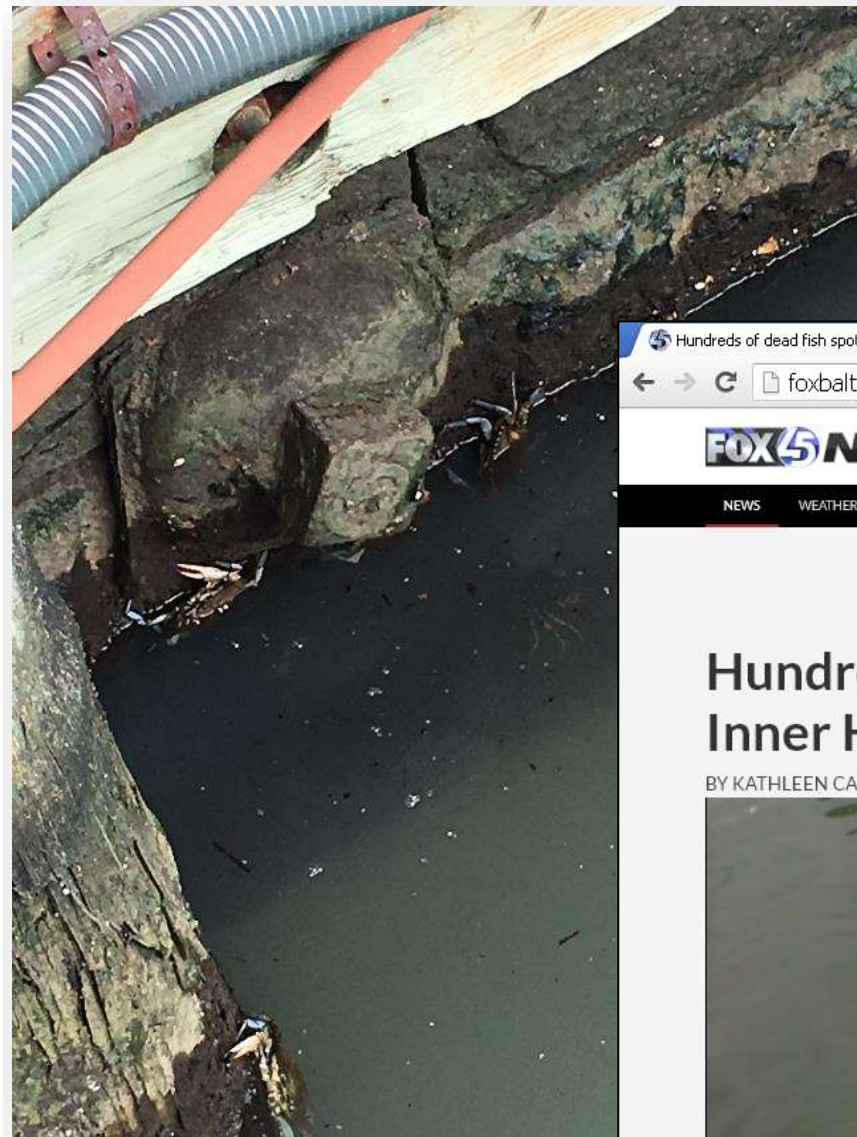
Water Quality Monitoring

Summer of 2016 – AUGUST



Water Quality Monitoring

Labor Day Bloom



Hundreds of dead fish spotted from Canton to the Inner Harbor

foxbaltimore.com/news/local/hundreds-of-dead-fish-spotted-from-canton-to-the-inner-harbor

FOX 5 NEWS

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Hundreds of dead fish spotted from Canton to the Inner Harbor

BY KATHLEEN CAIRNS | WEDNESDAY, SEPTEMBER 7TH 2016



Tourists are looking at the water between Canton and the Inner Harbor and counting dead fish. Hundreds of dead fish seemed to pop up overnight. (Photo courtesy Baltimore Harbor Waterkeeper)

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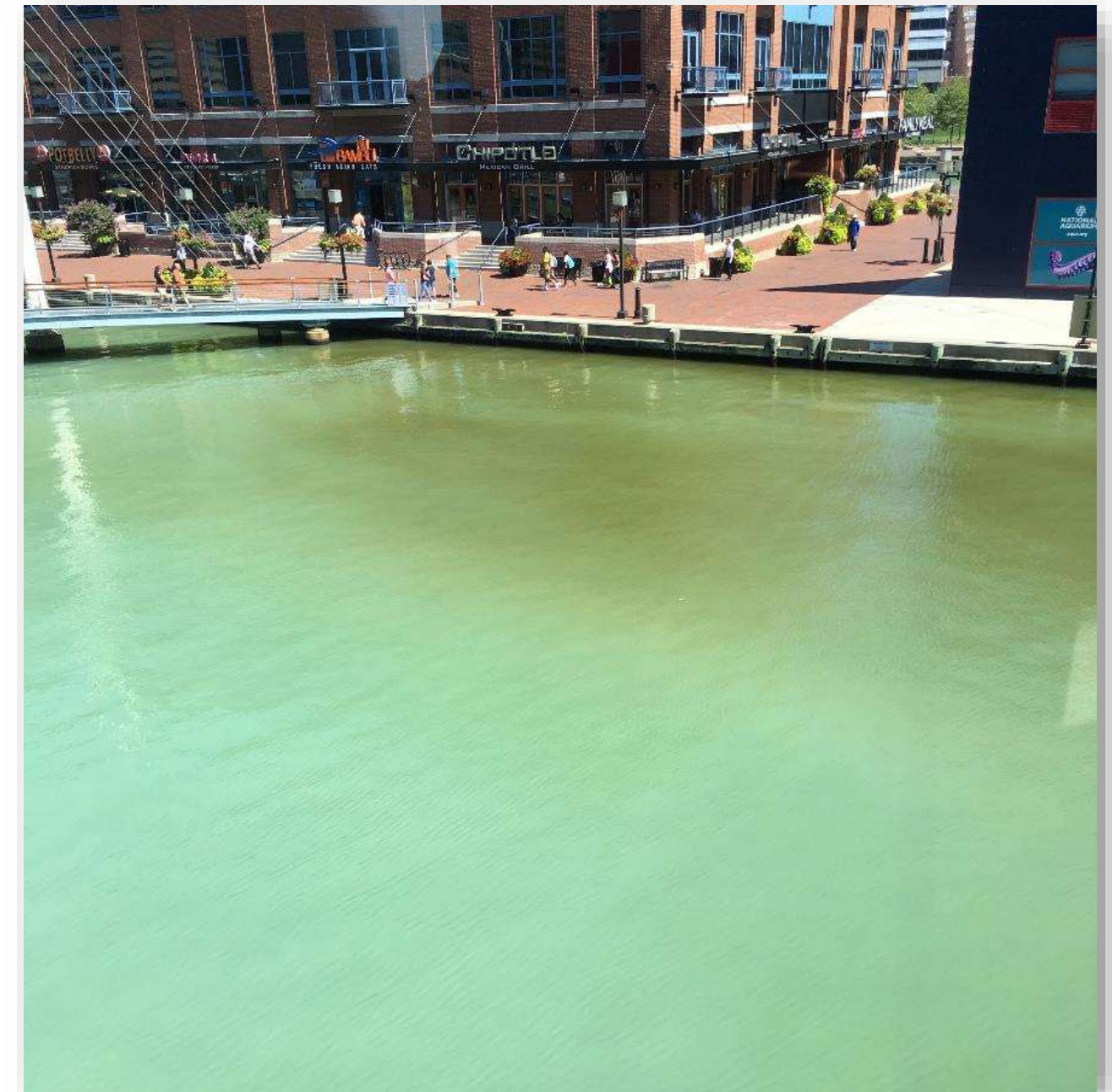
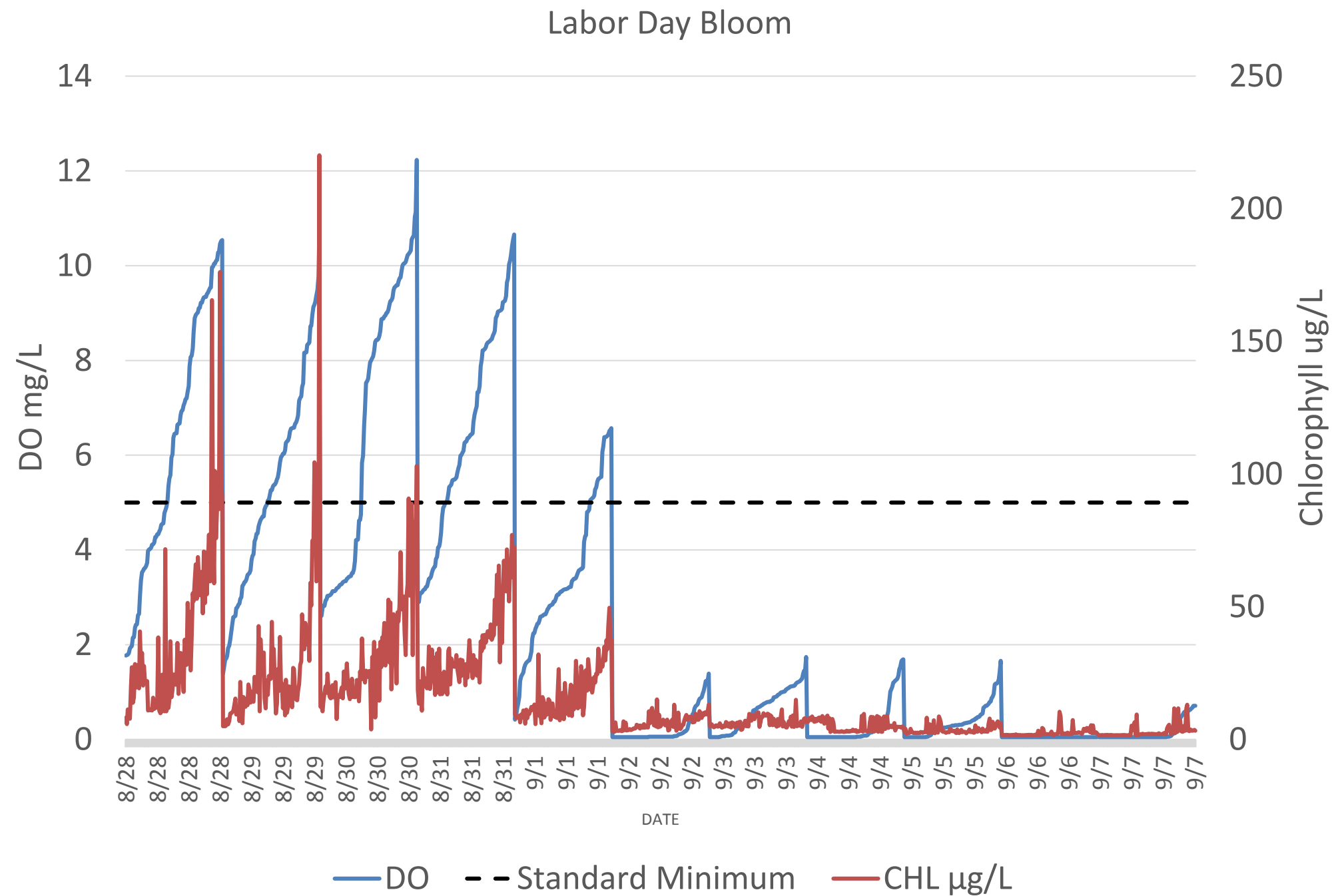
A Healthy Message from
KAISER PERMANENTE.
DO GOOD.
FEEL BETTER



Volunteering for a good cause helps us feel better and we make the quality of life better for those around us.
Volunteer and Thrive

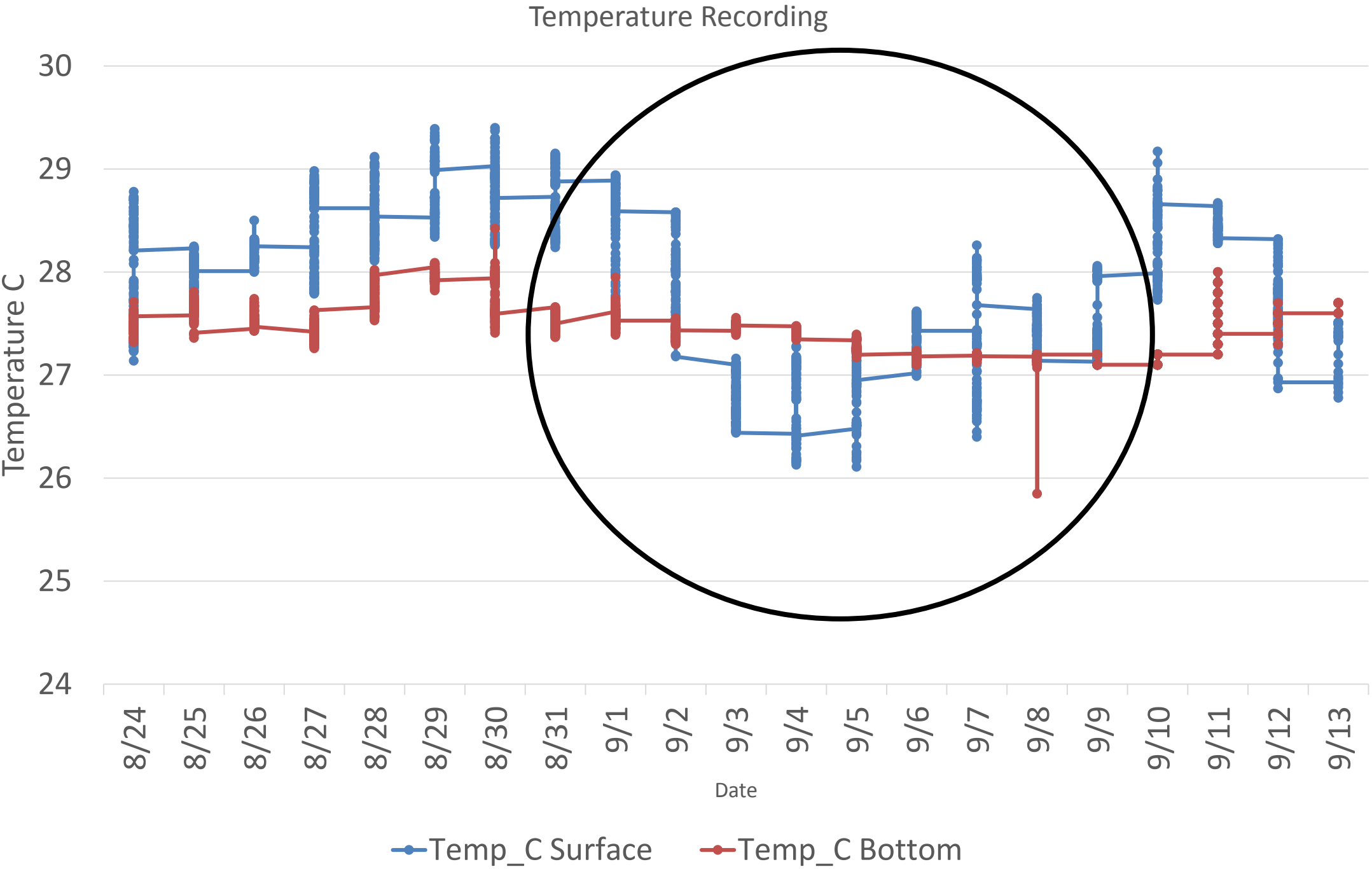
Water Quality Monitoring

Summer of 2016 – LABOR DAY BLOOM



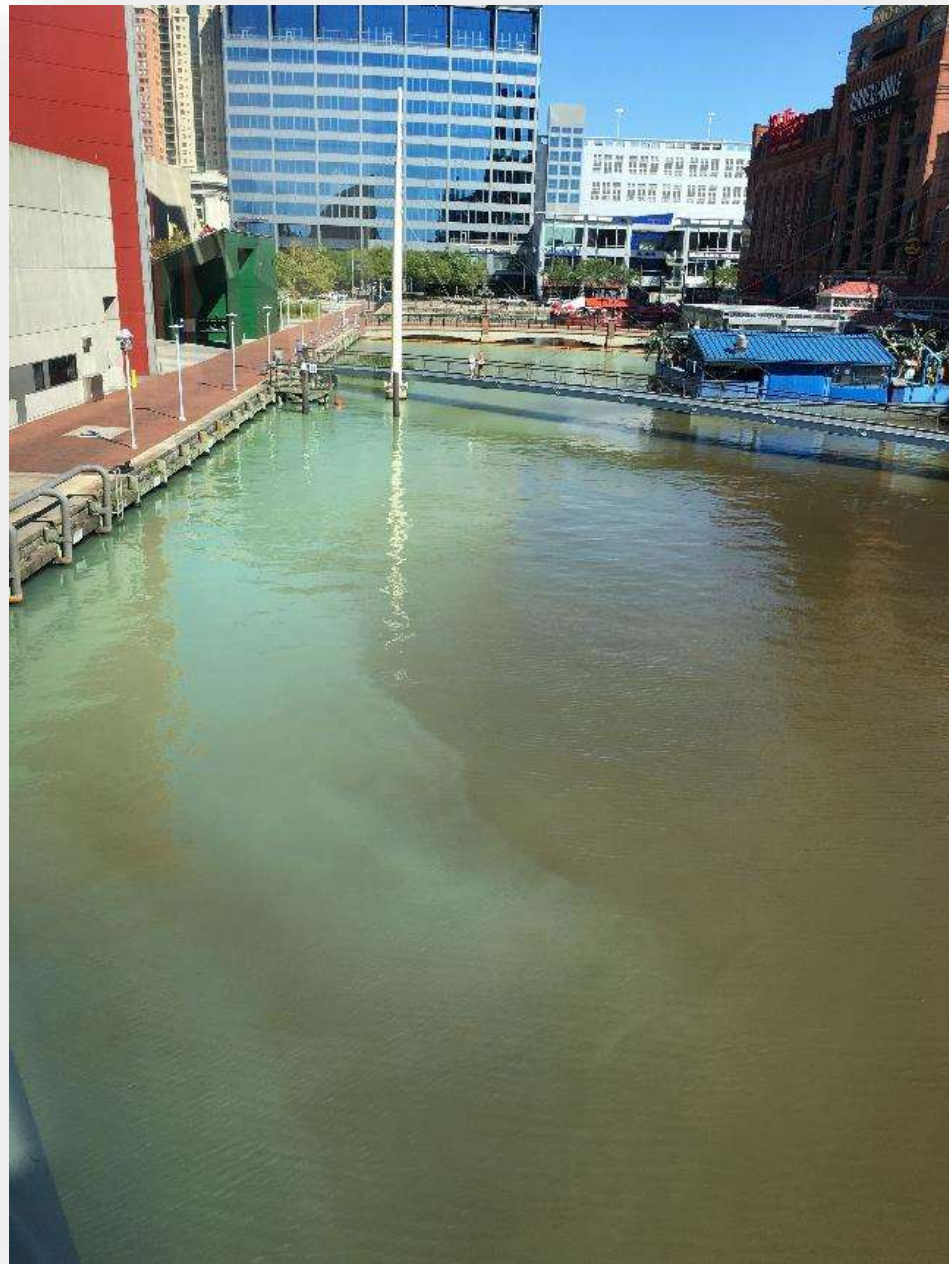
Water Quality Monitoring

Labor Day Bloom



Water Quality Monitoring

Summer of 2016 – LABOR DAY BLOOM



National Aquarium
28 September at 20:33 · 🌐

Pop quiz! Do you know what made the water in the Baltimore Harbor green over Labor Day weekend?

Need a hint? Our Conservation team has you covered! Read about the oxygen changes causing that pistachio hue on our blog >> <http://ow.ly/vFhx3D4AIL1>



Like · Comment · Share

You, John Racanelli, Ellen Erbe and 119 others · Top comments ·

3 shares

Write a comment...

Dan Seaman Dye, used to check for leaks in pipes.
Like · Reply · 28 September at 20:57

National Aquarium 🌐 It's actually a change in oxygen levels and water temperature!
Like · Reply · 27 September at 14:47

Sam Adler The luck of the Irish?
Like · Reply · 1 · 28 September at 21:17

Matt Friedman An algae bloom?
Like · Reply · 1 · 28 September at 20:39

Rande Wilson Low oxygen levels - algae bloom
Like · Reply · 2 · 28 September at 20:51

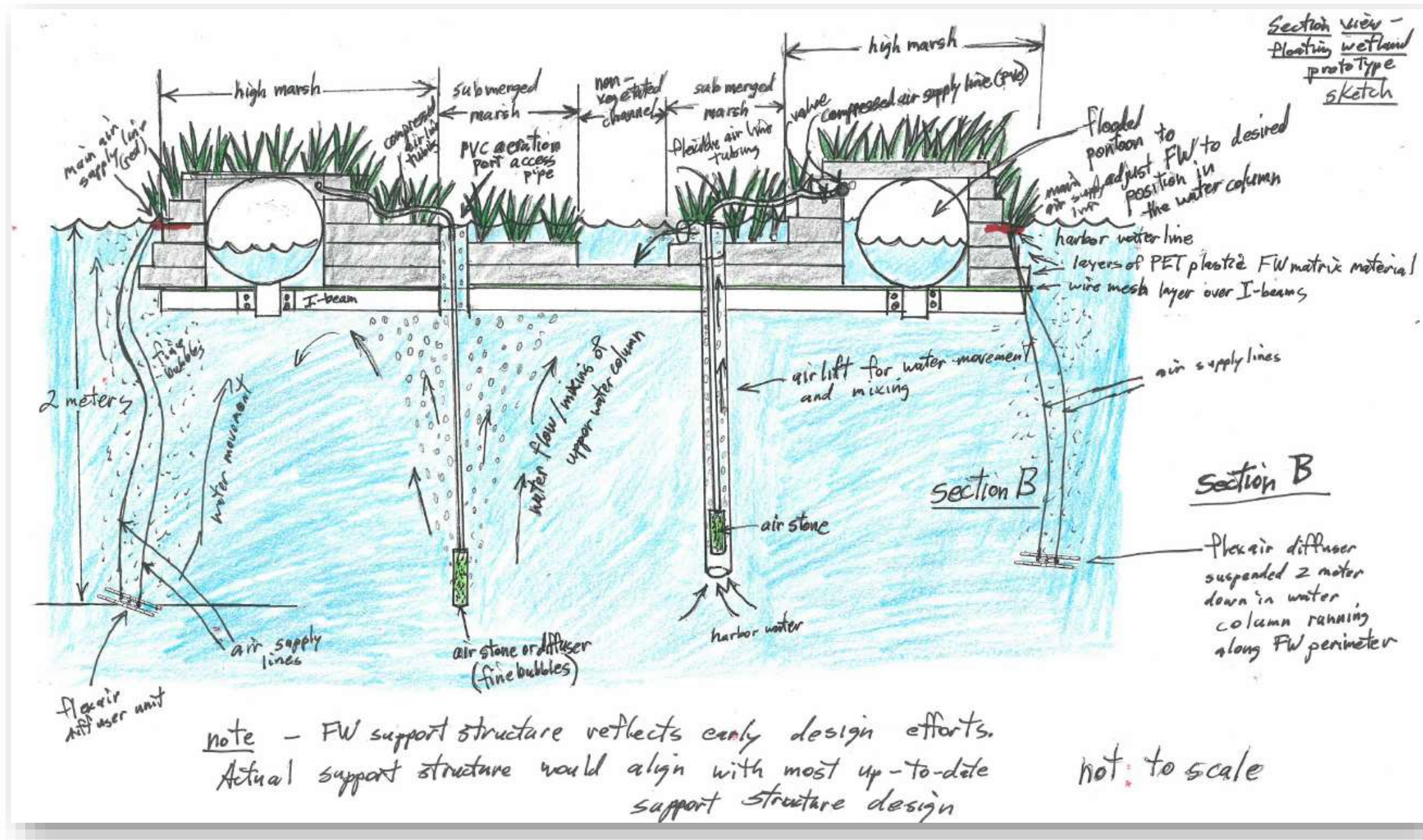
Rachel Waffle-Tabacchi I noticed it on Saturday and thought it must be pollution. Lol. Just read the link.
Like · Reply · 28 September at 20:53

Write a comment...



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What's Next

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General Curator, National
Aquarium