Converting a Stormwater Pond into a Multi-Stage Treatment Reactor for Arsenic, Ammonia, and Benzene at the Industri-plex Superfund Site

Bruce Thompson and Todd Majer, ***de maximis, inc.***

Mark Kelley, P.E., Haley & Aldrich, Inc.

Carl Elder, Ph.D., P.E., Geosyntec Consultants

Charles Elmendorf, Stauffer Management Company, LLC

Joseph Gabriel, Monsanto Company

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History / Background

Site located in Woburn, MA.

1853 – 1931. Chemical manufacturing: lead-arsenic insecticides, acetic, sulfuric and picric acids, phenol, benzene, toluene and trinitrotoluene.

1934 – 1969. Glue making using hides and chrome-tanned hide wastes

- Property developed in 1970s, which mixed 130 years of wastes with hide residues, forming piles in and near swampy areas of property.
- Contaminants of concern include: VOCs (benzene & toluene), ammonia, and metals (chromium, lead, arsenic).
- Listed as #5 on initial National Priorities List in September 1983.

http://www.epa.gov/region1/superfund/sites/industriplex

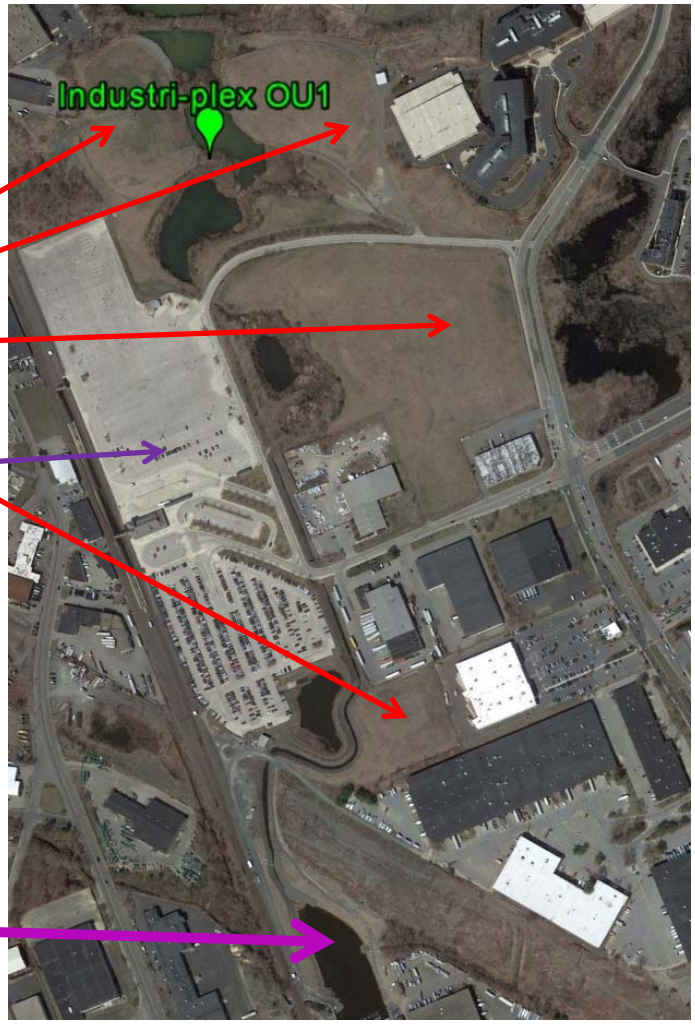
OU1 Project

OU1 ROD (1986) and RD/RA CD (1989) lead to ~$125 MM OU1 remedy.

Remedy consolidates wastes and caps ~110 acres, creating four “Hide Piles”.

Cover system allowed for development of 34-ac. Anderson Regional Transportation Center.

Hide waste creates ammonia and reducing conditions. Groundwater containing ammonia, arsenic, and benzene discharges to the 4.6 acre **Halls Brook Holding Area (HBHA) Pond**.



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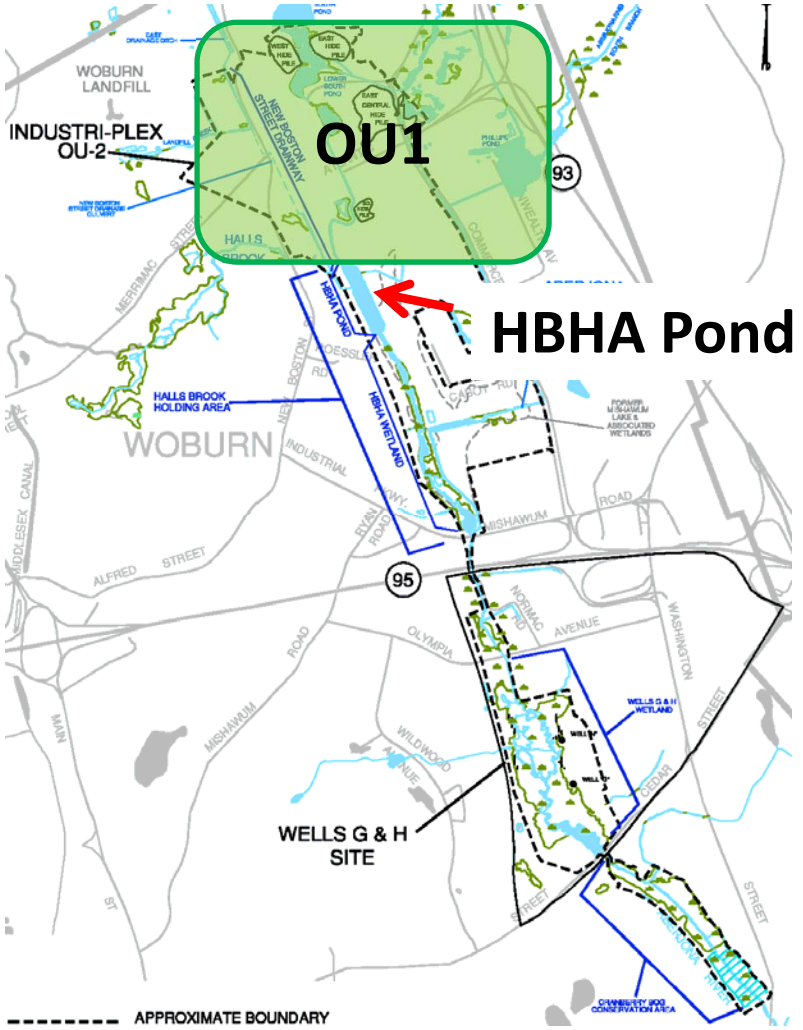
OU2 Project

OU1 ROD required OU2 investigation, which was merged with Wells G&H OU-3 Aberjona River Study (~6 miles of river).

HBHA Pond remedy required by OU2 ROD (2006) and RD/RA CD (2008). Surface water exiting Pond to be:

- < 150 µg/L arsenic,
- < 46 µg/L benzene, and
- < NRWQC for ammonia.

Additional goal to reduce arsenic migration "to maximum extent practicable."



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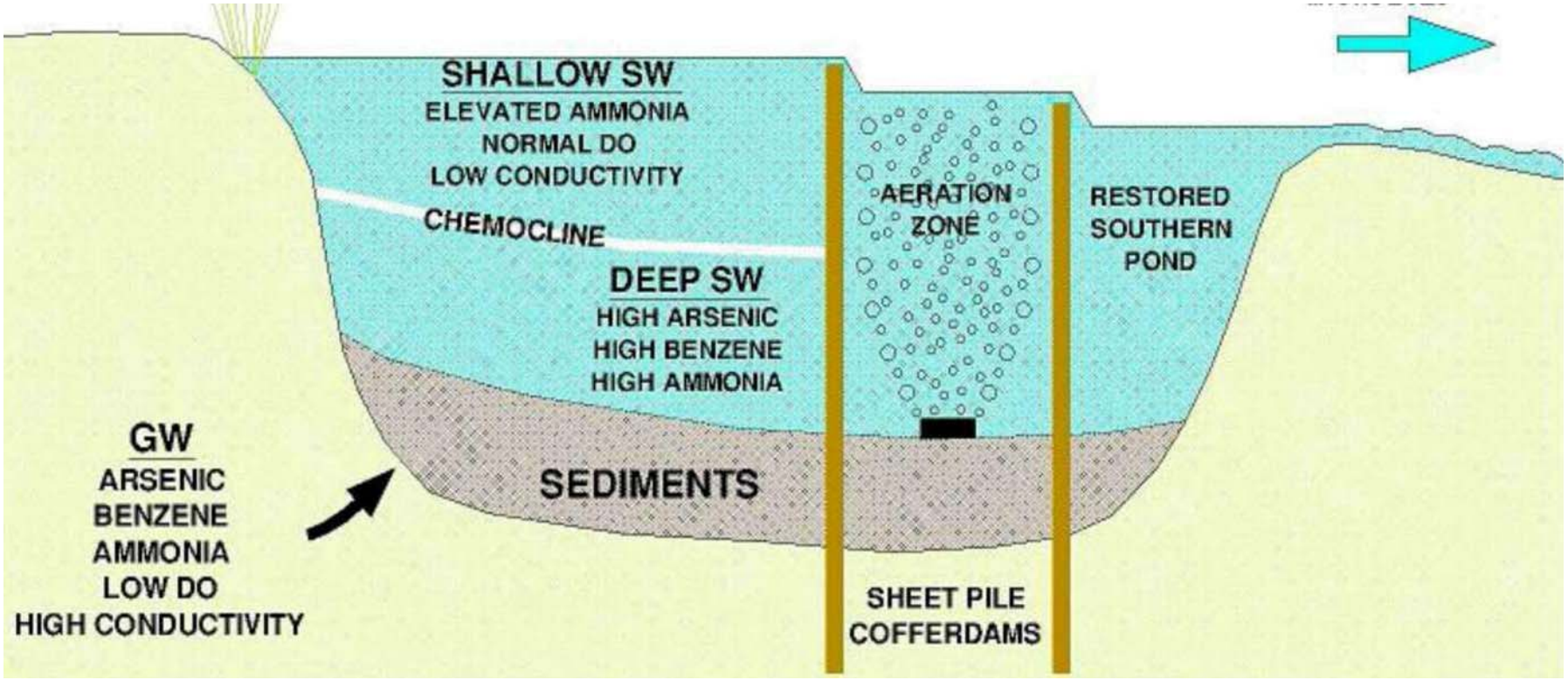
HBHA Pond Remedy Concept in EPA's Proposed Plan



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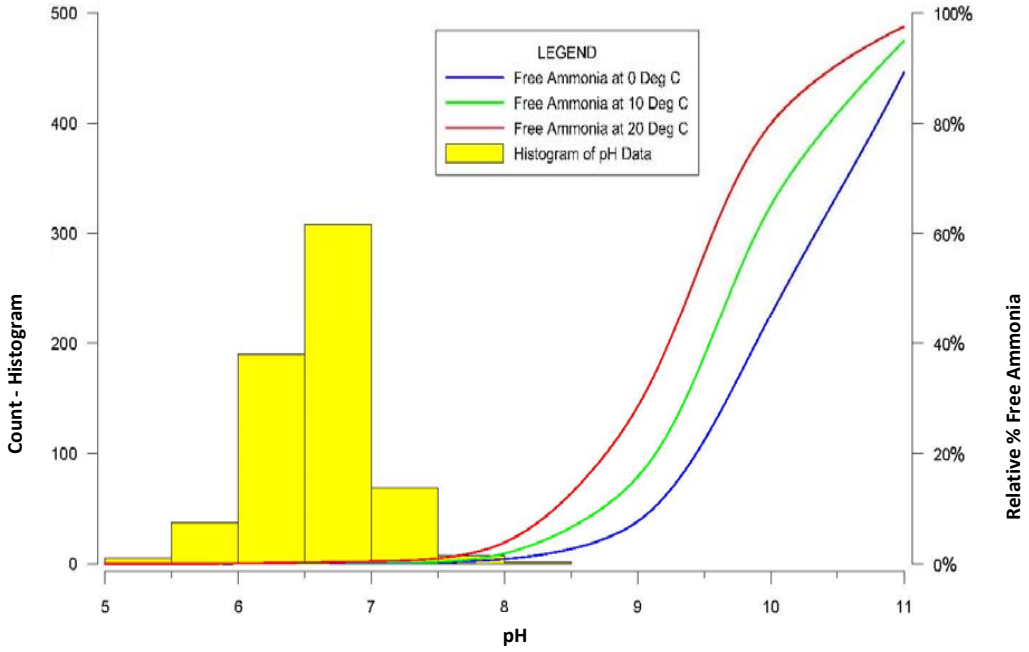
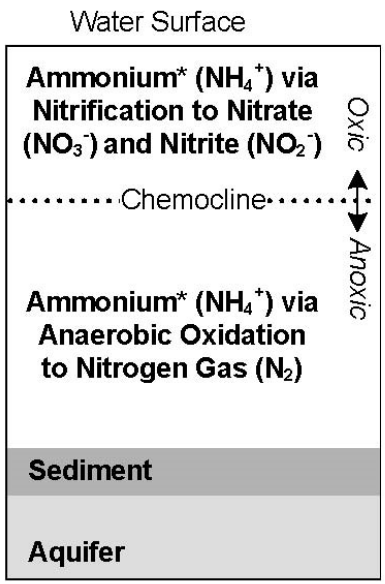
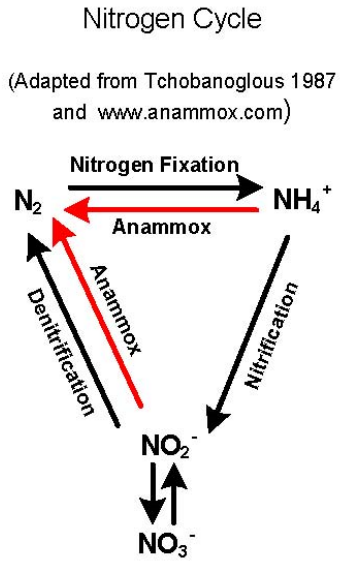
Ammonia Treatment Approach Change during RD

Volatilization (unlikely w/out pH change) → Biological Degradation







* Ammonium (NH_4^+) likely to be the dominate species present at pH of HBHA Pond

pH adjustment not considered feasible, as base flow ~2 to 9 cfs, storm flow ~150 (measured) to 570 cfs (100-year storm)

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HBHA Pond Remedy Components

- Construct Permeable Cap
- Install Cofferdam, Storm Water By-Pass / Base Flow Diversion, and energy dissipation at inlets (intended to prevent storm disturbance of “chemocline”)
- Ammonia Treatment with “Webitats”
- Dredge southern portion of pond
- Construct Outlet Structure (trapezoidal channel)

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Ammonia Treatment Pilot Study

"In pond" - 4 webitats at flow rates 60 – 380 gpm and "side stream" at ~0.15 gpm

Pilot study resulted in ammonia removal rate of ~3.9 x 10^{-3} kg/day/m^2 of media.

Design basis maximum removal rate of ~30.2 kg/day.

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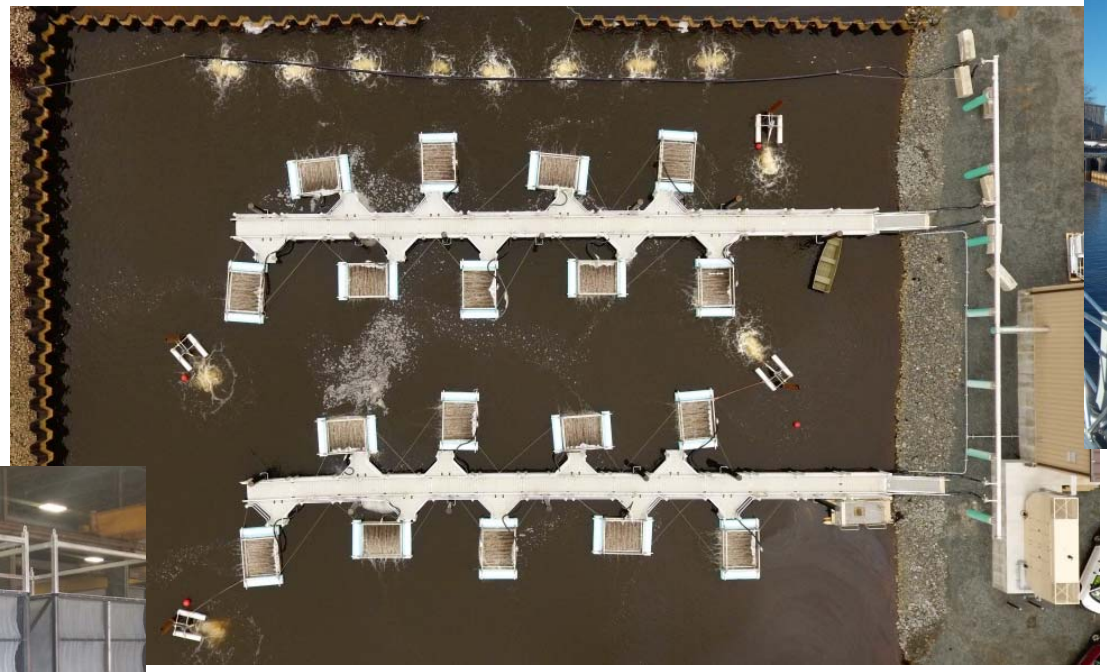
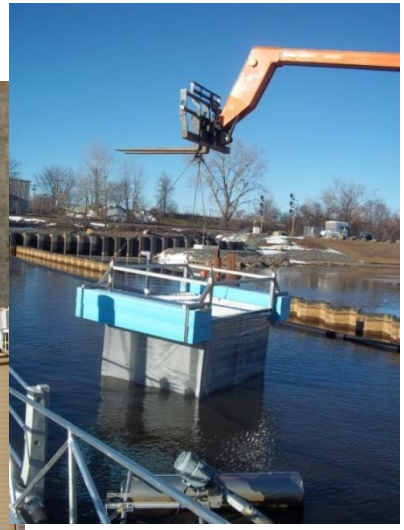
Webitats

18 units, 7'8" tall, each has 437 m^2 of media (AOB are film-forming bacteria)





AOB need oxygen – aeration provided by:

- **Eight fine bubble diffusers and 18 coarse bubble diffusers**
- **Diffusers fed by 150 hp, 2,000 scfm blower**
- **Four surface aspirating mixers provide additional O_2**

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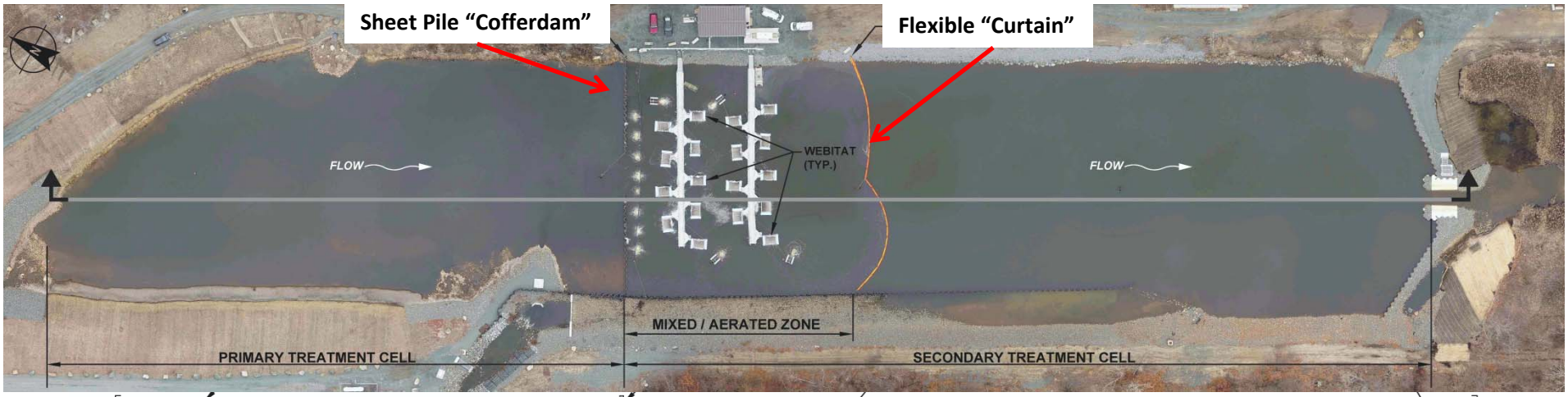
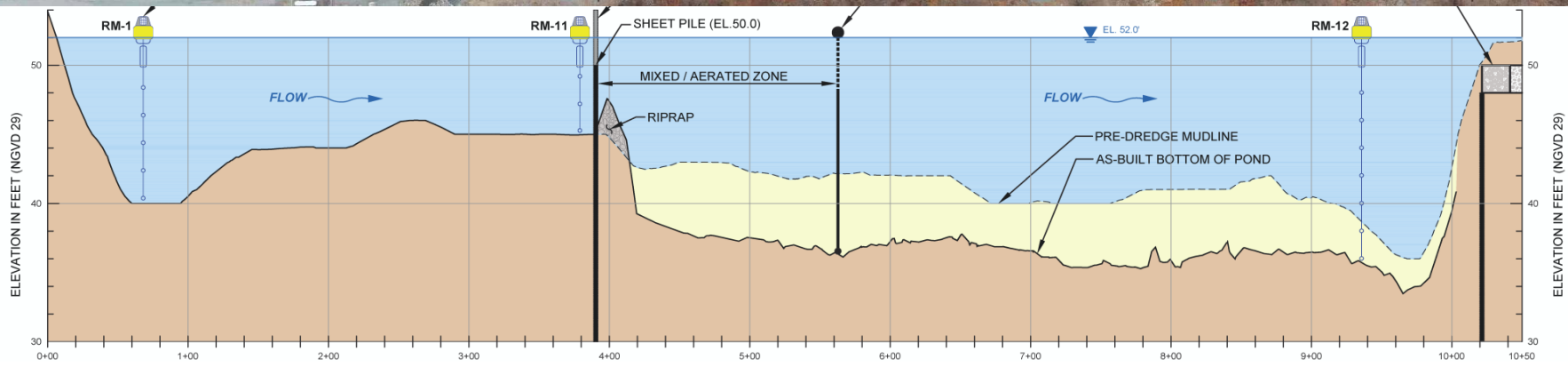
HBHA Pond – Storm Water Bypass & Cofferdam (2015)

HBHA Pond - Halls Brook, Storm Water Bypass, and Cofferdam (2016)

HBHA Pond – Dredging in progress (2016)

Completed Remedy - HBHA Pond





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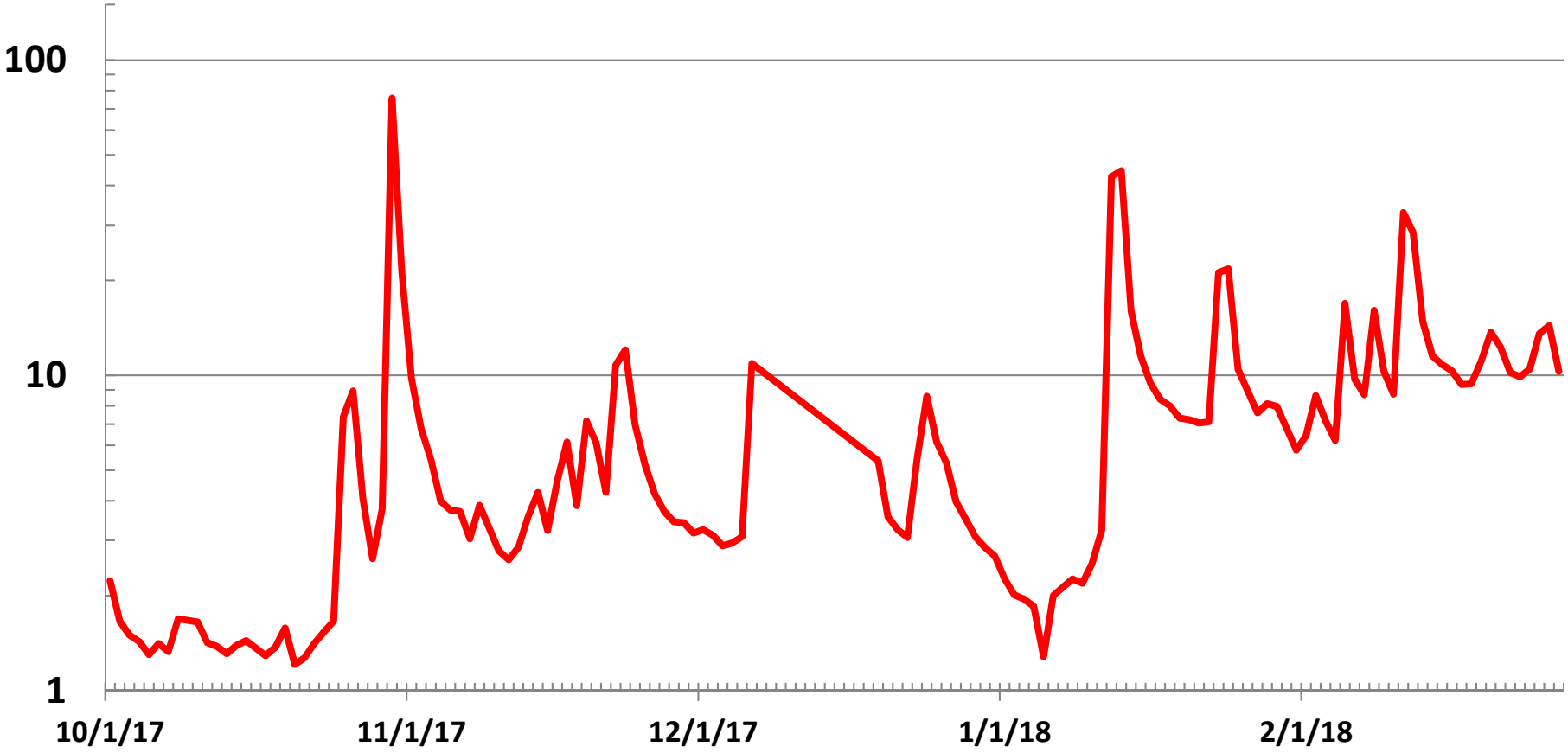
Flow Rate (cfs) – Daily Average



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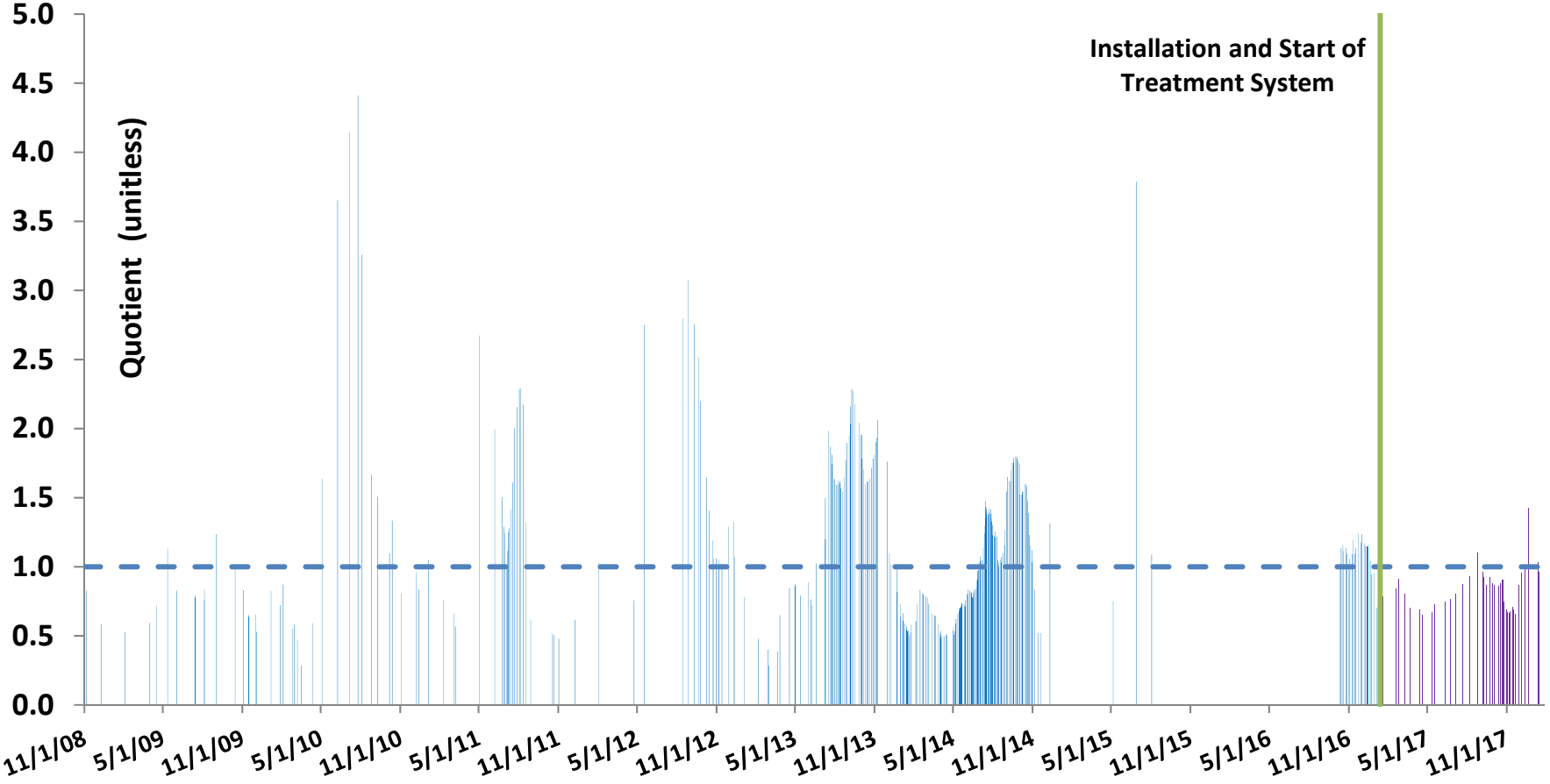
30-Day Average Outlet Ammonia Quotient (NRWQC = 1)



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Results / Conclusions

- Successfully adapted ROD remedy during RD process.
  - Concept → Treatability → Field Pilots → RD → Implementation
- Dredging increased likelihood for success – physical removal of ammonia & arsenic mass, increase pond volume / retention time
- Cofferdam & base-flow diversion reduced range of ammonia concentrations for treatment
- Webitat system successfully treating ammonia

Questions?

Bruce Thompson

de maximis, inc.

200 Day Hill Road, Suite 200

Windsor, CT 06095

860 298 0541

brucet@demaximis.com