ENCLOSURE 4

SUMMARY OF CLA-1/CLA-14 SEDIMENT PAH CONTAMINATION AND PROPOSED BENEFICIAL USE OF CLEVELAND HARBOR DREDGED SEDIMENTS

Sediment sampling and analyses in 2014 and 2015 indicated that several discrete locations within and south of the designated open-lake placement area CLA-1 are impacted by polycyclic aromatic hydrocarbon (PAH) contamination that is likely to be toxic to benthic organisms. Sediment sampled from the following locations represent conditions that are likely toxic: CLA1-5 (2014), CLA1-1 (2015), CLA14-1 (2014), CLA14-3 (2014), CLA14-4 (2014), CLA14-5 (2014) and LE-16 (2014). These sites were determined based on consideration of several different lines of evidence regarding the potential for PAH related toxicity, including bulk sediment PAH concentration, the presence of a petroleum odor and/or sheen in the field sample, sediment avoidance by worms in laboratory bioaccumulation tests, PAH sediment pore water concentrations and survival within laboratory solid phase bioassays. Attachment 1 provides a table summarizing this evaluation and Attachment 2 provides a figure of the impacted sample locations. Of additional note is that the benthic bioaccumulation of polychlorinated biphenyls (PCBs) from CLA1-5 (2014) sediments is predicted to be 55,015 µg/kg-lipid (550 µg/kg), which is elevated in comparison to channel and lake sediments.

The evidenced toxicity indicates that physical isolation of the impacted lake sediments would be appropriate. To abate the evidenced current and ongoing toxicity of the existing lake sediments at the sediment-water interface, USACE proposes to beneficially use sediments from the Upper Cuyahoga River Channel as a capping material. Dredged sediment placement in 2016 would be targeted to be within the southeast quadrant of CLA-1, which is the area encompassing samples CLA1-5 (2014) and CLA1-1 (2015) (see Attachment 2). Placing sediments within this area would markedly improve the existing aquatic ecosystem at impacted sites by restoring lake bottom habitat to a condition that is suitable for the re-establishment of a viable benthic community. Attachment 3 depicts the magnitude of PAH-related toxicity abatement that could be realized at these sites by thin-layer capping with the channel sediments. PAH toxicity to *Hyalella azteca* at the existing CLA-1 and CLA-14 sites is predicted based on the sediment pore water concentrations analyzed in 2014. Based on the U.S. Environmental Protection Agency (USEPA) narcosis model for benthic organisms in sediments contaminated with PAHs (USEPA 2003), total pore water toxic units (∑IWTUs) in excess of 200 and 400 were determined for some sediments in CLA-14 and CLA-1, respectively. These pore water concentrations would predict *H. azteca* body burdens of greater than 400 and 800 µmol/g-lipid respectively, indicating an expected mortality rate of 100% (Hawthorne *et al*. 2007). As shown in the graphic, placement of the dredged sediments (with high survival rates shaded in green) at certain sites in CLA-1 (and CLA-14 [see below]) could markedly increase benthic invertebrate survival from 0% (where there is 100% mortality shaded in red), to about 85 to 95%, thereby restoring the benthic community at those areas.

While placement of the dredged sediments could be accomplished over the CLA1-5 (2014) and CLA1-1 (2015) sites in 2016, it could not yet be accomplished for impacted sediments encountered south of CLA-1 (within CLA-14), because a Clean Water Act (CWA) Section 404(b)(1) Evaluation and environmental impact assessment documentation has not yet been completed. CWA Section 404(b)(1) regulations at 40 CFR 230.70 (c) provide that the selection

of a disposal site that has been used previously for dredged material discharge is an action that can be used to minimize potential adverse impacts. Thin-layer capping with this channel material would in essence take this one step further by improving degraded aquatic ecosystem conditions that exist at these sites. Moreover, it would also serve to further restore the chemical and biological integrity of Lake Erie waters, an original and fundamental objective of the CWA.

REFERENCES

Hawthorne SB, Azzolina NA, Neuhauser EF, Kreitinger JP (2007) Predicting bioavailability of sediment polycyclic aromatic hydrocarbons to *Hyalella azteca* using equilibrium partitioning, supercritical fluid extraction and pore water concentrations. Environ. Sci. Technol. 41:6297-6304.

USEPA (2003) Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures. USEPA, Office of Research and Development, Washington, DC. EPA/600/R-02/013.

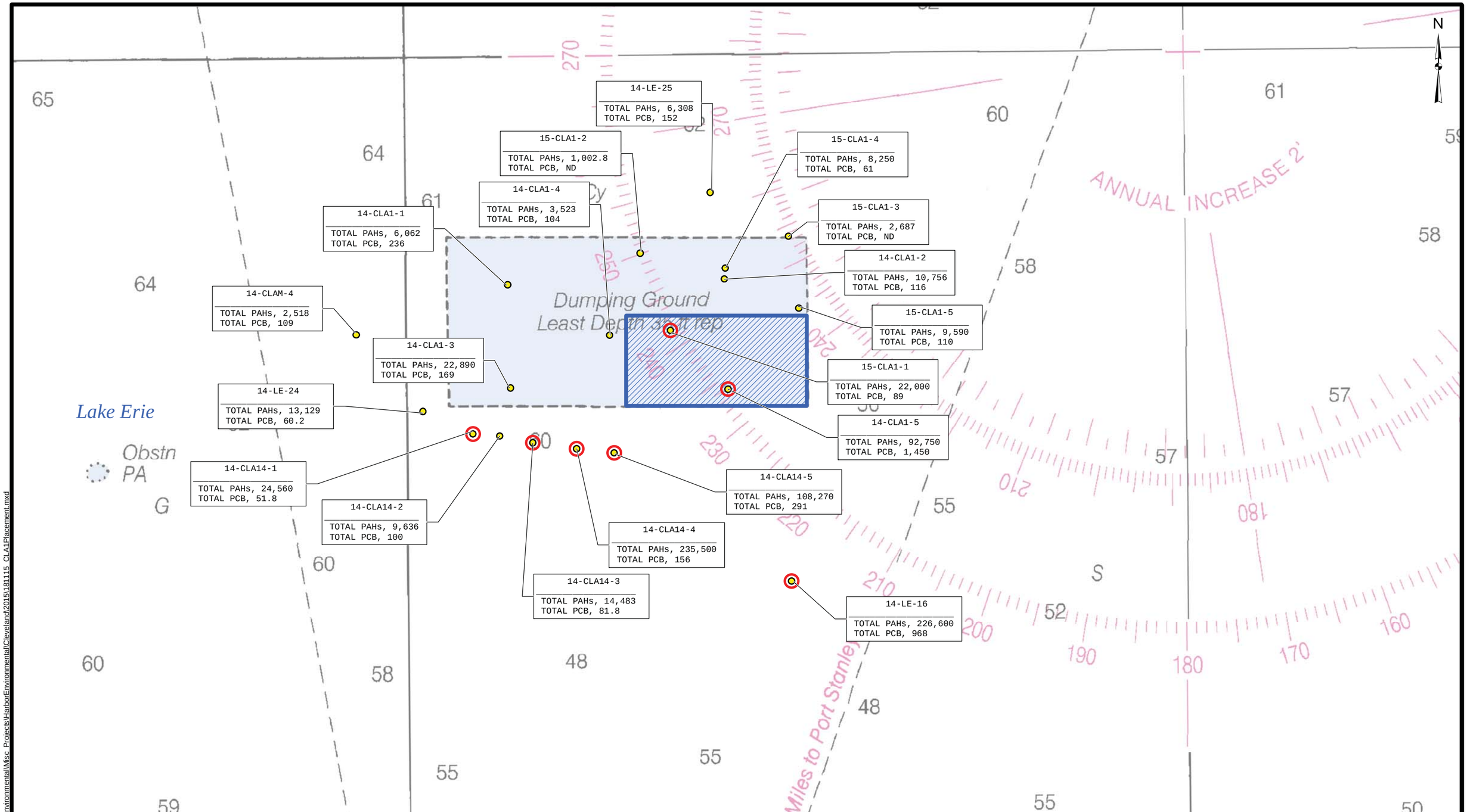
ATTACHMENT 1: Discrete Lake Erie sites in the vicinity of CLA-1 and CLA-14 with evidenced PAH related toxicity (based on data from USACE 2013, and RTI 2014 and 2015)

Discrete site (year)	Descriptive characteristic					Sediment PAH toxicity evident[3]?
	Elevated bulk sediment PAH concentration[1]?	Petroleum odor and/or sheen in the field?	Avoidance by worms in laboratory bioassay?	*H. azteca* toxicity predicted by PAH pore water analysis?	Unacceptable solid phase bioassay result on composite sample?	
CLA1-1 (2012)	N	**Y**	N[2]	N[2]	N	**N**
CLA1-2 (2012)	N	N	N[2]	N[2]	N	**N**
CLA1-3 (2012)	N	**Y**	N[2]	N[2]	N	**N**
CLA1-4 (2012)	N	N	N[2]	N[2]	N	**N**
CLA1-1 (2014)	N	N	N	**Y[2]**	N/A	**N**
CLA1-2 (2014)	N	N	N	**Y[2]**	N/A	**N**
CLA1-3 (2014)	N	N	N	**Y[2]**	N/A	**N**
CLA1-4 (2014)	N	N	N	**Y[2]**	N/A	**N**
CLA1-5 (2014)	**Y**	**Y**	**Y**	**Y[2]**	N/A	**Y**
CLA14-1 (2014)	N	**Y**	N	**Y[2]**	N/A	**Y**
CLA14-2 (2014)	N	N	N	**Y[2]**	N/A	**N**
CLA14-3 (2014)	N	**Y**	N	**Y[2]**	N/A	**Y**
CLA14-4 (2014)	**Y**	**Y**	**Y**	**Y[2]**	N/A	**Y**
CLA14-5 (2014)	**Y**	**Y**	N	**Y[2]**	N/A	**Y**
LE-16 (2014)	**Y**	**Y**	N/A	N/A	N/A	**Y**
CLA1-1 (2015)	N	**Y**	N/A	**Y**	N/A	**Y**
CLA1-2 (2015)	N	N	N[2]	N	N	**N**
CLA1-3 (2015)	N	N	N[2]	N	N	**N**
CLA1-4 (2015)	N	N	N[2]	N	N	**N**
CLA1-5 (2015)	N	N	N[2]	N	N	**N**

[1]Concentration > 33,409 µg/kg (CLA 4-3 2012 sample)

[2]Composite sample

[3]Affirmative statement for two or more characteristics



Legend

- Sediment Sample Location
- Lake Sample with Evidenced Toxic PAH Contamination
- Proposed Placement Area Within CLA1 Beneficial Use of Dredged Sediments

Notes:
1) All results are reported in ug/kg.
2) ND - Not Detected

0 0.25 0.5 1 Miles

US Army Corps of Engineers Buffalo District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

TOTAL PAH AND TOTAL PCB CONCENTRATIONS
IN SEDIMENT (JUNE & SEPTEMBER 2014 - MAY 2015)

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CLEVELAND, OHIO

ATTACHMENT 2

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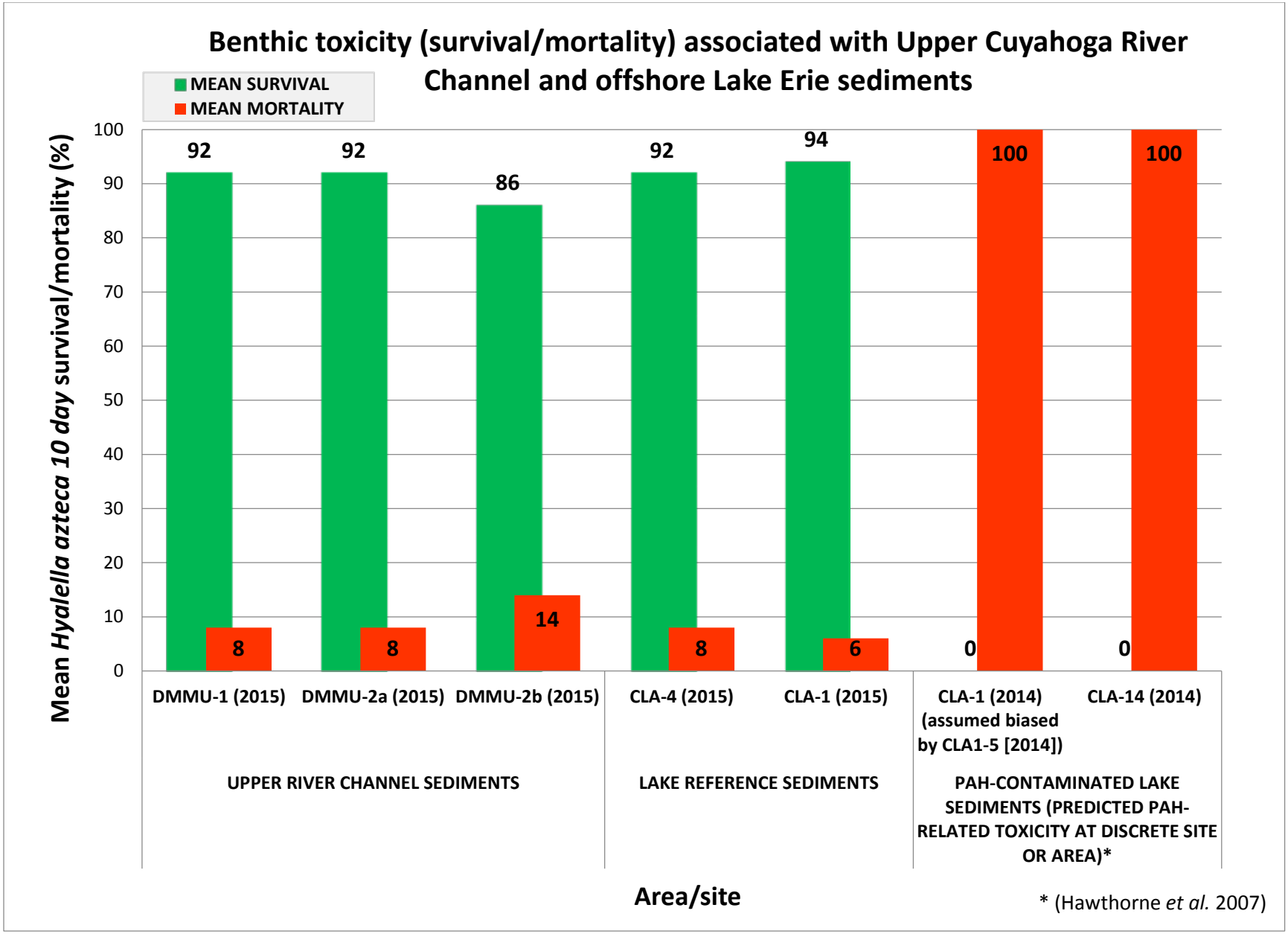
ATTACHMENT 3