Previous performance report indicated this project was 80% complete through December 31, 2018. Please update the following outcomes:

**A. Field Monitoring results from 2019**

Update

BGSU: As in previous years, an EXO-2 sonde was deployed on Sandusky Buoy 2 in lower (Eastern) Sandusky Bay to measure water quality parameters in order to establish baseline data in turbidity, conductivity, temperature, dissolved oxygen, pH and algal photopigments prior to the implementation of Sandusky Bay Initiative restoration efforts. *Planktothrix agardhii* was once again the dominant cyanobacterial bloom-forming species present in the Bay. Additional water quality data were also obtained from EXO-2 sondes placed at Big Island Water Works in the City of Sandusky and at the Edison Bridge. Sonde data is reported to the URLs below every 20 minutes. Complementing the sonde data at the Bridge site is a SL-500 Acoustic Doppler Current Profiler (ADCP) in constant operation since September 2018, and a NuLab nutrient analyzer measuring dissolved nitrate and phosphate every 4 hours. The nutrient analyzer was installed to yield a continuing data set starting June 12, 2019. Data from these instruments is publicly available at:

<https://glbuoys.glos.us/bgsusd2/> (Sandusky Buoy 2)

<https://glbuoys.glos.us/lebiww> (Big Island Water Works)

<https://glbuoys.glos.us/sbedison> (Edison Bridge; see the ‘Currents’ button for ADCP data)

<http://limnotechdata.com/nulab/sandusky_bay>/ (Edison Bridge NuLab nutrient analyzer)

The nutrient analyzer performance was validated by independent measurements of coincident grab samples. The NuLab was installed to monitor rates of denitrification in the Bay, as well as document internal loading of P from the sediments. Testing whether wind events cause the release of additional sediment phosphorus is an additional aim.

In addition to data obtained from deployed instruments, we sampled Sandusky Bay at 9 sites (see table below, Muddy Creek to Bells) roughly biweekly with the assistance of ODNR Watercraft crews on the following dates: June 10 and 17; July 8; August 5 and 19; September 9 and 23. Additional sampling was done during maintenance trips to the nutrient analyzer at the Bridge site. Samples were processed for dissolved and total nutrients, dissolved and total microcystin (to be tested by ELISA) and total chlorophyll. Samples were also taken at four sites (ODNR 1, 2, 4 and 6) for chlorophyll and microcystin toxin analysis by Ohio EPA.

**Sandusky Bay stations.** The lat/lon for each site are provided below.

|  |  |  |
| --- | --- | --- |
| **Station Name** | **Lat decimal N** | **Lon decimal W** |
| Sandusky Channel Bells (aka ‘Bells’) | 41.511667° | -82.657967° |
| Environment Canada Station EC 1163 (or ‘1163’) | 41.469000° | -82.715000° |
| ODNR 1 | 41.477367° | -82.739783° |
| Sandusky Buoy 2\* (or Buoy 2) | 41.463222o | -82.769028o |
| ODNR 2 | 41.479817° | -82.782867° |
| ODNR 6 | 41.457300° | -82.898655° |
| Edison Bridge\* (or ‘Bridge’) | 41.480156o | -82.834328o |
| ODNR 4 | 41.453333° | -82.960767° |
| Muddy Creek# | 41.4561o | -83.007133o |

We are currently completing all the analyses of grab samples, and all data when they are available can be found in the folder named ‘Sandusky Bay 2019’ in Google Drive:

<https://drive.google.com/drive/folders/0B8ktYgbIaZWIM3hNOG56enlkZUU>

The nutrient analyzer data clearly show the typical summertime trend of nitrogen depletion due to sedimentary denitrification as documented in Salk et al. (2018). The abundance of data points combined with flow velocities measured by the ADCP will allow the calculation of total N losses and Bay-wide denitrification rates during the bloom season. At the same time, consistent low levels of phosphate were measured throughout the summer, suggesting internal loading of P from the sediments. Microcystin toxin levels followed a trend of high springtime values at or above the Ohio EPA contact advisory (peaking above 20 ppb) to below 2 ppb by September. As typical for most years, the *Planktothrix agardhii* bloom was evident from late May into October, persisting well after the 2019 *Microcystis* bloom had declined in the open waters of Lake Erie.

Due to a lack of sustained wind events (24 h of 20 kts.) during late summer 2019, we are to date unable to document whether wind-mediated resuspension of sediments contributes to increased nitrate or phosphate in the water column. The nutrient analyzer will be deployed until late October, so perhaps a wind event will arise to help answer this question.

Salk, K. R., G.S. Bullerjahn, R.M.L. McKay, J.D. Chaffin, and N.E. Ostrom. 2018. Nitrogen cycling in Sandusky Bay, Lake Erie: Oscillations between strong and weak export and implications for harmful algal blooms, Biogeosciences 15: 2891–2907.

**B. Summary**

BGSU: As indicated above, summertime denitrification once again occurred during July and August 2019, yielding nitrate values below detection. Consistent detection of phosphate throughout the bloom season provided evidence of internal loading of phosphorus in the system. The *Planktothrix* bloom has been shown to persist in a low dissolved N:P environment, likely due to accumulation of N-rich storage polymers (cyanophycin) and the ability of *Planktothrix* to effectively scavenge regenerated ammonium (Hampel et al. 2019).

Hampel, J., M.J. McCarthy, M. Neudeck, G.S. Bullerjahn, R.M. McKay and S.E. Newell. 2019. Ammonium recycling supports toxic *Planktothrix* blooms in Sandusky Bay, Lake Erie: evidence from stable isotope and metatranscriptome data. Harmful Algae 81: 42-52.