Old Woman Creek (OWC) NERR Water Quality Metadata
January – December, 2017
Latest Update: 15 April 2019

I. Data Set and Research Descriptors

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2. Entry verification:

Deployment data are directly uploaded from a YSI EXO2 data logger to a personal computer (IBM compatible). The data were graphed and visually checked for any obvious outliers. Notes were made of any unusual data or faulty probes. Files are exported from Kor Software in an Excel file (.XLS) and uploaded to the CDMO where they undergo automated primary QAQC; automated depth/level corrections for changes in barometric pressure (cDepth or cLevel parameters); and become part of the CDMO's online provisional database. All pre- and post-deployment data are removed from the file prior to upload. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve for secondary QAQC where it is opened in Microsoft Excel and processed using the CDMO's NERRQAQC Excel macro. The macro inserts station codes, creates metadata worksheets for flagged data and summary statistics, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, remove any overlapping deployment data, append files, and export the resulting data file for upload to the CDMO. Upload after secondary QAQC results in ingestion into the database as provisional plus data, recalculation of cDepth or cLevel parameters, and finally tertiary QAQC by the CDMO and assimilation into the CDMO's authoritative online database. Where deployment overlap occurs between files, the data produced by the newly calibrated sonde is generally accepted as being the most accurate. For more information on QAQC flags and codes, see Sections 11 and 12. The files are archived at OWC.

Dr. Kristi Arend was responsible for both data logger deployment and data management at Old Woman Creek NERR during 2017.

3. Research Objectives:

Measurements are taken every 15 minutes over two to four-week periods at four sites within Old Woman Creek. Three sites are located in the estuary proper: one in the upper reaches at Darrow Road (DR); one near the mouth, just south of State Route 6 (WM); and the third upstream from the WM site (Lower Estuary; OL). The final site (BR) is just upstream of the

first riffle zone above the estuary in Old Woman Creek proper. The purpose of this monitoring program is to document the role of this Great Lakes estuary in the Lake Erie ecosystem, particularly the estuary's role in mitigating storm flow that passes through it. The role of the OL site is to document the degree of intrusion by lake water during northerly winds and subsequent seiche events.

4. Research methods:

The 2017 YSI monitoring program began at all sites on 22 February 2017, shortly after thaw. Sampling continued through 08 December 2017, when they were removed due to ice formation. EXO2 sondes were used at all four sites throughout this time period. Data loggers at BR, DR, and WM are deployed in 4-inch diameter PVC pipes, which are clamped to an 8-foot long metal post that had been driven into the sediment. The logger trap at site DR is not clamped to an 8-foot metal post, but rather is suspended from the north side of the road bridge by metal chain. Each pipe has 4 vertical slits ¾" wide drilled into it spanning the area of the probe guard on the data logger to ensure that the probes would have direct contact with the surrounding waters. The OL sonde is deployed on a deeply embedded steel pipe with a steel trap that has four vertical slits matching in length and width to the EXO 2 sonde guard slits. Additional field readings for dissolved oxygen, pH, temperature, turbidity, and specific conductance were taken using a EXO2 sonde when the instruments are changed at each site (see the Other Remarks Section). The data loggers are replaced in the field after a two to four-week deployment, depending on temperature and degree of fouling of the data loggers. The data are retrieved from each data logger and each data logger is recalibrated (according to the directions in the YSI Operations Manual) before being returned to the field. Conductivity, turbidity (2-point calibration using distilled water for zero turbidity and a YSI standard for the other turbidity point), and pH (2 point-calibration) are calibrated using commercial standards. These standards were prepared prior to each deployment. Sonde readings are checked against these standards within 24 hours of retrieval. The data loggers at all sites have non-vented depth sensors and optical DO sensors. The calibration logs provide sensor information.

In October 2014 the Data Management Committee determined that barometric pressure readings used for producing the depth offset during water quality data sonde calibration should be taken from the same weather station where barometric pressure is used to correct depth/level for the cDepth/cLevel parameters. This is a requirement for NERRS Reserves (like Old Woman Creek) where that weather station is located significantly above sea level. Please be aware that this protocol began being followed in March 2015 at the start of sampling and was following throughout the 2016 field season.

A Sutron Sat-Link2 transmitter was installed at site OL during October 2006. This system transmits data to the NOAA Goes satellite, NESDIS ID# 3B02849A. A WaterLog Storm3 data logger was installed at sites DR and WM in September 2017. These systems transmit data to the NOAA Goes satellites NESDIS ID# 3B0009A8 and 3B001ADE, respectively. The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen-minute data sampling intervals. Upon receipt by the CDMO, the data undergo the same automated primary QAQC process detailed in Section 2 above. The "real-time" telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO's authoritative online database. Provisional and authoritative data are available at http://cdmo.baruch.sc.edu.

5. Site Location and Character:

Old Woman Creek National Estuarine Research Reserve is located on the southern shore of Lake Erie, east of the city of Huron, Ohio (Latitude 41° 23'N; Longitude 82° 33'W). Land use in the Old Woman Creek (OWC) watershed is primarily row crop agriculture. Other than the non-point source pollutants coming into the estuary from these agricultural practices and from the town of Berlin Heights, there are no other major pollution sources in the estuary. Salinity in Old Woman Creek is normally 1 ppt. or less, although it will rise, on occasion, to nearly 2 ppt. The tidal range in Lake Erie (and therefore in the estuary) is on the order of 4 cm or less. Water levels in the estuary and in the creek are extremely variable, with changes occurring daily, seasonally and annually due to changing lake levels, seiches on the lake, storm runoff, and the mouth closing and opening through the year. Changes to the status of the mouth (open versus closed) during a quarter or year are included in the comments section.

The data logger at the State Route 6 (WM) site (Latitude 41° 22' 57" N, Longitude 82° 30'54" W) is very close to the mouth of Old Woman Creek. In this portion of the Reserve, the creek is very shallow but extends over a large surface area. This site frequently experiences influx of Lake Erie waters. The bottom sediments at this site are silty clay. At the beginning of the deployment for 2017, no rooted aquatic vegetation was present directly adjacent to the site, although both emergent and submerged vegetation were present within 3 meters of the site. The data logger is about 0.18 meters above the bottom sediments. On 17 August 2016, the sonde height was measured to be approximately 0.28 m above the bottom.

The data logger at site OL (Latitude 41° 22' 55" N, Longitude 82° 30'51" W) is in the lower reaches of the estuary. This site is not in direct sight of the mouth, so northerly winds and resulting seiche activities should be less noticeable at this site. The bottom sediments are silty clay. This site is located about 5 meters north of a Nelumbo lutea bed, but, there no plants were immediately adjacent to the data logger. In March 2009, a new logger site was established 5 meters north of the original site due to damage of the original site by a winter storm. In 2010, this temporary site became the OL site. At this site, the base of the logger is 26 cm above the sediment. One or two leaves of N. lutea are adjacent to this logger site. This is the site that is telemetered to the GOES satellite. On 1 December 2016 the deployment fencepost and PVC trap were replaced with a steel pipe equipped with a steel trap to achieve a more vertically stable deployment platform. The height of the logger above the sediment is now approximately 42 cm off the bottom.

The data logger at site DR (Latitude 41° 21'54"N, Longitude 82° 30' 17"W) is at the southern boundary of the reserve. The logger trap is suspended from the western most of the two, center guard rail supports on the north side of the Darrow Road bridge near the deepest part of the creek channel. At this site the creek is relatively narrow. Although water direction and flow is influenced at this site by changes in Lake Erie water levels, this site doesn't have direct contact with Lake Erie waters. The bottom sediments at his site are silty clay. No rooted aquatic vegetation is present near or upstream from this site. The trap was repaired and re-deployed in March 2016 and was measured to be at about 0.45 m above the bottom.

The data logger at site BR (Latitude 41° 20'54" N, Longitude 82° 30'30"W) is located in the lower portion of the creek proper. Just upstream from the data logger, Berlin Road crosses Old Woman Creek. Site BR is just upstream of the first riffle above the estuary. Unlike the other three sites, Lake Erie water levels have no impact on this site. The bottom of the creek at this

site is a combination of rocks interspersed with some clay-silt that has been washed in from upstream. No aquatic macrophytes are present at or near this site. The logger is 18 cm above the bottom at this site. Short guards were used on all loggers at this site through the year. During winter 2014, the logger distance above bottom was measured as being about 14 cm above the stream bottom.

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
BR	P	Berlin Road	Latitude 41° 20'54" N, Longitude 82° 30'30"W	2002 - current	NA	NA
DR	P	Darrow Road	Latitude 41° 21'54"N, Longitude 82° 30' 17"W	2008- current	NA	NA
SU	P	Route 2	Latitude 41° 22'02"N, Longitude 82° 30' 26"W	1995-2007	Bridge repair; couldn't access site	NA
OL	P	Lower Estuary	Latitude 41° 22' 55" N, Longitude 82° 30'51" W	2008 - current	NA	NA
WM	P	Route 6	Latitude 41° 22' 57" N, Longitude 82° 30'54" W	1995- current	NA	NA

6. Data collection periods:

Sampling at BR began on 22 February at 10:00 EST, and data were last downloaded on 08 December at 12:45 EST. Sampling at DR began on 22 February at 10:30:00 EST, and data were last downloaded on 08 December at 10:00 EST. Sampling at OL began on 22 February at 09:00 EST, and data were last downloaded on 08 December at 11:15 EST. Sampling at WM began on 22 February at 09:15:15 EST, and data were last downloaded on 08 December

at 11:30 EST. Specific deployment dates are listed below.

Site	Deploy Date	Deploy Time	Retrieve Date	Retrieve Time	Sonde
BR	2/22/2017	10:00	3/14/2017	9:00	EXO2 (BR1)
BR	3/14/2017	9:15	4/11/2017	8:00	EXO2 (BR2)
BR	4/11/2017	8:45	5/1/2017	8:30	EXO2 (BR1)
BR	5/1/2017	8:30	5/23/2017	12:30	EXO2 (BR2)
BR	5/23/2017	12:45	6/6/2017	8:30	EXO2 (BR1)
BR	6/6/2017	8:45	6/21/2017	10:15	EXO2 (BR2)
BR	6/21/2017	10:30	7/5/2017	12:15	EXO2 (BR1)
BR	7/5/2017	12:30	7/20/2017	9:30	EXO2 (BR2)
BR	7/20/2017	9:45	8/3/2017	9:15	EXO2 (BR1)
BR	8/3/2017	9:30	8/17/2017	8:15	EXO2 (BR2)
BR	8/17/2017	8:30	9/7/2017	7:30	EXO2 (BR1)
BR	9/7/2017	7:45	9/25/2017	9:15	EXO2 (BR2)
BR	9/25/2017	9:15	10/16/2017	8:00	EXO2 (BR1)
BR	10/16/2017	8:15	11/4/2017	11:30	EXO2 (BR2)
BR	11/4/2017	11:45	12/8/2017	12:45	EXO2 (BR1)
DR	2/22/2017	8:45	3/14/2017	9:15	EXO2 (DR2)
DR	3/14/2017	9:30	4/11/2017	8:15	EXO2 (DR1)
DR	4/11/2017	8:30	5/1/2017	8:45	EXO2 (DR2)
DR	5/1/2017	9:00	5/23/2017	12:45	EXO2 (DR1)
DR	5/23/2017	13:00	6/6/2017	9:00	EXO2 (DR2)
DR	6/6/2017	9:15	6/21/2017	10:30	EXO2 (DR1)
DR	6/21/2017	10:45	7/5/2017	12:30	EXO2 (DR2)
DR	7/5/2017	13:00	7/20/2017	9:45	EXO2 (DR1)
DR	7/20/2017	10:00	8/3/2017	9:30	EXO2 (DR2)
DR	8/3/2017	9:45	8/17/2017	8:45	EXO2 (DR1)
DR	8/17/2017	9:00	9/7/2017	7:45	EXO2 (DR2)
DR	9/7/2017	8:15	9/25/2017	9:30	EXO2 (DR1)
DR	9/25/2017	9:45	10/16/2017	8:15	EXO2 (DR2)
DR	10/16/2017	8:30	11/7/2017	8:30	EXO2 (DR1)
DR	11/7/2017	8:45	12/8/2017	10:00	EXO2 (DR2)
OL	2/22/2017	9:00	3/14/2017	10:15	EXO2 (OL2)
OL	3/14/2017	10:30	4/11/2017	9:00	EXO2 (OL1)
OL	4/11/2017	9:15	5/1/2017	9:30	EXO2 (OL2)
OL	5/1/2017	10:00	5/23/2017	13:30	EXO2 (OL1)
OL	5/23/2017	13:45	6/6/2017	10:00	EXO2 (OL2)
OL	6/6/2017	10:30	6/21/2017	11:15	EXO2 (OL1)
OL	6/21/2017	11:30	7/5/2017	13:15	EXO2 (OL2)
OL	7/5/2017	13:30	7/20/2017	10:15	EXO2 (OL1)
OL	7/20/2017	11:00	8/3/2017	8:15	EXO2 (OL2)

OL	8/3/2017	8:30	8/17/2017	11:00	EXO2 (OL1)
OL	8/17/2017	11:30	9/7/2017	8:45	EXO2 (OL2)
OL	9/7/2017	8:45	9/25/2017	10:00	EXO2 (OL1)
OL	9/25/2017	10:30	10/16/2017	9:15	EXO2 (OL2)
OL	10/16/2017	9:45	11/7/2017	9:30	EXO2 (OL1)
OL	11/7/2017	10:00	12/8/2017	11:15	EXO2 (OL2)
WM	2/22/2017	9:15	3/14/2017	10:00	EXO2 (WM1)
WM	3/14/2017	10:15	4/11/2017	9:15	EXO2 (WM2)
WM	4/11/2017	9:30	5/1/2017	9:45	EXO2 (WM1)
WM	5/1/2017	10:00	5/23/2017	13:30	EXO2 (WM2)
WM	5/23/2017	14:00	6/6/2017	10:15	EXO2 (WM1)
WM	6/6/2017	10:45	6/21/2017	11:15	EXO2 (WM2)
WM	6/21/2017	11:30	7/5/2017	13:30	EXO2 (WM1)
WM	7/5/2017	13:45	7/20/2017	10:45	EXO2 (WM2)
WM	7/20/2017	11:15	8/3/2017	8:30	EXO2 (WM1)
WM	8/3/2017	8:45	8/17/2017	10:45	EXO2 (WM2)
WM	8/17/2017	11:00	9/7/2017	8:30	EXO2 (WM1)
WM	9/7/2017	9:00	9/25/2017	10:15	EXO2 (WM2)
WM	9/25/2017	10:30	10/16/2017	9:30	EXO2 (WM1)
WM	10/16/2017	9:45	11/7/2017	9:15	EXO2 (WM2)
WM	11/7/2017	9:45	12/8/2017	11:30	EXO2 (WM1)

7. Distribution

NOAA retains the right to analyze, synthesize, and publish summaries of the NERRS System-wide Monitoring Program data. The NERRS and OWC Research Coordinator (RC) retain the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the RC and the NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined in the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government and the State of Ohio do not assume liability to the Recipient or third persons, nor will the Federal government or the State of Ohio reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:
National Estuarine Research Reserve System (NERRS). 2012. System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: http://www.nerrsdata.org/; *accessed* 12 October 2012.

NERR water quality data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see section 1, Principal Investigators and Contact Persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under general information link on CDMO homepage) and online at the CDMO

homepage www.nerrsdata.org. Data are available in comma delimited format.

8. Associated projects:

A Nile microwave water level sensor is located in close proximity to the WM site and at the DR site. These provide more accurate water level data at the southern and northern bounds of the estuary. Water level data are transmitted to each site's respective GOES satellite simultaneously with the sonde data.

As part of the SWMP long-term monitoring program, replicate samples for chemical analysis of the water are collected at least monthly. Samples for phytoplankton determination are collected at the same time at sites near two of the data logger deployment sites (DR and WM). A 26-hour water sampling regime (samples are collected at 2-hour intervals over the 26 hours) is conducted at the WM site once during each month. Additionally, a meteorological station collects 15-minute data. These data are available at www.nerrsdata.org.

II. Physical Structure and Descriptors:

9. Sensor specifications:

OWC NERR deployed eight EXO2 sondes in 2017. A ninth YSI EXO2 sonde was used for to collect simultaneous field measurements when sondes were exchanged.

YSI EXO2 datalogger

Parameter: Temperature
Units: Celsius (C)
Sensor Type: CT2 Probe, Thermistor
Model #: 599870
Range: -5 to 50 °C
Accuracy: -5 to 35 °C: $\pm$ 0.01 °C; 35 to 50 °C: $\pm$ 0.05 °C
Resolution: 0.01 °C

Parameter: Conductivity
Units: milli-Siemens per cm (mS/cm)
Sensor Type: CT2 probe, 4-electrode cell with autoranging
Model #: 599870
Range: 0 to 200 mS/cm
Accuracy: 0 to 100 mS/cm: $\pm$ 0.5% of reading or + 0.001 mS/cm, whichever is greater; 100 to 200 mS/cm: $\pm$ 1% of reading
Resolution: 0.001 mS/cm to 0.01 mS/cm (range dependent)

Parameter: Specific Conductance
Units: mS/cm
Sensor Type: CT2 probe; Calculated from conductivity and temperature
Model #: 599870
Range: 0 to 200 mS/cm

Accuracy: ± 0.5% of reading or 0.001 mS/cm, whichever is greatest
Resolution: 0.001, 0.01, 0.1 mS/cm (auto-scaling)

Parameter: Salinity
Units: practical salinity units (psu)
Sensor Type: CT2 probe; Calculated from conductivity and temperature
Range: 0 to 70 psu
Accuracy: ± 1.0% of reading or 0.1 psu, whichever is greater
Resolution: 0.01 psu

Parameter: Dissolved Oxygen % saturation
Units: percent air saturation (%)
Sensor Type: Optical probe w/ mechanical cleaning
Model #: 599100-01
Range: 0 to 500% air saturation
Accuracy: 0 to 200% air saturation- ± 1% of the reading or 1% air saturation, whichever is greater; 200 to 500% air saturation- ± 5% of the reading
Resolution: 0.1% air saturation

Parameter: Dissolved Oxygen mg/L (Calculated from % air saturation, temperature and salinity)
Units: milligrams per Liter (mg/L)
Sensor Type: Optical probe w/ mechanical cleaning
Model #: 599100-01
Range: 0 to 50 mg/L
Accuracy: 0 to 20 mg/L- ± 1% of the reading or 0.1 mg/L, whichever is greater; 20 to 50 mg/L- ± 5% of the reading
Resolution: 0.01 mg/L

Parameter: Non-vented Level - Shallow (Depth)
Units: feet or meters (ft or m)
Sensor Type: Stainless steel strain gauge
Range: 0 to 33 ft (10 m)
Accuracy: +/- 0.013 ft (0.004 m)
Resolution: 0.001 ft (0.001 m)

Parameter: pH
Units: pH units
Sensor Type: Glass combination electrode
Model #: 599702 (wiped)
Range: 0 to 14 units
Accuracy: ± 0.1 pH units within ± 10 °C of calibration temp; ± 0.2 pH units for entire temp range
Resolution: 0.01 units

Parameter: Turbidity
Units: formazin nephelometric units (FNU)
Sensor Type: Optical, 90 degree scatter
Model #: 599101-01

Range: 0 to 4000 FNU
Accuracy: 0 to 999 FNU: 0.3 FNU or ± 2% of reading (whichever is greater); 1000 to 4000 FNU: ± 15% of reading
Resolution: 0 to 999 FNU: 0.01 FNU; 1000 to 4000 FNU: 0.1 FNU

Dissolved Oxygen Qualifier (Rapid Pulse / Clark type sensor):

The reliability of dissolved oxygen (DO) data collected with the rapid pulse / Clark type sensor after 96 hours post-deployment for non-EDS (Extended Deployment System) data sondes may be problematic due to fouling which forms on the DO probe membrane during some deployments (Wenner et al. 2001). Some Reserves use the YSI 6600 EDS data sondes, which increase DO accuracy and longevity by reducing the environmental effects of fouling. Optical DO probes have further improved data reliability. The user is therefore advised to consult the metadata for sensor type information and to exercise caution when using rapid pulse / Clark type sensor DO data beyond the initial 96-hour time period. Potential drift is not always problematic for some uses of the data, i.e. periodicity analysis. It should also be noted that the amount of fouling is very site specific and that not all data are affected. If there are concerns about fouling impacts on DO data beyond any information documented in the metadata and/or QAQC flags/codes, please contact the Research Coordinator at the specific NERR site regarding site and seasonal variation in fouling of the DO sensor.

Depth Qualifier

The NERRS System-Wide Monitoring Program uses YSI data sondes that can be equipped with either vented or non-vented depth/level sensors. Readings for both vented and non-vented sensors are automatically compensated for water density change due to variations in temperature and salinity; but for all non-vented depth measurements, changes in atmospheric pressure between calibrations appear as changes in water depth. The error is equal to approximately 1.02 cm for every 1 millibar change in atmospheric pressure, and is eliminated for vented sensors because they are vented to the atmosphere throughout the deployment time interval.

Beginning in 2006, NERR SWMP standard calibration protocol calls for all non-vented depth sensors to read 0 meters at a (local) barometric pressure of 1013.25 mb (760 mm/hg). To achieve this, each site calibrates their depth sensor with a depth offset number, which is calculated using the actual atmospheric pressure at the time of calibration and the equation provided in the SWMP calibration sheet or Digital Calibration Log. This offset procedure standardizes each depth calibration for the entire NERR System. If accurate atmospheric pressure data are available, non-vented sensor depth measurements at any NERR site can be corrected. At OWC NERR in 2017, all sites employed non-vented depth sensors.

In 2010, the CDMO began automatically correcting depth/level data for changes in barometric pressure as measured by the Reserve's associated meteorological station during data ingestion. These corrected depth/level data are reported as cDepth and cLevel, and are assigned QAQC flags and codes based on QAQC protocols. Please see sections 11 and 12 for QAQC flag and code definitions.

NOTE: **older depth data cannot be corrected without verifying that the depth offset was in place and whether a vented or non-vented depth sensor was in use. No SWMP data prior to 2006 can be corrected using this method**. The following equation is used for

corrected depth/level data provided by the CDMO beginning in 2010: ((1013-BP)*0.0102)+Depth/Level = cDepth/cLevel.

Salinity Units Qualifier

In 2013, EXO sondes were approved for SWMP use and began to be utilized by Reserves. While the 6600 series sondes report salinity in parts per thousand (ppt) units, the EXO sondes report practical salinity units (psu). These units are essentially the same and for SWMP purposes are understood to be equivalent, however psu is considered the more appropriate designation. Moving forward the NERR System will assign psu salinity units for all data regardless of sonde type.

Turbidity Qualifier

In 2013, EXO sondes were approved for SWMP use and began to be used by Reserves. While the 6600 series sondes report turbidity in nephelometric turbidity units (NTU), the EXO sondes use formazin nephelometric units (FNU). These units are essentially the same but indicate a difference in sensor methodology, for SWMP purposes they will be considered equivalent. Moving forward, the NERR System will use FNU/NTU as the designated units for all turbidity data regardless of sonde type. If turbidity units and sensor methodology are of concern, please see the Sensor Specifications portion of the metadata.

10. Coded variable definitions:

Sampling Station	Sampling site code	Station code
State Route 6	WM	owcwmwq
Lower Estuary	OL	owcolwq
Darrow Road	DR	owcdrwq
Berlin Road	BR	owcbrwq

11. QAQC flag

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). During primary automated QAQC (performed by the CDMO), -5, -4, and -2 flags are applied automatically to indicate data that are missing and above or below sensor range. All remaining data are then flagged 0, passing initial QAQC checks. During secondary and tertiary QAQC 1, -3, and 5 flags may be used to note data as suspect, rejected due to QAQC, or corrected.

-5 Outside High Sensor Range
-4 Outside Low Sensor Range
-3 Data Rejected due to QAQC
-2 Missing Data
-1 Open- reserved for later flag
0 Good Data
1 Suspect Data
2 Data Outside 2 Standard Deviations from the historical seasonal mean
3 Data Outside 3 Standard Deviations from the historical seasonal mean
4 Historical Data: Pre-Auto QAQC
5 Corrected Data

12. QAQC code definitions

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with deployment or YSI datasonde, sensor errors are sensor specific, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point, but some comment codes (marked with an * below) can be applied to the entire record in the F_Record column.

General Errors

GIC	No instrument deployed due to ice
GIM	Instrument malfunction
GIT	Instrument recording error; recovered telemetry data
GMC	No instrument deployed due to maintenance/calibration
GNF	Deployment tube clogged / no flow
GOW	Out of water event
GPF	Power failure / low battery
GQR	Data rejected due to QA/QC checks
GSM	See metadata

Corrected Depth/Level Data Codes

GCC	Calculated with data that were corrected during QA/QC
GCM	Calculated value could not be determined due to missing data
GCR	Calculated value could not be determined due to rejected data
GCS	Calculated value suspect due to questionable data
GCU	Calculated value could not be determined due to unavailable data

Sensor Errors

SBO	Blocked optic
SCF	Conductivity sensor failure
SCS	Chlorophyll spike
SDF	Depth port frozen
SDG	Suspect due to sensor diagnostics
SDO	DO suspect
SDP	DO membrane puncture
SIC	Incorrect calibration / contaminated standard
SNV	Negative value
SOW	Sensor out of water
SPC	Post calibration out of range
SQR	Data rejected due to QAQC checks
SSD	Sensor drift
SSM	Sensor malfunction
SSR	Sensor removed / not deployed
STF	Catastrophic temperature sensor failure
STS	Turbidity spike
SWM	Wiper malfunction / loss

Comments

CAB*	Algal bloom
CAF	Acceptable calibration/accuracy error of sensor
CAP	Depth sensor in water, affected by atmospheric pressure
CBF	Biofouling
CCU	Cause unknown
CDA*	DO hypoxia (<3 mg/L)
CDB*	Disturbed bottom
CDF	Data appear to fit conditions
CFK*	Fish kill
CIP*	Surface ice present at sample station
CLT*	Low tide
CMC*	In field maintenance/cleaning
CMD*	Mud in probe guard
CND	New deployment begins
CRE*	Significant rain event
CSM*	See metadata
CTS	Turbidity spike
CVT*	Possible vandalism/tampering
CWD*	Data collected at wrong depth
CWE*	Significant weather event

13. Post deployment information:

End of Deployment Readings in Standard Solutions

Date is the date logger was deployed. Dissolved oxygen readings are the readings after retrieval, with the sonde place in a bucket of aerated water. All loggers were unvented; therefore, the depth reading in parentheses after the first depth reading is the expected depth reading when correcting for changes in barometric pressure. The specific conductivity standard is indicated in parenthesis (1.413 mS/cm). The pH standards are 7.00 and 10.00 (both are corrected for temperature). The turbidity standards are indicated in parenthesis (0.0, 124.0 FNU). The depth offset, based on current barometric pressure is indicated in parenthesis. Complete post deployment data are in the calibration sheets.

Site	Deploy Date	SpCond	ODO1	ODO2	pH7	pH10	Turb	Turb	Depth
BR	2/22/2017	1.44(1.413)	100.3	100.5	6.98	10.01	0.64(0.0)	123.3(124.0)	0.053(0.058)
BR	3/14/2017	1.394(1.413)	100.3	100.6	7.03	10.05	-0.55(0.0)	123.1(124.0)	0.043(0.058)
BR	4/11/2017	1.411(1.413)			7.03	10.04	5.29(0.0)	120.0(124.0)	-0.16(-0.125)
BR	5/1/2017	1.413(1.413)	98.1	99.6	7.00	10.02	-1.53(0.0)	124.01(124.0)	-0.113(-0.033)
BR	5/23/2017	1.416(1.413)	100.0	99.7	7.10	10.13	1.2(0.0)	117.9(124.0)	-0.0090(-0.0030)
BR	6/6/2017	1.41(1.413)	97.6	97.6	7.05	10.08	-0.1(0.0)	125.1(124.0)	-0.095(-0.084)
BR	6/21/2017	1.415(1.413)	98.6	99.4	7.03	9.97	0.32(0.0)	121.68(124.0)	0.0(0.018)
BR	7/5/2017	1.415(1.413)	98.0	97.8	7.12	10.09	0.45(0.0)	124.2(124.0)	-0.076(0.028)
BR	7/20/2017	1.4113(1.413)	96.9	97.1	6.96	10.07	0.19(0.0)	121.82(124.0)	0.0(0.049)
BR	8/3/2017	1.424(1.413)	97.8	97.5	6.96	9.98	0.01(0.0)	118.7(124.0)	-0.135(-0.023)
BR	8/17/2017	1.406(1.413)	99.2	99.0	7.00	10.03	0.02(0.0)	123.65(124.0)	0.048(0.028)
BR	9/7/2017	1.415(1.413)	101.1	101.0	7.02	10.00	0.15(0.0)	122.9(124.0)	-0.012(0.038)
BR	9/25/2017	1.424(1.413)	100.6	100.3	7.02	10.03	0.44(0.0)	122.11(124.0)	0.085(0.12)
BR	10/16/2017	1.42(1.413)	100.8	100.8	7.01	10.03	-0.06(0.0)	116.2(124.0)	0.055(0.069)
BR	11/4/2017	1.438(1.413)	100.6	100.7	7.10	9.99	0.2(0.0)	124.9(124.0)	0.0070(0.038)

DR	2/22/2017	1.431(1.413)	99.5	100.6	7.09	9.99	0.79(0.0)	123.4(124.0)	0.056(0.058)
DR	3/14/2017	1.492(1.413)	101.7	101.7	7.1	10.09	1.16(0.0)	128.5(124.0)	0.132(0.181)
DR	4/11/2017	1.412(1.413)	97.2	97.1	7.05	10.04	0.37(0.0)	119.03(124.0)	-0.155(-0.125)
DR	5/1/2017	1.413(1.413)	97.6	99.6	7[§]	10.02[§]	0.0(0.0)	124.0(124.0)	-0.115(-0.033)
DR	5/23/2017	1.4048(1.413)	99.7	99.3	7.05	10.08	1.22(0.0)	121.99(124.0)	-0.0070(-0.0030)
DR	6/6/2017	1.404(1.413)	96.2	96.4	7.09	10.09	-0.57(0.0)	105.84(124.0)	0.027(0.018)
DR	6/21/2017	1.417(1.413)	99	98.9	7.13	10.02	0.28(0.0)	122.1(124.0)	-0.011(-0.0030)
DR	7/5/2017	1.409(1.413)	97.9	97.7	8.38[§]	11.20[§]	0.28(0.0)	124.27(124.0)	0.027(0.018)
DR	7/20/2017	1.433(1.413)	97.2	97.8	7.02	10.06	0.2(0.0)	119.58(124.0)	-0.0040(0.049)
DR	8/3/2017	1.412(1.413)	96.8	96.8	7.16	10.17	-0.03(0.0)	122.5(124.0)	-0.045(-0.033)
DR	8/17/2017	1.3822(1.413)	98.4	98.6	7.05	10.09	0.28(0.0)	120.87(124.0)	0.029(0.028)
DR	9/7/2017	1.417(1.413)	102.7	102.5	7.07	10.09	-2.58(0.0)	124.3(124.0)	0.071(0.038)
DR	9/25/2017	1.4073(1.413)	99.8	100.1	7.20	10.20	0.8(0.0)	119.12(124.0)	0.13(0.12)
DR	10/16/2017	1.422(1.413)	101.3	101.2	7.02	10.04	0.04(0.0)	121.6(124.0)	0.099(0.099)
DR	11/7/2017	1.403(1.413)	96.6	97.6	7.07	10.04	0.34(0.0)	122.0(124.0)	-0.0020(0.018)
OL	2/22/2017	1.454(1.413)	100.7[§]	100.6[§]	7.03	10.01	0.31(0.0)	122.7(124.0)	0.08(0.058)
OL	3/14/2017	1.502(1.413)	102.1	101.7	7.06	10.1	1.21(0.0)	128.0(124.0)	0.169(0.181)
OL	4/11/2017	1.392(1.413)	99.9	99.7	7.01	10.05	0.51(0.0)	116.75(124.0)	-0.151(-0.125)
OL	5/1/2017	1.413(1.413)	97.9	99.7	7	10.02	0.0(0.0)	123.99(124.0)	-0.117(-0.033)
OL	5/23/2017	1.4082(1.413)	96.7	95.2	7.01	10.00	1.81(0.0)	118.73(124.0)	0.0(-0.0030)
OL	6/6/2017	1.413(1.413)	97.5	97.6	7.07	9.99	0.08(0.0)	124.4(124.0)	-0.102(-0.094)
OL	6/21/2017	1.43(1.413)	99.8	99.6	7.03	9.98	0.3(0.0)	121.78(124.0)	-0.0020(-0.0030)
OL	7/5/2017	1.411(1.413)	98	96.9	6.98	10.02	0.43(0.0)	123.8(124.0)	0.021(0.028)
OL	7/20/2017	1.3765(1.413)	99	98.7	7.04	10.05	0.58(0.0)	121.05(124.0)	-0.0060(0.038)
OL	8/3/2017	1.384(1.413)	97.3	97.5	7.04	10.07	-0.02(0.0)	121.8(124.0)	-0.042(-0.033)
OL	8/17/2017	1.3904(1.413)	99.3	99.0	7.06	10.08	0.26(0.0)	120.17(124.0)	0.034(0.028)
OL	9/7/2017	1.415(1.413)	102.4	102.5	7.06	10.05	0.37(0.0)	123.1(124.0)	0.07(0.029)
OL	9/25/2017	1.404(1.413)	101.9	101.9	7.00	10.01	1.1(0.0)	120.08(124.0)	0.129(0.131)
OL	10/16/2017	1.406(1.413)	101	101	7.11	10.1	0.07(0.0)	123.6(124.0)	0.095(0.099)
OL	11/7/2017	1.426(1.413)	100.2	100.2	6.97	9.98	0.33(0.0)	121.4(124.0)	-0.015(0.0080)
WM	2/22/2017	1.458(1.413)	100.8	100.7	7.01	10.02	-0.95(0.0)	122.5(124.0)	0.083(0.069)
WM	3/14/2017	1.488(1.413)	100.6	101.8	8.65	9.33	-1.17(0.0)	122.0(124.0)	0.185(0.181)
WM	4/11/2017	1.3802(1.413)	99.3	99.2	7.01	10.00	0.92(0.0)	118.85(124.0)	-0.158(-0.125)
WM	5/1/2017	1.413(1.413)	96.9	99.7	7	10.06	0.0(0.0)	121.24(124.0)	-0.122(-0.033)
WM	5/23/2017	1.3996(1.413)	100.4	100.1	7.02	10.02	3.41(0.0)	122.03(124.0)	0.0070(-0.0030)
WM	6/6/2017	1.385(1.413)	98.2	97.5	7.09	10.05	0.1(0.0)	124.4(124.0)	-0.109(-0.094)
WM	6/21/2017	1.403(1.413)	94.8	99.7	7.03	10.02	0.2(0.0)	122.8(124.0)	-0.0030(-0.0030)
WM	7/5/2017	1.153(1.413)	97.6	97.5	7.05	10.01	-0.43(0.0)	122.2(124.0)	0.018(0.018)
WM	7/20/2017	1.4294(1.413)	98.9	98.9	7.07	10.06	0.69(0.0)	121.42(124.0)	-0.012(0.038)
WM	8/3/2017	1.41(1.413)	97.4	97.5	7.00	9.99	-0.21(0.0)	123.6(124.0)	-0.033(-0.023)
WM	8/17/2017	1.3977(1.413)	99.1	99.1	7.04	10.07	0.76(0.0)	121.37(124.0)	0.033(0.028)
WM	9/7/2017	1.413(1.413)	99.0	99.1	7.03	10.01	-0.49(0.0)	119.36(124.0)	0.068(0.029)

WM	9/25/2017	1.4049(1.413)	101.9	102.0	7.03	10.06	0.68(0.0)	119.31(124.0)	0.126(0.129)
WM	10/16/2017	1.421(1.413)	100.9	101.2	7.05	10	-0.06(0.0)	124.1(124.0)	0.095(0.099)
WM	11/7/2017	1.424(1.413)	100.1	100.1	7.01	9.99	0.38(0.0)	127.4(124.0)	-0.026(-0.0030)

§ sensor malfunction

14. Other Remarks:

QAQC Flagging notes

Barrier Beach Status and Water Exchange

The water quality of the OL and WM sites at OWC are influenced by whether or not the barrier beach is breached/open (i.e., surface exchange is occurring between the estuary and the lake). When the barrier is open, wind-driven surface water exchange usually results in cycles of water inflow from the lake and outflow to the lake that can be detected in the water quality data. The change from closed to open can be rapid and dramatic, usually as a result of precipitation. Sometimes, this can be followed by seiche events, depending on winds during the storm. The transition from open to closed is gradual and usually marked by a gradual increase in water depth and specific conductivity. The opening of the mouth (and sometimes closing) is indicated in the "F_Record" column as "CSM" (see metadata). Mouth status data for Q1-Q4 are below.

Changes to mouth status, Jan. 1, 2017 – Jun. 30, 2017

Jan. 01 – Jan. 03: closed
Jan. 04 – Jan. 06: open, flowing
Jan. 07 – Jan. 09: open, frozen
Jan. 10 – Apr. 30: open, flowing
May 1: closed
May 2 – May 10: open, flowing
May 11 – May 12: closed
May 13 – May 20: open, flowing
May 21 – May 27: closed
May 28 – Jun. 18: open, flowing
Jun. 19 – Jun. 30: closed
July 1 – July 28: open (opening expanded on July 11)
July 29 – Nov. 5: closed
Nov. 6 – Dec. 31: open (opening expanded on Nov. 19)

Rain and weather events

For rain events that affect water quality parameters, the "F_Record" column is flagged for the time period over which the precipitation occurred (not the time period over which the parameters were affected). Sometimes, the parameters themselves are flagged during the time period over which they were affected.

Weather events include periods of high wind, which can result in the inflow of water from Lake Erie into the estuary (e.g., true seiche, wind-induced water exchange, waves overtopping the barrier beach into the estuary) or outflow of water from the estuary (e.g., large decrease in water level not associated with a breach of the barrier beach). Lake water inflow events are usually evident at the OL and WM sites and can be most easily detected by plotting both specific conductivity and water depth. The intrusion of lake water into the estuary both increases depth and decreases conductivity. Other parameters may or may not change. These are labeled as a weather event in the "F_Record" column for the duration of

the event, in 24-hour periods (i.e., full days are marked because of difficulty in identifying the exact start and end times of seiche events). Impacted parameter "F_" column(s) may also be marked, as deemed useful (e.g., if a seiche coincides with retrieval and deployment of sondes, causing the data to look like the retrieved and deployed sondes weren't reading similar values).

Darrow Road (DR): large storm events can cause the sonde to swing up or to swing up and down, alternately, due to high flows. As a result, shallower depths or more variable depths are recorded. This appears to have occurred on 05 May 2017, as the result of heavy rain and flow. The sonde depth is very shallow, sometimes reading out of water during this time, despite water levels being quite high. Alternatively, the sonde could have been tangled in a large tree branch. Swinging may also have occurred on 18 November 2017.

Depth (non-weather related)
No comments.

Turbidity
During the 11/04/2017 – 12/09/2017 deployment at BR, the central wiper had a partial walnut shell stuck in it. The shell was positioned over the pH sensor at retrieval (pH data do not indicate an effect). Based on wiper voltage readings, the walnut likely became stuck on 11/18 at 20:30. This could explain odd turbidity patterns from 11/23 17:30 – 11/24 13:15 and 11/28 20:15 – 11/29 04:45. However, all readings starting 11/18 20:30 through the end of the deployment were marked as suspect.

Turbidity spikes at sites OL and WM, particularly from April through June, could be due to biological activity, especially activity of *Cyprinus carpio L*.

DO
No comments.

pH
EXO2 sonde pH sensors can appear to drift $\leq$ 0.1 pH units during deployment. These are flagged at the new deployment date-time as 0 GSM CND.

Specific conductivity / Salinity
No comments.

Multiple parameters
No comments.

Missing Data
Data are missing due to equipment or associated specific probes not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.

Field verification
Field data collected at time of data logger retrieval and deployment are reported below. The data were collected using a field sonde (YSI EXO2) that was deployed simultaneous to the

retrieved and newly deployed sondes.

Site	*Data sonde*	*Date (m/d/y)*	*Time (hh:mm:ss)*	*Temp (C)*	*SpCond (mS/cm)*	*Sal (ppt)*	*pH*	*Turbid (NTU, FNU)*	*ODOsat (%)*	*ODO (mg/L)*	*Depth (meters)*
BR	deployed	2/22/2017									
BR	retrieved	3/14/2017	9:00:00	0.05	0.638	0.30	7.93	3.60	96.50	14.06	0.196
BR	deployed	3/14/2017	9:03:00	0.05	0.638	0.30	7.94	3.65	96.80	14.10	0.194
BR	retrieved	4/11/2017	8:03:00	13.38	0.521	0.25	7.77	8.35	86.80	9.05	0.440
BR	deployed	4/11/2017	8:10:00	13.37	0.521	0.25	7.76	8.66	87.10	9.08	0.468
BR	retrieved	5/1/2017	8:15:00	15.61	0.509	0.25	7.65	26.50	84.80	8.43	0.390
BR	deployed	5/1/2017	8:18:00	15.61	0.509	0.25	7.64	26.90	84.80	8.43	0.423
BR	retrieved	5/23/2017	12:30:00	16.80	0.584	0.28	7.83	7.24	93.80	9.09	0.073
BR	deployed	5/23/2017	12:35:00	16.85	0.583	0.28	7.84	7.07	93.90	9.09	0.075
BR	retrieved	6/6/2017	8:32:00	17.03	0.592	0.29	7.89	8.16	86.30	8.33	0.086
BR	deployed	6/6/2017	8:41:00	17.03	0.592	0.29	7.85	17.56	86.20	8.31	0.090
BR	retrieved	6/21/2017	9:53:00	19.83	0.628	0.31	7.70	14.27	76.00	6.92	0.059
BR	deployed	6/21/2017	10:00:00	19.85	0.628	0.31	7.71	13.76	75.50	6.87	0.063
BR	retrieved	7/5/2017	12:15:00	20.83	0.558	0.27	7.78	9.55	92.60	8.27	0.256
BR	deployed	7/5/2017	0.511806	20.85	0.558	0.27	7.77	15.21	92.60	8.27	0.253
BR	retrieved	7/20/2017	9:29:00	23.48	0.594	0.29	7.90	10.84	84.70	7.19	0.163
BR	deployed	7/20/2017	9:34:00	23.49	0.594	0.29	7.91	11.07	84.80	7.19	0.162
BR	retrieved	8/3/2017	9:10:00	20.98	0.690	0.34	7.66	6.80	73.60	6.55	0.077
BR	deployed	8/3/2017	9:17:00	20.90	0.689	0.34	7.64	5.54	69.30	6.18	0.075
BR	retrieved	8/17/2017	8:25:00	21.03	0.669	0.33	7.47	8.10	56.10	4.99	0.033
BR	deployed	8/17/2017	8:29:00	21.02	0.669	0.33	7.48	7.13	56.40	5.02	0.033
BR	retrieved	9/7/2017	7:39:00	15.30	0.652	0.32	7.50	12.98	74.80	7.48	0.101
BR	deployed	9/7/2017	7:43:00	15.35	0.658	0.32	7.66	14.31	74.10	7.40	0.103
BR	retrieved	9/25/2017	9:07:00	19.21	0.834	0.41	7.23	9.63	21.70	2.00	0.064
BR	deployed	9/25/2017	9:10:00	19.20	0.833	0.41	7.24	4.67	18.60	1.71	0.064
BR	retrieved	10/16/2017	7:55:00	15.76	0.654	0.32	7.50	5.79	71.60	7.09	0.256
BR	deployed	10/16/2017	8:04:00	15.79	0.660	0.32	7.49	4.68	66.70	6.60	0.255
BR	retrieved	11/4/2017	11:39:00	9.45	0.414	0.20	7.54	57.78	91.10	10.40	0.406
BR	deployed	11/4/2017	11:42:00	9.46	0.414	0.20	7.53	52.12	91.10	10.40	0.487
BR	retrieved	12/8/2017	9:49:00	0.06	0.665	0.32	7.76	2.94	94.20	13.72	0.149
DR	deployed										
DR	retrieved	3/14/2017	9:18:00	1.05	0.624	0.30	8.04	6.55	98.60	13.96	1.291
DR	deployed	3/14/2017	9:27:00	1.06	0.623	0.30	8.04	6.79	98.70	13.98	1.287
DR	retrieved	4/11/2017	8:25:00	14.62	0.518	0.25	7.81	20.87	78.30	7.95	1.021
DR	deployed	4/11/2017	8:30:00	14.61	0.520	0.25	7.80	21.03	78.00	7.92	1.027
DR	retrieved	5/1/2017	8:37:00	16.21	0.528	0.26	7.64	46.56	75.70	7.43	1.351
DR	deployed	5/1/2017	8:47:00	16.19	0.529	0.26	7.63	46.34	75.40	7.40	1.356
DR	retrieved	5/23/2017	12:46:00	16.81	0.694	0.34	7.58	18.65	60.80	5.88	1.232
DR	deployed	5/23/2017	12:50:00	16.74	0.672	0.33	7.51	21.98	50.60	4.90	1.234
DR	retrieved	6/6/2017	8:55:00	19.15	0.589	0.29	7.63	12.65	58.50	5.40	1.009

DR	deployed	6/6/2017	9:09:00	19.17	0.590	0.29	7.60	12.02	56.30	5.19	1.007
DR	retrieved	6/21/2017	10:14:00	21.44	0.584	0.28	7.43	16.37	30.20	2.67	1.003
DR	deployed	6/21/2017	10:22:00	21.48	0.590	0.29	7.44	15.12	30.80	2.72	1.007
DR	retrieved	7/5/2017	12:30:00	21.44	0.525	0.25	7.54	17.16	64.40	5.68	0.860
DR	deployed	7/5/2017	12:45:00	21.39	0.530	0.26	7.51	19.55	63.30	5.59	0.864
DR	retrieved	7/20/2017	9:48:00	22.13	0.652	0.32	7.65	18.35	55.60	4.84	1.197
DR	deployed	7/20/2017	9:52:00	22.22	0.652	0.32	7.66	20.87	57.90	5.04	1.203
DR	retrieved	8/3/2017	9:29:00	22.98	0.556	0.27	7.78	11.55	82.80	7.09	1.001
DR	deployed	8/3/2017	9:37:00	22.93	0.570	0.28	7.74	12.40	78.20	6.71	1.004
DR	retrieved	8/17/2017	8:45:00	21.39	0.614	0.30	7.44	7.21	40.40	3.57	1.090
DR	deployed	8/17/2017	8:50:00	21.35	0.617	0.30	7.43	6.98	38.50	3.40	1.092
DR	retrieved	9/7/2017	7:54:00	17.51	0.617	0.30	7.46	15.06	43.00	4.11	1.159
DR	deployed	9/7/2017	8:04:00	17.62	0.623	0.30	7.49	12.31	38.80	3.70	1.161
DR	retrieved	9/25/2017	9:25:00	19.18	0.643	0.31	7.12	3.88	2.30	0.21	1.553
DR	deployed	9/25/2017	9:34:00	19.18	0.644	0.31	7.13	2.99	0.90	0.08	1.557
DR	retrieved	10/16/2017	8:14:00	16.91	0.503	0.24	7.07	7.11	22.20	2.15	1.751
DR	deployed	10/16/2017	8:23:00	17.18	0.506	0.25	7.08	7.15	10.30	0.99	1.754
DR	retrieved	11/7/2017	8:39:00	10.22	0.363	0.17	7.41	76.41	89.40	10.02	1.148
DR	deployed	11/7/2017	8:45:00	10.22	0.364	0.18	7.41	65.28	89.30	10.01	1.159
DR	retrieved	12/8/2017	10:20:00	0.82	0.664	0.32	7.83	4.65	89.30	12.73	0.410
OL	deployed										
OL	retrieved	3/14/2017	10:23:00	0.74	0.374	0.18	8.11	27.66	97.40	13.94	0.726
OL	deployed	3/14/2017	10:26:00	0.76	0.375	0.18	8.10	30.67	97.40	13.92	0.713
OL	retrieved	4/11/2017	9:00:00	9.27	0.320	0.15	8.02	29.23	97.60	11.20	0.711
OL	deployed	4/11/2017	9:07:00	9.32	0.320	0.15	7.98	28.55	97.70	11.20	0.792
OL	retrieved	5/1/2017	9:40:00	16.34	0.439	0.21	7.86	26.02	89.10	8.72	0.408
OL	deployed	5/1/2017	9:46:00	16.36	0.441	0.21	7.85	25.44	89.40	8.74	0.415
OL	retrieved	5/23/2017	13:25:00	20.66	0.432	0.21	7.73	29.23	92.30	8.27	0.460
OL	deployed	5/23/2017	13:39:00	20.73	0.433	0.21	7.75	28.02	99.40	8.90	0.437
OL	retrieved	6/6/2017	10:01:00	19.41	0.383	0.18	7.78	31.11	74.50	6.84	0.461
OL	deployed	6/6/2017	10:17:00	19.25	0.375	0.18	7.62	28.20	71.00	6.54	0.434
OL	retrieved	6/21/2017	10:57:00	23.85	0.459	0.22	7.78	26.88	89.10	7.52	0.609
OL	deployed	6/21/2017	11:09:00	24.00	0.458	0.22	7.89	26.34	102.10	8.58	0.577
OL	retrieved	7/5/2017	13:15:00	24.77	0.384	0.18	7.95	21.90	114.10	9.46	0.578
OL	deployed	7/5/2017	13:27:00	24.93	0.391	0.19	8.09	19.80	128.20	10.60	0.596
OL	retrieved	7/20/2017	10:30:00	26.19	0.366	0.17	7.87	18.85	96.70	7.81	0.797
OL	deployed	7/20/2017	10:44:00	26.12	0.389	0.19	7.83	19.91	97.70	7.90	0.854
OL	retrieved	8/3/2017	8:15:00	24.32	0.338	0.16	7.39	19.91	63.10	5.27	0.721
OL	deployed	8/3/2017	8:28:00	24.33	0.340	0.16	7.38	18.63	61.70	5.16	0.711
OL	retrieved	8/17/2017	11:10:00	23.92	0.413	0.20	7.25	8.90	43.70	3.68	0.621
OL	deployed	8/17/2017	11:15:00	23.92	0.413	0.20	7.24	8.88	43.50	3.66	0.597
OL	retrieved	9/7/2017	8:23:00	18.46	0.425	0.20	7.33	17.28	38.20	3.58	0.700
OL	deployed	9/7/2017	8:36:00	18.52	0.426	0.21	7.31	14.99	34.70	3.25	0.753
OL	retrieved	9/25/2017	10:02:00	22.84	0.463	0.22	7.26	9.18	26.00	2.24	0.970

OL	deployed	9/25/2017	10:14:00	22.83	0.463	0.22	7.20	8.96	24.00	2.07	0.964
OL	retrieved	10/16/2017	9:18:00	17.78	0.406	0.20	7.27	13.25	38.90	3.69	0.729
OL	deployed	10/16/2017	9:30:00	17.79	0.407	0.20	7.23	12.25	36.50	3.47	0.824
OL	retrieved	11/7/2017	9:43:00	10.43	0.322	0.15	7.40	113.71	75.40	8.41	0.850
OL	deployed	11/7/2017	9:49:00	10.48	0.321	0.15	7.35	108.11	72.50	8.08	0.857
OL	retrieved	12/8/2017	11:15:00	0.53	0.595	0.28	7.99	14.75	93.40	13.43	0.432
WM	deployed										
WM	retrieved	3/14/2017	10:12:00	0.72	0.363	0.17	8.17	34.05	98.90	14.15	1.103
WM	deployed	3/14/2017	10:15:00	0.84	0.364	0.17	8.14	46.09	98.50	14.05	1.093
WM	retrieved	4/11/2017	9:16:00	10.61	0.338	0.16	7.91	33.69	94.80	10.54	0.731
WM	deployed	4/11/2017	9:23:00	11.14	0.348	0.17	7.88	31.51	92.80	10.19	0.738
WM	retrieved	5/1/2017	9:49:00	16.22	0.421	0.20	7.89	21.72	89.90	8.82	0.338
WM	deployed	5/1/2017	9:51:00	16.28	0.424	0.20	7.89	21.23	90.10	8.83	0.329
WM	retrieved	5/23/2017	13:46:00	20.70	0.424	0.20	7.77	18.48	92.50	8.29	0.407
WM	deployed	5/23/217	13:54:00	20.63	0.425	0.20	7.66	20.99	86.00	7.71	0.380
WM	retrieved	6/6/2017	10:24:00	19.71	0.369	0.18	7.71	22.60	79.10	7.22	0.902
WM	deployed	6/6/2017	10:33:00	19.20	0.361	0.17	7.66	27.91	74.40	6.87	0.906
WM	retrieved	6/21/2017	11:17:00	23.73	0.452	0.22	7.64	22.48	77.30	6.54	1.154
WM	deployed	6/21/2017	11:26:00	23.98	0.450	0.22	7.72	22.27	87.40	7.35	1.158
WM	retrieved	7/5/2017	13:36:00	24.64	0.350	0.17	7.84	16.90	103.40	8.60	0.604
WM	deployed	7/5/2017	13:44:00	24.58	0.349	0.17	7.84	14.22	104.70	8.71	0.645
WM	retrieved	7/20/2017	10:55:00	26.36	0.353	0.17	7.96	22.38	105.30	8.48	0.833
WM	deployed	7/20/2017	11:00:00	26.26	0.351	0.17	7.98	19.79	106.20	8.57	0.808
WM	retrieved	8/3/2017	8:33:00	24.40	0.344	0.16	7.36	10.48	53.70	4.48	0.691
WM	deployed	8/3/2017	8:42:00	24.42	0.344	0.16	7.34	7.54	51.20	4.27	0.683
WM	retrieved	8/17/2017	10:55:00	23.89	0.410	0.20	7.29	10.34	47.50	4.00	0.623
WM	deployed	8/17/2017	11:00:00	23.99	0.410	0.20	7.29	8.28	50.00	4.20	0.644
WM	retrieved	9/7/2017	8:40:00	18.57	0.426	0.21	7.29	10.37	32.10	3.00	0.681
WM	deployed	9/7/2017	8:59:00	18.59	0.427	0.21	7.27	11.64	31.00	2.90	0.686
WM	retrieved	9/25/2017	10:22:00	22.80	0.461	0.22	7.24	7.10	29.10	2.50	0.988
WM	deployed	9/25/2017	10:28:00	22.78	0.462	0.22	7.23	7.08	29.70	2.55	0.970
WM	retrieved	10/16/2017	9:33:00	17.95	0.406	0.20	7.24	12.80	39.60	3.75	0.750
WM	deployed	10/16/2017	9:42:00	17.98	0.406	0.20	7.24	11.33	38.20	3.61	0.726
WM	retrieved	11/7/2017	9:27:00	10.44	0.321	0.15	7.42	114.06	77.50	8.65	0.751
WM	deployed	11/7/2017	9:32:00	10.44	0.321	0.15	7.42	129.60	77.70	8.67	0.780
WM	retrieved	12/8/2017	11:40:00	0.62	0.522	0.25	8.00	14.90	92.80	13.31	0.496