Old Woman Creek (OWC) NERR Water Quality Metadata
January – December, 2015
Latest Update: 23 August 2017

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I. Data Set and Research Descriptors

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2. Entry verification:

Deployment data were directly uploaded from aYSI PC6600 EDS data logger or 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 EcoWatch (PC6600 EDS loggers) or Kor (EXO2 loggers) in a comma-delimited format (.CDF) 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 the 2015 deployment.

3. Research Objectives:

Measurements are taken every 15 minutes over two or three-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 2015 YSI monitoring program began at sites BR, DR, OL, and WM on 25 March 2015, immediately after ice out and ended 31 December 2015. EXO2 sondes were used at sites BR and DR all year and at OL starting with the 11 August deployment. Data loggers 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 was not clamped to an 8-foot metal post, but rather was suspended from the north side of the road bridge by metal chain. Each pipe had 4 vertical slits ¾" wide drilled into it spanning the area of the probe guard on the data logger to insure that the probes would have direct contact with the surrounding waters. Additional field readings for dissolved oxygen, pH, temperature, turbidity, and specific conductance were taken using a 6600V2 sonde when the instruments were changed at each site (see the Other Remarks Section). The data loggers were replaced in the field after a two or three-week deployment, depending on temperature and degree of fouling of the data loggers. All data loggers were the extended deployment loggers. The data were retrieved from each data logger and each data logger was 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) were calibrated using commercial standards. These standards were prepared prior to each deployment. Sonde readings were checked against these standards within 24 hours of retrieval. The data loggers at site WM had a vented water level sensor while the loggers at sites BR, DR, and OL had non-vented depth sensors. The ROX optical dissolved oxygen probe was used with the 6600V2 sondes deployed at the OL and WM sites. The calibration logs provide sensor information.

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. The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen minute data sampling intervals. Upon receipt by the CDMO, the data undergoes 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 2014, 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 .18 meters above the bottom sediments. With the deployment beginning on 31 March 2014, a small guard was used thus effectively lowering the logger 5 cm in the trap.

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 11 July 2013, a powerful rain storm and subsequent current broke the logger trap off of the post, causing the trap and logger to rest on the bottom of the water column. The logger was recovered and a new logger deployed on 12 July 2013; it is about 28 cm above the bottom. On 16 July 2014, a longer post was driven into the sediment approximately 66 cm to the southwest of the current logger post. The post was set a vertical as possible, using a level. The logger housing and logger were transferred to the new post between 8:55-9:15 EST. The logger is located at about 27 cm above 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 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 data logger is about 20 cm above the bottom at this site. Prior to deployment on 14 April, 2011 (08:15) the trap was raised about 5 cm. Beginning with the deployment on 26 June, 2011 (08:00) the longer guard was used on the logger thus effectively raising the logger 5 cm in the water column. The trap was raised 6 cm on 3 October, 2011 between 10:15 and 10:30. The trap was moved approximately 2 m to the east and lowered 22 cm on October 22, 2012 at about 10:50. With the deployment beginning on 24 October, 2012, a small guard was used thus effectively lowering the logger another 5 cm in the trap. Starting in 2013, the logger was always deployed with the longer guard, thus raising the trap about 5 cm. The logger trap was repositioned in March 2014 and the logger sensors were measured to be at about 50 cm above the bottom.

The PVC trap suspension wire broke on 23 November 2015; the trap was suspended using the chain only, which caused raised the sensors in the water column 0.3 m.

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. Wire mesh fencing around the trap was installed to diminish debris build-up around the logger. The logger trap was destroyed by storm runoff during the last part of May and was reinstalled on 3 June, 2011 at about 10:15 am. The logger is now 22 cm above the bottom. The stream bottom under the logger was excavated on 17 July, 2011 at about 07:40 and the logger and trap were lowered about 18 cm. The bottom of the logger is now about 10 cm above the bottom of the creek. When the loggers were exchanged on 7 August, 2011 (about 07:55), the logger was lowered another 5 cm. The logger is 5 cm above the stream bottom. When the loggers were exchanged on 24 July, 2012, the logger trap was lowered 5 cm. Since 2011 the streambed under the logger has been eroded out slightly and so the logger after this latest change was still about 5 cm above the bottom. The data logger trap was partially detached from the fence post during winter 2014. The trap was reattached and the logger distance above bottom re-measured to account for any difference in positioning and the use of an EXO2 sonde, which has a longer guard and longer sensors. The logger sensors are now about 14 cm above the stream bottom.

6. Data collection periods:

Sampling Dates:
WM began on 25 March at 10:15 EST and ended on 31 December at 23:45 EST.
OL began on 25 March at 10:15 EST and ended 31 December at 23:45 EST.
DR began on 25 March at 09:15 ESTand ended 31 December at 23:45 EST.
BR began on 25 March at 08:45 ESTand ended 31 December at 23:45 EST.
Specific deployment dates are listed below.

*Date and time were recorded in UTC at the DR site during the 08/04/2015 and 08/25/2015 deployments. Dates and times were converted to EST in the .csv file. Dates and times in the .bin file remain in UTC and thus will not match those in the .csv file.

Site	Deploy Date	Deploy Time	Retrieve Date	Retrieve Time	Sonde
BR	3/25/2015	8:45	4/14/2015	7:45	EXO2 (BR1)
BR	4/14/2015	8:00	5/6/2015	8:00	EXO2 (BR2)
BR	5/6/2015	8:15	5/26/2015	8:00	EXO2 (BR1)
BR	5/26/2015	8:15	6/9/2015	8:15	EXO2 (BR2)
BR	6/9/2015	8:30	6/30/2015	7:45	EXO2 (BR1)
BR	6/30/2015	8:15	7/14/2015	7:45	EXO2 (BR2)
BR	7/14/2015	8:00	8/4/2015	7:45	EXO2 (BR1)
BR	8/4/2015	8:00	8/25/2015	7:45	EXO2 (BR2)

BR	8/25/2015	8:00	9/9/2015	8:15	EXO2 (BR1)
BR	9/9/2015	8:30	9/29/2015	7:45	EXO2 (BR2)
BR	9/29/2015	8:00	10/14/2015	8:30	EXO2 (BR1)
BR	10/14/2015	8:45	11/3/2015	9:45	EXO2 (BR2)
BR	11/3/2015	10:00	11/23/2015	10:15	EXO2 (BR1)
BR	11/23/2015	10:30	12/8/2015	9:15	EXO2 (BR2)
BR	12/8/2015	9:30	12/21/2015	10:00	EXO2 (BR1)
BR	12/21/2015	10:15	1/5/2016	9:30	EXO2 (BR2)
DR	3/25/2015	9:15	4/16/2015	10:30	EXO2 (DR2)
DR	4/16/2015	10:45	5/6/2015	8:30	EXO2 (DR1)
DR	5/6/2015	8:45	5/26/2015	8:45	EXO2 (DR2)
DR	5/26/2015	9:00	6/9/2015	8:45	EXO2 (DR1)
DR	6/9/2015	9:00	6/30/2015	8:15	EXO2 (DR2)
DR	6/30/2015	8:45	7/14/2015	8:15	EXO2 (DR1)
DR	7/14/2015	8:30	8/4/2015	8:15	EXO2 (DR2)
DR	8/4/2015	8:30	8/25/2015	8:00	EXO2 (DR1)
DR	8/25/2015	8:30	9/9/2015	8:45	EXO2 (DR2)
DR	9/9/2015	9:00	9/29/2015	8:15	EXO2 (DR1)
DR	9/29/2015	8:30	10/14/2015	9:00	EXO2 (DR2)
DR	10/14/2015	9:15	11/3/2015	10:00	EXO2 (DR1)
DR	11/3/2015	10:15	11/23/2015	10:30	EXO2 (DR2)
DR	11/23/2015	11:00	12/8/2015	9:30	EXO2 (DR1)
DR	12/8/2015	10:00	12/21/2015	10:15	EXO2 (DR2)
DR	12/21/2015	10:30	1/5/2016	9:45	EXO2 (DR1)
OL	3/25/2015	10:15	4/14/2015	9:00	6600V2 (25)
OL	4/14/2015	9:15	5/6/2015	9:15	6600V2 (22)
OL	5/6/2015	9:30	5/26/2015	10:30	6600V2 (25)
OL	5/26/2015	10:45	6/9/2015	10:00	6600V2 (22)
OL	6/9/2015	10:15	6/30/2015	9:30	6600V2 (25)
OL	6/30/2015	10:00	7/14/2015	9:15	6600V2 (22)
OL	7/14/2015	9:30	8/5/2015	10:45	6600V2 (25)
OL	8/5/2015	11:00	8/11/2015	13:15	6600V2 (22)
OL	8/11/2015	13:30	8/25/2015	9:15	EXO2 (OL-1)
OL	8/25/2015	9:30	9/9/2015	9:45	EXO2 (OL-2)
OL	9/9/2015	10:30	9/29/2015	9:15	EXO2 (OL-1)
OL	9/29/2015	9:30	10/14/2015	9:45	EXO2 (OL-2)
OL	10/14/2015	10:00	11/3/2015	11:00	EXO2 (OL-1)
OL	11/3/2015	11:15	11/23/2015	11:30	EXO2 (OL-2)
OL	11/23/2015	12:00	12/8/2015	10:30	EXO2 (OL-1)
OL	12/8/2015	10:45	12/22/2015	11:45	EXO2 (OL-2)
OL	12/22/2015	12:15	1/5/2016	11:00	EXO2 (OL-1)
WM	3/25/2015	10:45	4/14/2015	9:30	6600V2 (23)

WM	4/14/2015	9:45	5/6/2015	9:30	6600V2 (15)
WM	5/6/2015	9:45	5/26/2015	11:00	6600V2 (23)
WM	5/26/2015	11:15	6/9/2015	10:30	6600V2 (15)
WM	6/9/2015	10:45	6/30/2015	10:00	6600V2 (23)
WM	6/30/2015	10:30	7/14/2015	9:45	6600V2 (15)
WM	7/14/2015	10:00	8/4/2015	9:00	6600V2 (23)
WM	8/4/2015	9:15	8/25/2015	9:45	6600V2 (15)
WM	8/25/2015	10:00	9/9/2015	10:30	6600V2 (23)
WM	9/9/2015	10:30	9/15/2015	12:45	6600V2 (15)
WM	9/15/2015	13:00	9/29/2015	9:30	6600V2 (23)
WM	9/29/2015	9:45	10/14/2015	10:00	6600V2 (15)
WM	10/14/2015	10:15	11/3/2015	12:00	6600V2 (23)
WM	11/3/2015	12:15	11/24/2015	13:15	6600V2 (15)
WM	12/22/2015	12:15	1/5/2016	11:15	6600V2 (15)

7. Distribution

NOAA retains the right to analyze, synthesize, and publish summaries of the NERRS System-wide Monitoring Program data. The NEERS and OWC Research Coordinator (RC) retain the right to be fully credited for having collected and processed the data. Following academic courtesy standard, 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. Manuscripts resulting from this NOAA OCM-supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Coastal Management, National Ocean Service, National Oceanic and Atmospheric Administration.

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: 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 http://cdmo.baruch.sc.edu/. Data are available in comma delimited format.

8. Associated projects:

Replicate samples for chemical analysis of the water are collected at each site every time the data loggers are changed. Samples for phytoplankton determination are collected at the same time at sites near two of the data logger deployment sites (DR and WM). Additionally, a 26 hour sampling regime (samples are collected at 2 hour intervals over the 26 hours) is conducted at the WM site once during each month.

In addition, meteorological data are collected at 15-minute intervals at OWC and are available as part of the OWC SWMP meteorological dataset.

II. Physical Structure and Descriptors:

9. Sensor specifications:

OWC NERR deployed four 6600 V2 data sondes (sites OL and WM) and six EXO2 sondes (sites BR, DR, and OL) in 2015. Two 6600V2 data sondes were deployed at the OL site through 11 August 2015, when they were replaced with EXO2 sondes.

YSI 6600 V2 datalogger

Parameter: Temperature
Units: Celsius (C)
Sensor Type: Thermistor
Model #: 6560
Range: -5 to 45 °C
Accuracy: +/-0.15 °C
Resolution: 0.01 °C

Parameter: Conductivity
Units: milli-Siemens per cm (mS/cm)
Sensor Type: 4-electrode cell with autoranging
Model #: 6560
Range: 0 to 100 mS/cm
Accuracy: +/-0.5% of reading + 0.001 mS/cm
Resolution: 0.001 mS/cm to 0.1 mS/cm (range dependent)

Parameter: Salinity
Units: parts per thousand (ppt)
Sensor Type: Calculated from conductivity and temperature
Range: 0 to 70 ppt
Accuracy: +/- 1.0% of reading or 0.1 ppt, whichever is greater
Resolution: 0.01 ppt

Parameter: Dissolved Oxygen mg/L (Calculated from % air saturation, temperature and salinity)
Units: milligrams per Liter (mg/L)
Sensor Type: Rapid Pulse – Clark type, polarographic (YSI 6600 EDS loggers only)
Model #: 6562

Range: 0 to 50 mg/L
Accuracy: 0 to 20 mg/L, +/- 2 % of the reading or 0.2 mg/L, whichever is greater; 20 to 50 mg/L, +/- 6 % of the reading
Resolution: 0.01 mg/L

Parameter: Dissolved Oxygen % saturation
Units: percent air saturation (%)
Sensor Type: Optical probe with mechanical cleaning
Model #: 6150 ROX (YSI 6600 V2 loggers only)
Range: 0 to 500% air saturation
Accuracy: 0-200% air saturation- +/- 1% of the reading or 1% air saturation, whichever is greater; 200-500% air saturation- +/- 15% 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 with mechanical cleaning
Model #: 6150 ROX (YSI 6600 V2 loggers only)
Range: 0-50 mg/L
Accuracy: 0-20 mg/L- +/- 2% of the reading or 0.2 mg/L, whichever is greater; 20-50 mg/L- +/- 6% 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 30 ft (9.1 m)
Accuracy: +/- 0.06 ft (0.018 m)
Resolution: 0.001 ft (0.001 m)

Parameter: Vented Level – Shallow (Depth)
Units: feet or meters (ft or m)
Sensor Type: Stainless steel strain gauge
Range: 0 to 30 ft (9.1 m)
Accuracy 0-10 ft: +/- 0.01 ft (0.003 m)
Accuracy 10-30 ft: +/- 0.06 ft (0.018 m)
Resolution: 0.001 ft (0.001 m)

Parameter: pH (EDS probe)
Units: units
Sensor Type: Glass combination electrode
Model #: 6561
Range: 0 to 14 units
Accuracy: +/- 0.2 units
Resolution: 0.01 units

Parameter: Turbidity
Units: nephelometric turbidity units (NTU)

Sensor Type: Optical, 90 ° scatter, with mechanical cleaning
Model #: 6136
Range: 0 to 1000 NTU
Accuracy: +/- 5 % reading or 2 NTU (whichever is greater)
Resolution: 0.1 NTU

YSI EXO2 datalogger

Parameter: Temperature
Units: Celsius (C)
Sensor Type: Thermistor
Model #: 599870-01
Range: -5 to 50 °C
Accuracy: -5 to 35 °C : ± 0.01 °C; 35 to 50 °C : ± 0.05 °C
Resolution: 0.001 °C

Parameter: Conductivity
Units: milli-Siemens per cm (mS/cm)
Sensor Type:
Model #: 599870-01
Range: 0 to 200 mS/cm
Accuracy: 0 to 100 mS/cm : ± 0.5% of reading or + 0.001 mS/cm, whichever is greater; 100 to 200 mS/cm: ± 1% of reading
Resolution: 0.0001 mS/cm to 0.01 mS/cm (range dependent)

Parameter: Specific Conductance
Units: mS/cm
Sensor Type: Calculated from conductivity and temperature
Model #: 599870-01
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: parts per thousand (ppt)
Sensor Type: Calculated from conductivity and temperature
Range: 0 to 70 ppt
Accuracy: ± 1.0% of reading or 0.1 ppt, whichever is greater
Resolution: 0.01 ppt

Parameter: Dissolved Oxygen % saturation
Units: percent air saturation (%)
Sensor Type: Optical probe
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
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: Depth
Units: meters (m) or feet (ft)
Sensor Type: integral; non-vented; shallow
Range: 0 to 10 m (0 to 33 ft)
Accuracy: ± 0.04 % FS (± 0.04 m or ± 0.13 ft)
Resolution: 0.001 m (0.001 ft)

Parameter: pH
Units: units
Sensor Type:
Model #: 599706 (unguarded)
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
Model #: 599101-01
Range: 0 to 4000 FNU
Accuracy: 0 to 999 FNU: 0.3 FNU or ± 2% of reading, whichever is greatest; 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 utilize 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 utilizing 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 utilizes YSI data sondes that can be equipped with either depth or water level sensors. Both sensors measure water depth, but by convention, level sensors refer to atmospherically vented measurements and depth refers to non-vented measurements. Standard calibration protocols for the non-vented sensor use the atmosphere pressure at the time of calibration. Therefore, changes in atmospheric pressure between calibrations appear as changes in water depth. The error is equal to approximately 1.03 cm for every 1 millibar change in atmospheric pressure. This error is eliminated for level sensors because they are vented to the atmosphere throughout the deployment time interval. If proper atmospheric pressure data is available, non-vented sensor depth measurements can be corrected for deployments between calibrations. Readings for both vented and non-vented sensors are automatically compensated for water density changes due to variations in temperature and salinity.

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. The Research Coordinator at the specific NERR site should be contacted in order to obtain information regarding atmospheric pressure data availability. At OWC NERR in 2015, site WM employed water level sensors (i.e., vented depth sensors), and sites BR, OL, and DR 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.

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 utilized 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, -2, 2, and 3 flags are applied automatically to indicate data that are above or below sensor range, missing, or outside 2 or 3 standard deviations from the historical seasonal mean. All remaining data are then flagged 0, as "good". 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 pre and post-calibration (after retrieval). Depth is always 0.0 meters for the vented loggers (site WM). For the unvented loggers, 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 1.413 mS/cm. If the conductivity ports were inhabited by Chironomid larvae, the sp cond reading after clearing the ports is in parentheses after the initial Sp. Cond reading. The pH standards are 7.00 and 10.00 (both are corrected for temperature). The primary turbidity standard is zero, and the second standard is in parentheses. For WM and OL before 8/11/2015, turbidity is in NTU; for DR, BR, and OL after 8/11/2015, turbidity is in FNU. An asterisk after a turbidity reading is the reading after wiping the sensor. A ¥ after a turbidity or DO reading signifies problems with the wiper partially or fully obscuring the sensor during post-calibration. Complete post deployment data are in the calibration sheets.

Site	Deploy Date	SpCond	ROXDO1	ROXDO2	pH7	pH10	Turb	Turb	Depth
BR	3/25/2015	1.34	98.8	101.1	6.96	9.94	-0.07(0.0)	122.0(124.0)	0.108
BR	4/14/2015	1.392	99.9	100.8	6.91	9.94	0.07(0.0)	121.9(124.0)	0.104
BR	5/6/2015	1.281	99.3	100.4	6.99	10.04	0.1(0.0)	119.0(124.0)	0.036
BR	5/26/2015	1.4591	96.2	99.6	6.94	9.92	0.36(0.0)	120.19(124.0)	-0.039
BR	6/9/2015	1.355	103.9	99.9	7.06	10.1	0.0(0.0)	120.89(124.0)	-0.012
BR	6/30/2015	1.355	100.7	100.3	7.04	9.96	0.0(0.0)	123.2(124.0)	0.028
BR	7/14/2015	1.4673	99.9	100.6	7	9.99	0.34(0.0)	124.86(124.0)	0.029
BR	8/4/2015	1.3681	99.3	100.2	7.03	10.09	-0.36(0.0)	121.37(124.0)	0.02
BR	8/25/2015	1.4183	100.2	100.1	7.04	10.01	-0.15(0.0)	123.58(124.0)	0.057
BR	9/9/2015	1.418	98.8	100.1			0.34(0.0)	120.63(124.0)	0.015
BR	9/29/2015	1.4269	99.6	99.9	7.12	10.09	0.02(0.0)	123.76(124.0)	0.004
BR	10/14/2015	1.3893	100.4		7.03	10.03	-0.03(0.0)	122.42(124.0)	0.097
BR	11/3/2015	1.396	100.2	100.6	6.95	9.92	-0.29(0.0)	121.61(124.0)	0.055
BR	11/23/2015	1.396	100.4	100.4	7.04	10.06	0.01(0.0)	120.45(124.0)	0.017
BR	12/8/2015	1.433	100.3	99.9	6.92	9.97	0.03(0.0)	120.7(124.0)	-0.046
BR	12/21/2015	1.412	102.3	102.1	6.94	9.94	0.12(0.0)	119.8(124.0)	0.209
DR	3/25/2015	1.292	100.3	100.8	6.98	10.01	0.72(0.0)	121.6(124.0)	0.079
DR	4/16/2015	1.358	100.6	100.8	7	9.97	0.28(0.0)	125.31(124.0)	0.103
DR	5/6/2015	1.373	97.9	100.2	7.05	10.02	0.23(0.0)	118.62(124.0)	0.021
DR	5/26/2015	1.44	93.8	99.3	7.06	10.02	0.47(0.0)	120.2(124.0)	-0.062
DR	6/9/2015	1.399	107.5	100.2	7.22	10.25	1.06(0.0)	121.52(124.0)	0.015
DR	6/30/2015	1.394	100.7	100.3	7.04	9.99	0.7(0.0)	118.7(124.0)	0.027
DR	7/14/2015	1.4681	99	100.3	7.16	10.03	-0.01(0.0)	125.3(124.0)	0.031

DR	8/4/2015	1.3662	98.1	100.2	6.97	9.92	-0.88(0.0)	121.66(124.0)	0.026
DR	8/25/2015	1.4172	98.5	100	6.89	10.09	0.58(0.0)	122.22(124.0)	0.009
DR	9/9/2015	1.4292	98.1	100.1	6.95	9.96	0.37(0.0)	121.22(124.0)	0.006
DR	9/29/2015	1.379	98.7	100.1	7	9.99	-0.03(0.0)	123.7(124.0)	0.001
DR	10/14/2015	1.4505	101	100.9	7	10.01	0.03(0.0)	122.16(124.0)	0.089
DR	11/3/2015	1.364	99.6	100.7	7.01	10	-0.13(0.0)	122.01(124.0)	0.049
DR	11/23/2015	1.4676	100.4	100.3	7.01	10.01	0.06(0.0)	120.06(124.0)	0.018
DR	12/8/2015	1.448	100.3	99.9	6.99	9.97	-0.1(0.0)	121.91(124.0)	-0.041
DR	12/21/2015	1.365	103.4	102.1	7.02	9.98	0.28(0.0)	120.4(124.0)	0.205
OL	3/25/2015	1.334	101.8	101.1	6.99	10	1.3(0.0)	124.3(126.0)	0.111
OL	4/14/2015	1.367	100.6	100.8	7.01	10	-0.9(0.0)	122.5(126.0)	0.066
OL	5/6/2015	1.245	98.4	100.3	7.1	10.06	0.4(0.0)	120.4(126.0)	0.006
OL	5/26/2015	1.408	96.2	99.4	7.06	9.98	1.4(0.0)	123.6(126.0)	-0.07
OL	6/9/2015	1.369	103	100.1	7.04	10.13	0.8(0.0)	124.2(126.0)	0.024
OL	6/30/2015	1.383	98.7	98.7	7.04	10.02	-0.1(0.0)	123.6(126.0)	-0.144
OL	7/14/2015	1.358	93.7	100	7.05	9.93	0.4(0.0)	129.1(126.0)	0.024
OL	8/5/2015	1.346	95.1	100.2	6.96	9.98	0.4(0.0)	126.0(126.0)	0.015
OL	8/11/2015	1.411	100.3	99.7	7.06	9.93	-0.08(0.0)	121.37(124.0)	0.013
OL	8/25/2015	1.4289	100.8	100	7.12	10.12	-0.23(0.0)	122.88(124.0)	-0.002
OL	9/9/2015	1.3131	98.8	100	7	9.84	0.31(0.0)	121.74(124.0)	0
OL	9/29/2015	1.3898	100.4	99.9	7.02	10.02	-0.19(0.0)	123.51(124.0)	0.005
OL	10/14/2015	1.4238	100.7	101.1	7	10.01	-0.15(0.0)	122.38(124.0)	0.096
OL	11/3/2015	1.329	102	101.4	7	9.89	-0.06(0.0)	122.9(124.0)	0.151
OL	11/23/2015	1.4143	101.1	100.3	6.98	10.1	-0.06(0.0)	119.94(124.0)	0.017
OL	12/8/2015	1.427	99.5	99.2	6.99	9.88	0.02(0.0)	120.78(124.0)	-0.097
OL	12/22/2015	1.434	102.2	101.6	7	9.98	0.1(0.0)	120.35(124.0)	0.176
WM	3/25/2015	1.461	101.8	101.1	7.06	10.05	2.0(0.0)	125.5(126.0)	-0.007
WM	4/14/2015	1.32	100.8	100.8	7.02	10.03	0.1(0.0)	122.0(126.0)	-0.004
WM	5/6/2015	1.359	100.2	100.2	37.5	37.48	1.0(0.0)	121.6(126.0)	-0.009
WM	5/26/2015	1.459	100.2	99.8	7.02	9.94	0.6(0.0)	123.3(126.0)	0.001
WM	6/9/2015	1.144	101.3	100.3	7	10.01	1.1(0.0)	120.5(126.0)	-0.004
WM	6/30/2015	1.341	97.8	100.3	7.05	9.97	1.8(0.0)	123.6(126.0)	-0.012
WM	7/14/2015	1.321	100.8	100	7.06	9.97	0.4(0.0)	124.9(126.0)	-0.007
WM	8/4/2015	1.38	101.4	100	7.08	10.05	-0.1(0.0)	125.2(126.0)	-0.011
WM	8/25/2015	1.487	98.5	99.8	7.05	10.01	-0.3(0.0)	113.4(126.0)	-0.011
WM	9/9/2015	1.388	101.3	101.6	7.03	9.99	0.1(0.0)	127.4(126.0)	-0.015
WM	9/15/2015	1.451	97.5	100	7.04	10.02	-0.2(0.0)	120.3(126.0)	-0.002
WM	9/29/2015	1.416	99.3	100	7	10.01	0.0(0.0)	116.1(126.0)	-0.013
WM	10/14/2015	1.483	101.3	100	7	9.93	-0.5(0.0)	123.8(126.0)	-0.007
WM	11/3/2015	1.401	99.1	101.7	6.93	9.94	0.4(0.0)	127.0(126.0)	-0.015
WM	12/22/2015	1.452	102.1	101.7	6.92	9.98	0.4(0.0)	123.5(126.0)	-0.039

* after cleaning
¥ wiper problem

14. Other Remarks:

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 begin followed in March 2015 at the start of sampling.

QAQC Flagging notes

Barrier Beach Status

The water quality of the OL and WM sites at OWC are influenced by whether or not the barrier beach is open (i.e., surface exchange is occurring between the estuary and the lake). 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, 2015 – Sep. 30, 2015

Jan. 01 – March 11: open, frozen
March 12 – April 27: open, flowing
April 28 – May 03: closed
May 03 – May 10: open
May 11 – May 30: closed
May 31 – June 12: open
June 13 – June 14: closed
June 15 – July 29: open
July 30 – Aug 02: closed
Aug 03 – Aug 07: open
Aug 08 – Sep 03: closed
Sep 04 – Sep 11: open
Sep 12 – Dec 21: closed
Dec 22 – Dec 31: open

On 19 December, 2015, someone dug a trench in the barrier beach; on 21 December at approximately 8:30 pm, the water broke open the beach and water levels dropped dramatically in about four hours.

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). Seiche 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).

A rain even on 30 May led to a fairly rapid and relative large increase in water depth at the Route 6 (WM), Lower Estuary (OL), and Darrow Road (DR) sites; the pressure caused the barrier beach to breach during the evening of 31 May, leading to a rapid decrease in water levels at these sites.

Darrow Road (DR): large storm events appear to have caused the sonde to swing up due to high flows and record data at shallower depths on:

- from approximately 6/27 05:30 – 6/28 19:00
- from 7/9 07:00 – 7/10 03:30.

Lower Estuary (OL): Heavy rain and associated rise in water levels caused the sonde to rise up in the pvc trap around 6/27 and become suspended at that higher position until the sonde was exchanged on 6/30.

Water depth, turbidity, pH, and DO on 10/10/2015 look as though a rain event occurred. However, only about 0.5 mm of rain was recorded throughout the watershed.

A large weather event occurred from 12/22/2015 – 12/29/2015, causing strong winds (mostly from N and heavy rain. This caused water quality to be affected by precipitation at all sites and by seiche at the Lower Estuary (OL) and Route 6 (WM) sites.

<u>Depth (non-weather related)</u>

At Lower Estuary (OL) sonde was out of water occasionally during the 25 March deployment due to low water levels. Parameters appear to be affected by changes in water depth partially or fully exposing sensors to surface water or the air.

Darrow Road depth measurements throughout the 5/26 deployment were a little low compared to the previous and subsequent deployments. The pre-deployment calibration and post-deployment checks were very close to the barometric pressure offset, so the reason for the difference is unknown.

Darrow Road deployment depth decreased by ~0.3 m with the 11/23/2015 (10:45) deployment. The sonde hangs from a chain by a wire strung across the PVC trap. The wire broke during deployment; the first 15-minute reading reflects when the sonde was sitting on the bottom of the water column. The change in depth is due to having to attach the PVC trap to the chain directly.

Lower estuary (OL) 9/9/2015 and 11/23/2015 deployments: the sondes did not descend fully into the PVC pipe upon deployment. The sondes collected data at the incorrect depth on 9/9 from 10:30-12:15 EST and from 11/23 12:15 EST – 11/24 13:00 EST, when each was

repositioned correctly.

On the following dates and times, corrected depths indicated the depth sensor was in the water, yet other sensor data suggest the sensor(s) was (were) out of water:

1. OL 03/29 22:00 – 23:45: data for all sensors suggest an out of water event; all data were rejected.
2. OL 12/23 22:45 – 12/24 05:45: temperature and specific conductivity data for 12/23 22:00 through 12/24 06:30 suggest that the depth and temperature/conductivity sensors were out of water, so data for all parameters were rejected as a general out of water event.

The Route 6 (WM) sonde was very difficult to access due to high water levels and did not descend fully into the PVC pipe during the following two deployments: 9/29 – 10/14 and 11/03 – 11/24. Water quality profiles conducted during the summer of 2014 suggest that that water in this area is very well mixed, so the parameter values should, and appear to, reflect similar conditions despite the differences in deployment depths.

Depth on the Route 6 (WM) sonde was accidently corrected for barometric pressure during calibration for the 12/22/2015 deployment. This was corrected by adding the offset back in to the data. The offset originally used was -0.033 m, so 0.033 m was added to all data during this deployment.

Turbidity

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

pH

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

Sites/times affected:

BR:
10/14
11/3
11/23
12/21

DR:
11/23
12/8

At Route 6 (WM) the pH sensor malfunctioned from 12 May 19:15 through the end of the 6 May deployment.

Specific conductivity / Salinity

Minor drift in specific conductivity and salinity is marked on the final data point of the deployment as 1 SSD.

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.

Route 6 (WM) 25 August and 9 September deployments: an electrical problem caused the sondes to record data only sporadically between 9/3 – 9/9 and not at all between 9/9 – 9/15.

Due to unusually high water levels and cold water temperatures, the Route 6 (WM) sonde was retrieved via snorkeling on 11/24/2015 at 13:30 and was not re-deployed until 12/22/2015 at 12:00 when water levels had dropped significantly.

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 6600V2) 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)*	*Depth (meters)*	*pH*	*Turbid+ NTU*	*ODOsat (%)*	*ODO (mg/L)*
BR	pulled	4/14/2015	7:50:07	10.91	0.605	0.3	0.169	7.79	10.4	90.7	10.01
	deployed	4/14/2015	8:00:07	10.89	0.605	0.3	0.166	7.82	10.1	91.3	10.07
	pulled	5/6/2015	8:00:53	13.56	0.717	0.35	0.181	7.68	7.9	83.7	8.69
	deployed	5/6/2015	8:09:16	13.55	0.717	0.35	0.18	7.69	8.1	83.8	8.7
	pulled	5/26/2015	8:00:07	18.63	0.854	0.42	0.075	7.56	11.7	58	5.41
	deployed	5/26/2015	8:10:31	18.64	0.854	0.42	0.074	7.54	11.3	57.3	5.34
	pulled	6/9/2015	8:25:07	18.13	0.689	0.34	0.104	7.65	14	81.1	7.64
	deployed	6/9/2015	8:28:31	18.13	0.688	0.34	0.11	7.66	14.4	81	7.63
	pulled	6/30/2015	7:55:31	17.44	0.5	0.24	0.382	7.66	20	91.9	8.79
	deployed	6/30/2015	8:06:31	17.45	0.501	0.24	0.383	7.67	19.7	91.7	8.77
	pulled	7/14/2015	7:46:31	19.05	0.596	0.29	0.136	7.78	12.8	91.6	8.48
	deployed	7/14/2015	7:55:31	19.05	0.596	0.29	0.135	7.77	12.5	91.3	8.45
	pulled	8/4/2015	7:45:08	20.01	0.689	0.34	0.129	7.76	14.2	81.2	7.36
	deployed	8/4/2015	7:45:08	20.01	0.689	0.34	0.129	7.76	14.2	81.2	7.36
	pulled	8/25/2015	7:51:31	18.02	0.761	0.37	0.051	7.61	10	74.8	7.07
	deployed	8/25/2015	7:53:31	18.02	0.761	0.37	0.052	7.63	8.3	74.7	7.05
	pulled	9/9/2015	8:24:16	22.59	0.631	0.31	0.018	7.71	11.5	75.4	6.51
	deployed	9/9/2015	8:36:16	22.58	0.631	0.31	0.035	7.74	11.5	75.4	6.51
	pulled	9/29/2015	7:43:31	18.91	0.725	0.36	0.026	7.67	32.4	72.8	6.75
	deployed	9/29/2015	7:55:31	18.91	0.726	0.36	0.026	7.67	32.9	70.9	6.57
	pulled	10/14/2015	8:35:07	13.5	0.817	0.4	0.022	7.33	21.5	57	5.93
	deployed	10/14/2015	8:40:31	13.52	0.823	0.41	0.031	7.35	19.2	46.9	4.87
	pulled	11/3/2015	9:46:16	9.87	0.65	0.32	0.192	7.59	3.5	83.4	9.42
	deployed	11/3/2015	9:53:16	9.89	0.65	0.32	0.204	7.52	3.3	80.8	9.13
	pulled	11/23/2015	10:18:31	1.86	0.769	0.37	0.182	7.85	4.2	97	13.43
	deployed	11/23/2015	10:22:31	1.86	0.769	0.37	0.181	7.79	4.2	94.7	13.12
	pulled	12/8/2015	9:15:00	4.6	0.707			7.61	3.81	94.3	12.01
	deployed	12/8/2015	9:30:00	4.6	0.707			7.61	3.81	94.3	12.01
	pulled	12/21/2015	10:15:00	3.4	0.723			7.96	3.78	97.1	12.95
	deployed	12/21/2015	10:15:00	3.4	0.723			7.96	3.78	97.1	12.95
	pulled	1/5/2016	9:32:31	-0.03	0.617	0.29	0.463	8.13	4.5	97	14.17

DR	pulled	4/16/2015	10:34:16	10.88	0.603	0.29	0.518	7.98	10.6	90	9.94
	deployed	4/16/2015	10:37:16	10.92	0.602	0.29	0.526	7.99	10.8	90.2	9.94
	pulled	5/6/2015	8:30:53	14.99	0.714	0.35	0.578	7.61	25.4	73.2	7.36
	deployed	5/6/2015	8:35:53	14.99	0.714	0.35	0.592	7.61	25.6	72.3	7.28
	pulled	5/26/2015	8:45:31	17.66	0.859	0.42	0.65	7.6	17.1	63.1	6
	deployed	5/26/2015	8:57:31	17.68	0.858	0.42	0.652	7.58	19.2	61	5.8
	pulled	6/9/2015	8:46:31	19.22	0.665	0.32	0.265	7.64	26.6	66.3	6.11
	deployed	6/9/2015	8:58:31	19.23	0.672	0.33	0.269	7.67	27.4	65.8	6.07
	pulled	6/30/2015	8:23:31	17.58	0.493	0.24	0.531	7.65	25.5	88.5	8.44
	deployed	6/30/2015	8:38:31	17.58	0.494	0.24	0.531	7.65	26.4	88.4	8.43
	pulled	7/14/2015	8:13:31	19.47	0.586	0.29	1.02	7.71	19.5	86.1	7.9
	deployed	7/14/2015	8:25:31	19.46	0.587	0.29	1.038	7.7	18.8	85.9	7.88
	pulled	8/4/2015	8:15:08	21.3	0.705	0.34	1.047	7.67	13.9	61.8	5.46
	deployed	8/4/2015	8:15:08	21.3	0.705	0.34	1.047	7.67	13.9	61.8	5.46
	pulled	8/25/2015	8:12:31	20.67	0.649	0.32	1.26	7.45	12.5	55.4	4.96
	deployed	8/25/2015	8:20:31	20.69	0.651	0.32	1.272	7.52	17.4	47.6	4.26
	pulled	9/9/2015	8:51:16	23	0.583	0.28	0.445	7.49	20.5	43.9	3.76
	deployed	9/9/2015	9:01:16	22.93	0.578	0.28	0.476	7.45	38	36.8	3.16
	pulled	9/29/2015	8:13:31	19.4	0.552	0.27	0.434	7.51	0.6	68.1	6.25
	deployed	9/29/2015	8:25:06	19.36	0.552	0.27	0.437	7.52	0.9	66.4	6.1
	pulled	10/14/2015	8:55:07	14.78	0.671	0.33	0.88	7.28	5	29	2.93
	deployed	10/14/2015	9:07:31	14.88	0.671	0.33	0.89	7.28	5.5	21.5	2.17
	pulled	11/3/2015	10:08:16	9.92	0.576	0.28	1.132	7.28	11.4	58.1	6.56
	deployed	11/3/2015	10:14:16	9.93	0.576	0.28	1.136	7.28	12.6	53.4	6.03
	pulled	11/23/2015	10:38:31	6.18	0.742	0.36	0.977	7.56	3.6	62.9	7.77
	deployed	11/23/2015	10:53:31	6.23	0.742	0.36	1.004	7.59	4.7	59.4	7.34
	pulled	12/8/2015	9:30:00	4	0.697			8.01	3.9	102.6	13.43
	deployed	12/8/2015	10:15:00	4	0.697			8.01	3.9	102.6	13.43
	pulled	12/21/2015	10:30:00	5.2	0.721			7.89	5.05	82.6	10.51
	deployed	12/21/2015	10:30:00	5.2	0.721			7.89	5.05	82.6	10.51
	pulled	1/5/2016	9:53:31	0.14	0.548	0.26	0.466	7.94	5.9	91.6	13.32
OL	pulled	4/14/2015	9:06:31	12.71	0.649	0.32	0.362	7.86	71.7	91.1	9.65
	deployed	4/14/2015	9:15:08	12.69	0.649	0.32	0.35	7.83	70.8	89.1	9.44
	pulled	5/6/2015	9:20:53	14.15	0.497	0.24	0.803	7.58	59	67.8	6.96
	deployed	5/6/2015	9:24:16	14.18	0.499	0.24	0.806	7.57	38.5	67.5	6.92
	pulled	5/26/2015	10:33:31	22.58	0.766	0.37	0.686	7.81	47.8	78.2	6.75
	deployed	5/26/2015	10:43:31	22.72	0.766	0.37	0.69	7.81	46.4	79.3	6.83
	pulled	6/9/2015	10:00:07	19.74	0.479	0.23	0.656	7.98	59.8	93.1	8.5
	deployed	6/9/2015	10:10:31	19.56	0.466	0.22	0.663	7.94	58.2	96.4	8.83
	pulled	6/30/2015	9:37:31	18.28	0.462	0.22	0.969	7.52	44	76	7.14
	deployed	6/30/2015	9:52:31	18.29	0.46	0.22	0.965	7.49	41.7	74.5	7
	pulled	7/14/2015	9:17:31	20.78	0.469	0.23	0.992	7.51	46.8	70	6.26
	deployed	7/14/2015	9:35:07	21.43	0.455	0.22	0.9	7.5	28.2	64.7	5.71
	pulled	8/5/2015	10:45:53	23.88	0.355	0.17	0.831	7.77	27.2	66.3	5.59
	deployed	8/5/2015	10:57:16	23.83	0.362	0.17	1.074	7.68	160.3	60.7	5.12
	pulled	8/11/2015	13:20:16	24.95	0.451	0.22	0.813	7.43	19.7	50.1	4.14
	deployed	8/11/2015	13:20:16	24.95	0.451	0.22	0.813	7.43	19.7	50.1	4.14
	pulled	8/25/2015	9:20:07	22.26	0.52	0.25	0.635	7.45	18.2	48.5	4.22
	deployed	8/25/2015	9:27:31	22.3	0.52	0.25	0.661	7.43	17.8	47.7	4.14
	pulled	9/9/2015	9:45:51	25.35	0.405	0.19	0.47	7.35	22.1	36.2	2.97

	deployed	9/9/2015	9:53:16	25.25	0.397	0.19	0.479	7.35	24.9	37.5	3.08
	pulled	9/29/2015	9:13:31	20.81	0.486	0.23	0.956	7.45	8.5	66.7	5.96
	deployed	9/29/2015	9:20:31	20.77	0.485	0.23	0.95	7.42	9.7	64.1	5.74
	pulled	10/14/2015	9:52:31	15.34	0.476	0.23	1.057	7.58	16.9	71.4	7.14
	deployed	10/14/2015	9:57:31	15.4	0.476	0.23	1.065	7.56	20.9	70.4	7.03
	pulled	11/3/2015	11:09:16	11.66	0.503	0.24	1.167	7.43	8.3	64.7	7.02
	deployed	11/3/2015	11:16:16	11.63	0.503	0.24	1.172	7.43	8.4	62.6	6.79
	pulled	11/23/2015	11:40:07	5.39	0.57	0.28	1.141	7.87	5.9	91.2	11.51
	deployed	11/23/2015	11:43:31	5.39	0.57	0.28	0.847	7.85	6.2	89.3	11.27
	pulled	12/8/2015	10:30:00	4.8	0.576			7.84	4.33	80.35	10.32
	deployed	12/8/2015	10:45:00	4.8	0.576			7.84	4.33	80.35	10.32
	pulled	12/22/2015	11:58:16	6.55	0.642	0.31	0.088	7	28.6	41.6	5.1
	deployed	12/22/2015	11:58:16	6.55	0.642	0.31	0.088	7	28.6	41.6	5.1
	pulled	1/5/2016	11:08:31	0.65	0.485	0.23	0.485	7.72	18.9	88.2	12.64
WM	pulled	4/14/2015	9:30:31	12.5	0.631	0.31	0.322	7.82	68.6	88.3	9.39
	deployed	4/14/2015	9:38:31	12.61	0.626	0.31	0.307	7.81	59.4	88.7	9.41
	pulled	5/6/2015	9:36:16	13.57	0.422	0.2	0.621	7.7	57.3	84.6	8.79
	deployed	5/6/2015	9:41:16	13.62	0.425	0.21	0.622	7.69	51.8	82.5	8.56
	pulled	5/26/2015	10:55:07	22.76	0.768	0.38	0.469	7.73	45.5	78.2	6.72
	deployed	5/26/2015	11:01:31	22.84	0.768	0.38	0.472	7.73	44.8	70.2	6.03
	pulled	6/9/2015	10:26:31	19.54	0.425	0.2	0.506	8.04	42.1	96.3	8.83
	deployed	6/9/2015	10:35:31	19.6	0.428	0.21	0.511	8.07	54.8	102.3	9.36
	pulled	6/30/2015	10:06:31	19.5	0.416	0.2	1.133	7.48	37.2	67	6.15
	deployed	6/30/2015	10:30:31	19.66	0.423	0.2	1.125	7.45	33.8	65.3	5.97
	pulled	7/14/2015	9:47:31	21.53	0.414	0.2	1.076	7.6	23.4	83.2	7.33
	deployed	7/14/2015	9:58:31	21.48	0.428	0.21	1.083	7.58	22.2	78.4	6.92
	pulled	8/4/2015	9:15:08	24.16	0.354	0.17	1.047	7.79	23.9	80.4	6.74
	deployed	8/4/2015	9:15:08	24.16	0.354	0.17	1.047	7.79	23.9	80.4	6.74
	pulled	8/25/2015	9:43:31	22.49	0.522	0.25	1.375	7.38	15.6	40.7	3.52
	deployed	8/25/2015	9:55:31	22.45	0.522	0.25	1.643	7.29	13.9	32.4	2.81
	pulled	9/9/2015	10:35:51	24.61	0.29	0.14	0.677	8.22	20.6	91.5	7.61
	deployed	9/9/2015	10:40:51	24.62	0.291	0.14	0.69	8.2	16	91.4	7.6
	pulled	9/25/2015	9:40:31	20.67	0.482	0.23	1.35	7.4	935.6	58.7	5.26
	deployed	9/25/2015	9:55:31	20.7	0.482	0.23	1.352	7.41	611.9	62.2	5.57
	pulled	10/14/2015	10:07:00	15.6				7.61		62.7	6.15
	deployed	10/14/2015	10:07:00	15.6				7.61		62.7	6.15
	pulled	11/3/2015	12:04:16	12.03	0.504	0.25	1.658	7.53	20.5	73.8	7.94
	deployed	11/3/2015	12:11:16	11.96	0.504	0.24	1.667	7.5	62.8	71.5	7.7
	pulled	11/24/2016	15:15:00								
	deployed	12/22/2015	12:10:52	7.14	0.683	0.33	0.109	7	42.2	44.3	5.35
	pulled	1/5/2016	11:30:09	0.78	0.505	0.24	0.569	7.89	67.3	88.3	12.61