

Kachemak Bay Research Reserve (KAC) NERR Water Quality Metadata
January – December 2022
Latest Update: 07/24/2024

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons

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2) Entry verification

Deployment data are uploaded from the YSI data logger to a Personal Computer (IBM compatible). Files are exported from EcoWatch in a comma-delimited format (.CDF) , EcoWatch Lite in a comma separated file (CSV) or 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. Jim Schloemer and Chris Guo were responsible for these tasks.

3) Research objectives

The YSI electronic data loggers are programmed to measure the water temperature, specific conductivity, dissolved oxygen, depth, pH, and turbidity conditions at 15-minute intervals. In Kachemak Bay, there are two permanent water quality monitoring stations (Homer and Seldovia), each having two data sondes. One site is located on the northeast side of the Bay at the end of the Homer Spit, and the other on the southwest side of the Bay in Seldovia. At each site, one data logger is suspended 1-meter below the surface ("Surface"), and one data logger is suspended 1-meter from the bottom ("Deep"). At both locations the surface sondes are horizontally within 100 meters of the deep sondes.

The circulation in Kachemak Bay is driven primarily by the 8-meter tidal flux. Regional circulation is characterized by generally cyclonic ocean currents in the Gulf of Alaska flowing onto the shelf off of Cook Inlet. Nutrient rich bottom water is upwelled and mixed with surface water. These enriched waters may enter into Kachemak Bay, the inflow tending to stay along the southern shore flowing past the Seldovia instruments, while water flowing out of the bay stays

along the Inner Bay and north shore, flowing past the Homer instruments. These trapped coastal flows separate the bay into two distinct ecosystems, and the instruments are positioned to reflect this distinction. Within each system there is vertical stratification of the water. The vertical placement of the sondes is designed to help elucidate the differences in circulation of the surface and deep waters.

As the inflowing water proceeds up the bay, fresh water runoff from the surrounding ice fields and watersheds dilute the salinity and increase the sediment load in the path of the Homer instruments. The in-flowing water, in the path of the Seldovia instruments, initially supports a marine system, while the northern out-flowing water of the Homer instruments is more estuarine. The Kachemak Bay water quality instruments capture this difference with deployments along the north and south shores. These data will be used to supplement studies on primary productivity, larval distribution, settlement, recruitment, growth rates, community dynamics, and biodiversity in the bay.

4) Research methods

Both telemetered instruments (“Deep”) are stationary and housed in ABS pipe mounted vertically on the ferry docks of Homer and Seldovia. The pipes are positioned to ensure that the sensors are approximately 1-meter above the bottom of the ocean floor (actual depth changes with respect to the tides). The surface sondes are attached to a buoy and a sonde guard that slides vertically on a cable to ensure that the sonde remains 1-meter below the surface as the tide is changing.

Calibration and deployment were performed monthly using methods outlined in the YSI Operations Manual. The following sensors are calibrated using standards purchased from YSI: pH (7 and 10), conductivity (50 mS/cm), and turbidity (126 NTU). Depth is calibrated at zero.

The Chlorophyll probe is calibrated at zero in DI water. QA/QC of this parameter is conducted by comparing sonde data to our monthly grab samples that are analyzed on a Turner 10-AU Spectrophotometer (see Nutrient data/metadata for 2017). Sonde data are accepted or rejected based on this comparison. The estimates of chlorophyll concentration produced by the YSI chlorophyll probe are meant to complement the more accurate results obtained by the monthly grab samples.

A Sutron Sat-Link2 transmitter was installed at the Homer Dolphin Deep station on 12/13/2005 and transmits data to the NOAA GOES satellite, NESDIS ID # 3B00077A WQ. A Sutron Sat-Link2 transmitter was installed at the Seldovia Deep station on 07/31/2007 and transmits data to the NOAA GOES satellite, NESDIS ID # 3B040240 WQ. 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

Kachemak Bay is located approximately 200 kilometers south of Anchorage on the western shore of the Kenai Peninsula. Kachemak Bay, at 59.6° N and 151.5° W, is a temperate regional fjord with hydrographic conditions unique among the NERR system estuaries. The tidal range of 8-meters is among the largest in the world, and salinity ranges from near zero at stream mouths to 33.3 PSU at the entrance to the inner Bay. The bay is 35 kilometers wide at its mouth and approximately 57 kilometers long. The head of Kachemak Bay is located to the northeast at the Fox River Flats, and the mouth lies to the southwest, along a line between Anchor Point and Point Pogibshi. The 6-kilometer long Homer Spit that extends into the Bay from the northern shoreline splits Kachemak Bay into inner and outer bays. The Kachemak Bay NERR encompasses both the inner and outer bays. Water flows between the inner and outer Bays through a narrow opening formed between the Spit and the southern shoreline. The Bay has an average depth of 41-meters, and a maximum of 169-meters. Fresh water introduced primarily by the Fox, Bradley, and Martin Rivers and Sheep Creek at the head of the Bay, flows along the northwest shore of the inner Bay.

The Homer YSI data logger site is located on the north side of Kachemak Bay at 59.60203°N 151.40877°W. The “deep” sonde is deployed at a depth 1 meter from the bottom, in water fluctuating between 7.5 and 16.8 meters. The “surface” data sonde is deployed at a nominal depth of 1 meter. The bottom habitat is predominantly sand. Pollutants in the area are from the excessive boat traffic at the entrance of the Homer harbor, and a nearby fish waste outfall line. Throughout the year, salinity has ranged from 20.5 to 32.4 ppt, as the instrument's location in the stratified water column is dependent on tide height, with a tidal range of 8.1 meters. It is predominately an estuarine environment during summer months when glacial runoff is highest, and during the winter months it reverts to a more marine-like system with glacial runoff at a minimum.

The Seldovia YSI data logger site is located on the south side of Kachemak Bay at 59.44097°N 151.72089°W, approximately 25 kilometers southwest of the Homer site. As with the Homer site, the data loggers are situated on the ferry terminal dock, with one instrument 1 meter below the surface, and one 1 meter above the bottom, in water fluctuating between 4.3 and 13.0 meters. The access to Seldovia is limited to boat or air, as the site is located off the highway system. The bottom habitat is predominantly sand. Pollutants in the area are minimal. Throughout the year, salinity has ranged from 25.0 to 33.9 ppt at this site with a tidal range of 8.0 meters.

SWMP Station Timeline

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
kach3wq	p	Homer Surface 3	59° 36' 7.38 N, 151° 24' 33.90 W	05/31/2012 12:15 -	NA	NA
kachdwq	P	Homer Dolphin Deep	59° 36' 7.24 N, 151° 24' 31.61 W	01/01/2003 00:00 -	NA	NA
kacsdwq	P	Seldovia Deep	59° 26' 27.56 N, 151° 43' 15.46 W	01/01/2004 00:00 -	NA	NA
kacsswq	P	Seldovia Surface	59° 26' 27.56 N, 151° 43' 15.46 W	01/01/2004 00:00 -	NA	NA
kacbcwq	P	Bear Cove	59° 42' 20.41 N, 151° 3' 33.84 W	06/18/2002 11:30 - 09/24/2003 17:30	Change in research questions and difficult access.	Site was seasonal, because access was too difficult in winter.
kacdlwq	P	Homer Dolphin	59° 36' 7.24 N, 151° 24' 31.61 W	10/24/2002 10:00 - 12/31/2002 23:30	Just renamed to kachdwq.	Exact same site as kachdwq. Naming convention changed when installing paired surface-deep sondes.
kachowq	P	Homer	59° 36' 8.34 N, 151° 24' 36.00 W	07/12/2001 07:45 - 11/20/2002 12:30	On city dock. City built a newer dock surrounding old one.	1 meter off bottom, 62 meters from current kachdwq site. Data overlaps kacdlwq site in late 2002. Old mount destroyed by storm November 2002.
kachswq	P	Homer Dolphin Surface	59° 36' 7.24 N, 151° 24' 31.61 W	02/13/2004 09:30 - 11/28/2011 16:00	Sonde was getting destroyed by banging against pilings. Moved 35 meters.	Essential equivalent to kach3wq. Site was relocated to a safer location for the sonde in rough seas.
kacpgwq	P	Port Graham	59° 22' 13.91 N, 151° 53' 46.03 W	06/21/2002 10:00 - 09/24/2003 15:30	Change in research questions and difficult access.	Site was seasonal, because access was too difficult in winter.
kacsewq	P	Seldovia	59° 26' 27.56 N, 151° 43' 15.46 W	08/17/2001 15:15 - 12/31/2003 23:30	Just renamed to kacsdwq.	Exact same site as kacsdwq. Naming convention changed when installing paired surface-deep sondes.

6) Data collection period – Included in annual metadata document.

Monitoring at Homer Deep, Seldovia Deep, and Seldovia Surface was continuous throughout 2022. The Homer Surface site was sampled from 03/23/2022 and was removed during the winter months when ice formed on the surface waters at this site. Deployment and retrieval dates and times for 2022 are listed below:

Homer Surface 3

Loc	Deploy Start Time		Retrieve End Time		Sonde	pH		DO	Turb	Cond	Chl	Notes
H3	3/16/2022	15:45	4/27/2022	15:00	EXO2 (X-Ray)	599701		599100-01	599101-01	599827	599103-01	
H3	4/27/2022	15:30	6/02/2022	10:15	EXO2 (Papa)	599701		599100-01	599101-01	599827	599103-01	
H3	6/02/2022	11:00	6/20/2022	14:45	EXO2 (X-Ray)	599701		599100-01	599101-01	599827	599103-01	
H3	6/20/2022	16:15	7/18/2022	10:30	EXO2 (Papa)	599701		599100-01	599101-01	599827	599103-01	
H3	7/18/2022	10:45	8/12/2022	12:30	EXO2 (X-Ray)	599701		599100-01	599101-01	599827	599103-01	
H3	8/12/2022	13:00	9/14/2022	09:15	EXO2 (Papa)	599701		599100-01	599101-01	599827	599103-01	
H3	9/14/2022	10:00	10/12/2022	12:30	EXO2 (X-Ray)	599701		599100-01	599101-01	599827	599103-01	
H3	10/12/2022	13:00	11/18/2022	13:15	EXO2 (Papa)	599701		599100-01	599101-01	599827	599103-01	
H3	11/18/2022	13:45	12/22/2022	14:00	EXO2 (X-Ray)	599701		599100-01	599101-01	599827	599103-01	
H3	12/22/2022	14:30	01/17/2023	17:45	EXO2 (Papa)	599701		599100-01	599101-01	599827	599103-01	

Homer Deep

Loc	Deploy Start Time		Retrieve End Time		Sonde	pH		DO	Turb	Cond	Notes
HD	12/09/2021	13:00	01/19/2022	14:30	EXO2 (Romeo)	599702		599100-01	599101-01	599827	
HD	4/27/2022	15:15	6/2/2022	11:30	EXO2 (Romeo)	599702		599100-01	599101-01	599827	
HD	6/2/2022	11:45	6/20/2022	14:45	EXO2 (Sierra)	599702		599100-01	599101-01	599827	
HD	6/20/2022	15:00	7/18/2022	10:00	EXO2 (Romeo)	599702		599100-01	599101-01	599827	
HD	7/18/2022	10:30	8/12/2022	12:15	EXO2 (Sierra)	599702		599100-01	599101-01	599827	
HD	8/12/2022	12:45	9/14/2022	9:15	EXO2 (Romeo)	599702		599100-01	599101-01	599827	
HD	9/14/2022	9:30	10/12/2022	12:15	EXO2 (Sierra)	599702		599100-01	599101-01	599827	
HD	10/12/2022	12:30	11/18/2022	13:00	EXO2 (Romeo)	599702		599100-01	599101-01	599827	
HD	11/18/2022	13:15	12/22/2022	14:00	EXO2 (Sierra)	599702		599100-01	599101-01	599827	
HD	12/22/2022	14:15	01/17/2023	13:45	EXO2 (Romeo)	599702		599100-01	599101-01	599827	Sonde power failure – no data

Seldovia Surface

Loc	Deploy Start Time		Retrieve End Time		Sonde	pH		DO	Turb	Cond	Chl	Notes
SS	12/17/2021	13:45	1/20/2022	12:00	EXO2 (Whiskey)	599702		599100-01	599101-01	599827	599103-01	
SS	1/20/2022	12:30	2/23/2022	9:45	EXO2 (Gandalf)	599701		59100-01	599101-01	599827	599103-01	
SS	2/23/2022	10:15	3/18/2022	11:00	EXO2 (Whiskey)	599702		599100-01	599101-01	599827	599103-01	
SS	3/18/2022	11:30	4/29/2022	9:30	EXO2 (Gandalf)	599701		59100-01	599101-01	599827	599103-01	
SS	4/29/2022	10:00	5/30/2022	9:45	EXO2 (Whiskey)	599702		599100-01	599101-01	599827	599103-01	
SS	5/30/2022	10:15	6/20/2022	9:15	EXO2 (Gandalf)	599701		59100-01	599101-01	599827	599103-01	
SS	6/20/2022	9:45	7/23/2022	9:00	EXO2 (Whiskey)	599702		599100-01	599101-01	599827	599103-01	
SS	7/23/2022	9:30	8/11/2022	9:15	EXO2 (Gandalf)	599701		59100-01	599101-01	599827	599103-01	
SS	8/11/2022	9:45	9/13/2022	13:45	EXO2 (Whiskey)	599702		599100-01	599101-01	599827	599103-01	
SS	9/13/2022	14:15	10/24/2022	10:30	EXO2 (Gandalf)	599701		59100-01	599101-01	599827	599103-01	
SS	10/24/2022	11:15	11/17/2022	10:45	EXO2 (Whiskey)	599702		599100-01	599101-01	599827	599103-01	
SS	11/17/2022	12:00	12/21/2022	11:00	EXO2 (Gandalf)	599701		59100-01	599101-01	599827	599103-01	
SS	12/21/2022	11:30	01/12/2023	10:45	EXO2 (Whiskey)	599702		599100-01	599101-01	599827	599103-01	

Seldovia Deep

Loc	Deploy Start Time		Retrieve End Time		Sonde	pH		DO	Turb	Cond	Notes
SD	12/17/2021	13:45	1/20/2022	12:00	EXO2 (Taxi)	599702		599100-01	599101-01	599827	
SD	1/20/2022	12:15	2/23/2022	9:45	EXO2 (Valence)	599702		599100-01	599101-01	599827	
SD	2/23/2022	10:00	3/18/2022	10:45	EXO2 (Taxi)	599702		599100-01	599101-01	599827	
SD	3/18/2022	11:15	4/29/2022	9:30	EXO2 (Valence)	599702		599100-01	599101-01	599827	
SD	4/29/2022	9:45	5/30/2022	9:45	EXO2 (Taxi)	599702		599100-01	599101-01	599827	
SD	5/30/2022	10:00	6/20/2022	9:00	EXO2 (Valence)	599702		599100-01	599101-01	599827	
SD	6/20/2022	9:30	7/23/2022	8:45	EXO2 (Taxi)	599702		599100-01	599101-01	599827	
SD	7/23/2022	9:15	8/11/2022	9:15	EXO2 (Valence)	599702		599100-01	599101-01	599827	
SD	8/11/2022	9:30	9/13/2022	13:45	EXO2 (Taxi)	599702		599100-01	599101-01	599827	
SD	9/13/2022	14:00	10/24/2022	10:30	EXO2 (Valence)	599702		599100-01	599101-01	599827	
SD	10/24/2022	10:45	11/17/2022	10:45	EXO2 (Taxi)	599702		599100-01	599101-01	599827	
SD	11/17/2022	11:00	12/21/2022	10:45	EXO2 (Valence)	599702		599100-01	599101-01	599827	
SD	12/21/2022	11:15	01/12/2023	10:45	EXO2 (Taxi)	599702		599100-01	599101-01	599827	

7) Distribution

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The NERRS retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the NERR site where the data were collected should 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 by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government 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:

NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: <http://www.nerrsdata.org/>; accessed 12 October 2022.

NERR water quality data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal Investigators and Contact Persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page www.nerrsdata.org. Data are available in comma delimited format.

8) Associated researchers and projects

The data are being combined with hydrographic survey data to examine water exchange between Kachemak Bay and Lower Cook Inlet. The sonde data provides the temporal context while the survey data provides the spatial information.

In addition, these data complement the other concurrent System-Wide Monitoring Program modules such as meteorological and nutrient data collection.

II. Physical Structure Descriptors

Sensor specifications, continued (YSI EXO sondes):

Parameter	Units	Sensor Type	Model	Range	Accuracy	Resolution
Temperature	Celsius (C)	Wiped probe; Thermistor	599827	-5 to 50 °C	±0.2 C	0.001 C
Conductivity	milli-Siemens per cm (mS/cm)	CT2 probe, 4- electrode cell with autoranging	599870	0 to 200 mS/cm	0 to 100: +/- 0.5% of reading or 0.001 mS/cm; 100 to 200: +/- 1% of reading	0.001 mS/cm to 0.1 mS/cm (range dependant)
Salinity	practical salinity units (psu)/parts per thousand (ppt)	CT2 probe, Calculated from conductivity and temperature		0 to 70 psu	+/- 1.0% of reading pr 0.1 ppt, whichever is greater	0.01 psu
Dissolved Oxygen %	percent air saturation (%)	Optical probe w/ mechanical cleaning	599100- 01	0 to 500% air saturation	0-200% air saturation: +/- 1% of the reading or 1% air saturation, whichever is greater 200-500% air saturation: +/- 5% or reading	0.1% air saturation
Dissolved Oxygen mg/L	milligrams per Liter (mg/L); Calculated from % air saturation, temp and salinity	Optical probe w/ mechanical cleaning	599100- 01	0 to 50 mg/L	0-20 mg/L: +/-0.1 mg/l or 1% of the reading, whichever is greater 20 to 50 mg/L: +/- 5% of the reading	0.01 mg/L
Depth	feet or meters (m)	Stainless steel strain gauge		0 to 30 ft (9.1 m)	: +/- 0.013 ft (0.004 m)	0.001 ft (0.001 m)
pH	pH units	Glass combination electrode	599701 and 599702	0 to 14 units	+/- 0.1 units within +/- 10° of calibration temperature, +/- 0.2 units for entire temperature range	0.01 units
Turbidity	formazin nephelometric units (FNU)	Optical, 90 ° scatter, with mechanical cleaning	599101- 01	0 to 4000 FNU	0 to 999 FNU: 0.3 FNU or +/-2% of reading (whichever is greater); 1000 to 4000 FNU +/-5% of reading	0 to 999 FNU: 0.01 FNU, 1000 to 4000 FNU: 0.1 FNU
Chlorophyll	micrograms/Liter (µg/L)	Optical probe w/ mechanical cleaning	599102- 01	~0 to 400 µg/L	Dependent on methodology	0.1 ug/L chl a, 0.1% FS

Sensor specifications, continued (YSI 6600EDS V2-2 and 660 V2-4 data sondes):

Parameter	Units	Sensor Type	Model	Range	Accuracy	Resolution
Temperature	Celsius (C)	Thermistor	6560	-5 to 50 °C	+/-0.15 °C	0.01 °C
Conductivity	milli-Siemens per cm (mS/cm)	4-electrode cell with autoranging	6560	0 to 100 mS/cm	+/-0.5% of reading + 0.001 mS/cm	0.001 mS/cm to 0.1 mS/cm (range dependent)
Salinity	parts per thousand (ppt)	Calculated from conductivity and temperature		0 to 70 ppt	+/- 1.0% of reading or 0.1 ppt, whichever is greater	0.01 ppt
Dissolved Oxygen %	percent air saturation (%)	Rapid Pulse – Clark type, polarographic	6562	0 to 500 % air saturation	0-200 % air saturation, +/- 2 % of the reading or 2 % air saturation, whichever is greater; 200-500 % air saturation, +/- 6 % of the reading	0.1 % air saturation
Dissolved Oxygen mg/L	milligrams per Liter (mg/L); Calculated from % air saturation, temp and salinity	Rapid Pulse – Clark type, polarographic	6562	0 to 50 mg/L	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	0.01 mg/L
Dissolved Oxygen %	% Saturation	Optical probe w/ mechanical cleaning	6150 ROX	0 to 500% air saturation	0-200% air saturation: +/- 1% of the reading or 1% air saturation, whichever is greater; 200-500% air saturation: +/- 15% of reading	0.1% air saturation
Dissolved Oxygen mg/L	milligrams/Liter (mg/L)	Optical probe w/ mechanical cleaning	6150 ROX	0 to 50 mg/L	0-20 mg/L: +/-0.1 mg/L or 1% of the reading, whichever is greater; 20 to 50 mg/L: +/- 15% of the reading	0.01 mg/L
Depth	feet or meters (m)	Stainless steel strain gauge		0 to 30 ft (9.1 m)	+/- 0.06 ft (0.018 m)	0.001 ft (0.001 m)
pH	pH units	Glass combination electrode	6561 and 6561FG	0 to 14 units	+/- 0.2 units	0.01 units
Turbidity	nephelometric turbidity units (NTU)	Optical, 90 ° scatter, with mechanical cleaning	6136	0 to 1000 NTU	+/- 2 % reading or 0.3 NTU (whichever is greater)	0.1 NTU
Chlorophyll	micrograms/Liter (µg/L)	Optical probe w/ mechanical cleaning	6025	~0 to 400 µg/L 0 to 100 RFU	The accuracy of the in vivo measurement will be completely dependent on the method of calibration	0.1 µg/L Chl 0.1% RFU

Depth Qualifier:

The NERR System-Wide Monitoring Program utilizes 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 can be corrected.

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:

$$((1013-BP)*0.0102)+\text{Depth/Level} = \text{cDepth/cLevel}.$$

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 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.

Chlorophyll Fluorescence Disclaimer:

YSI chlorophyll sensors (6025 or 599102-01) are designed to serve as a proxy for chlorophyll concentrations in the field for monitoring applications and complement traditional lab extraction methods; therefore, there are accuracy limitations associated with the data that are detailed in the YSI manual including interference from other fluorescent species, differences in calibration method, and effects of cell structure, particle size, organism type, temperature, and light on sensor measurements.

10) Coded variable definitions

File name definitions: Reserve/deployment site/file definition/year
(ex: kacsswq2017 = Kachemak Bay/Seldovia Surface/WaterQuality/2017).

Sampling station	Sampling site code	Station code
Homer Surface	H3	kach3wq
Homer Deep	HD	kachdwq
Seldovia Surface	SS	kacsswq
Seldovia Deep	SD	kacsdwq

11) QAQC flag definitions

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 is 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 Optional SWMP Supported Parameter
- 0 Data Passed Initial QAQC Checks
- 1 Suspect Data
- 2 *Open - reserved for later flag*
- 3 Calculated data: non-vented depth/level sensor correction for changes in barometric pressure
- 4 Historical Data: Pre-Auto QAQC
- 5 Corrected Data

12) QAQC code definitions – This section details the secondary QAQC Code definitions used in combination with the flags above. Include the following excerpt:

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

the 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

Homer Surface (H3):

Site	Deploy Date	Sonde	SpCond (50mS/cm)		DO (%)	pH (7)	pH (10)		Turb (0 NTU)	Turb (124 NTU)	Depth (m)	Chl (0)	Chl (118)
H3	3/14/2022	X-Ray	49.84		98.3	7.02	10.01		2.24	286.42	-0.014	0.35	60.62
H3	4/24/2022	Papa	50.14		99.8	7.07	10.19		1.17	124.8	-0.077	0.02	0.02
H3	6/2/2022	X-Ray	50.25		99.8	7.03	9.94		0.99	122.39	-0.015	0.016	78.91
H3	6/20/2022	Papa	50.267		99.8	7	9.83		1.74	127.06	0.016	-0.15	60.49
H3	7/18/2022	X-Ray	49.915		99.9	7.09	10.08		1.84	129.41	-0.082	-0.02	50.89
H3	8/12/2022	Papa	50.141		98.1	7.03	10.21		2.36	126.75	-0.12	0.34	91.6
H3	9/14/2022	X-Ray	49.469		96.6	13.98	14.6		1.12	130.04	-0.282	0.12	61.64
H3	10/12/2022	Papa	49.015		97.8	6.96	10.01		1.96	123.48	-0.192	0.59	70.84
H3	11/18/2022	X-Ray	49.076		97.7	7.21	10.28		1.56	124.14	-0.442	-0.15	73.47
H3	12/22/2022	Papa	50.008		98.1	7.0	9.98		0.68	124.05	-0.252	-0.18	66.89

Homer Deep (HD):

Site	Deploy Date	Sonde	SpCond (50 mS/cm)			DO (%)		pH (7)	pH (10)		Turb (0 NTU)	Turb (126 NTU)	Depth (m)	Notes
HD	1/17/2022	Sierra												No sonde deployed
HD	3/14/2022	Romeo												No sonde deployed
HD	4/27/2022	Romeo	49.960			98.9		7.03	10.04		0.89	123.25	-0.08	
HD	6/2/2022	Sierra	50.210			100.1		7.03	9.96		0.25	123.25	0.017	
HD	6/22/2022	Romeo	50.278			102.6		11.25	13.17		0.79	124.15	0.101	
HD	7/18/2022	Sierra	50.052			98.3		7.02	10.09		1.16	127.88		
HD	8/12/2022	Romeo	50.191			99.4		7.19	10.36		0.05	125.04	-0.136	
HD	9/14/2022	Sierra	49.920			97.7		7.01	10.24		0.26	130.14	-0.269	
HD	10/12/2022	Romeo	49.213			97.3		7.08	10.16		-0.16	118.02	-0.169	
HD	11/18/2022	Sierra	49.422			97.7		7.08	10.08		3.22	123.6	-0.415	
HD	12/22/2022	Romeo												Sonde power failure – no data

Seldovia Surface (SS):

Site	Deploy Date	Sonde	SpCond (50 mS/cm)			DO (%)		pH (7)	pH (10)		Turb (0 NTU)	Turb (124 NTU)	Depth (m)	Chl (0)	Chl (118)
SS	1/17/2022	Gandalf	49.76			100.5		7.05	10.12		2.8	127.79	-0.51	-0.15	73.12
SS	2/14/2022	Whiskey	46.54			97.6		7.13	10.2		246.42	130.83	-0.24		
SS	3/23/2022	Gandalf	49.8			99.8		7.02	9.85		97.75	222.78	0.006	16.14	65.42
SS	4/24/2022	Whiskey	49.96			98.6		7.02	10.07		0.63	123.6	-0.079	0.02	78.43
SS	5/30/2022	Gandalf	9.98			100.1		7.03			0.014	125.26	0.019	0.01	61.44
SS	6/20/2022	Whiskey	50.306			101.2		7	9.82		0.83	127.86	0.109	0.2	71.5
SS	7/23/2022	Gandalf	49.885			99.4		7.01	10.02		0.63	129.67	-0.077	-0.02	51.5
SS	8/11/2022	Whiskey				96.8		7.08	10.23		0.82	126.2	-0.133	0.02	88.35
SS	9/13/2022	Gandalf	49.986			94.7		7.03	10.13		1.02	133.56	-0.544	2.85	63.44
SS	10/24/2022	Whiskey	49.085			97.7		7.06	10.09		-0.25	123.8	-0.181	-0.02	72.66
SS	11/17/2022	Gandalf	49.350			69.9		7.02	10.02		0.62	125.68	-0.451	-0.02	70.85
SS	12/21/2022	Whiskey	49.797			98.3		7.01	10.06		0.32	124.04	-0.262	0.01	68.54

Seldovia Deep (SD):

Site	Deploy Date	Sonde	SpCond (50 mS/cm)		DO (%)		pH (7)	pH (10)		Turb (0 NTU)	Turb (124 NTU)	Depth (m)
SD	1/17/2022	Valence	52.500		99.5		6.78	10		1.6	123.95	-0.2
SD	2/23/2022	Taxi	50.11		97.4		7.17	10.23		0.67	131.92	-0.24
SD	3/14/2022	Valence	50.15		98.5		7.15	10.27		2.28	296.09	0.246
SD	4/29/2022	Taxi	49.96		99.6		7.03	10.06		0.86	125.32	-0.087
SD	5/30/2022	Valence	50.03				7.03	9.99		1.2	122.39	0.018
SD	6/20/2022	Taxi	50.464		101.1		6.9	9.75		1.46	127.33	0.136
SD	7/23/2022	Valence			98.3		7.03	10.06		0.54	128.08	-0.081
SD	8/11/2022	Taxi	50.067		98.1		7.04	10.12		0.06	125.75	-0.131
SD	9/13/2022	Valence	50.008		94.3		7.05	10.18		1.35	134.56	-0.545
SD	10/24/2022	Taxi	49.139		97.1		7.18	10.17		-0.11	124.32	-0.167
SD	11/17/2022	Valence	48.895		96.7		7.03	10.00		1.27	125.28	-0.401
SD	12/21/2022	Taxi	50.163		97.1		7.0	9.9		0.3	124.82	-0.264

14) Other remarks/notes

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. Any NaNs in the dataset stand for “not a number” and are the result of low power, disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.

Homer Surface (H3)

Homer Surface site moves up and down on a cable. Sometimes the sonde gets hung-up on the cable, causing out of water events. <1.0-meter and >0.1-meter data are retained.

Chlorophyll

11/18/22 13:45 – 12/22/22 14:00, <-3> SSM, rejected due to sensor malfunction causing negative values during entire deployment, cause unknown

pH

9/6/22 8:30 – 9/10/22 4:15, <1> CSM, data during this period exhibit sharp jump in pH mV continuity; however, values were not unrealistic, thus data were marked suspect

10/1/22 19:00 – 10/12/22 12:30, <-3> SSM, rejected due to sensor malfunction

10/12/22 13:00 – 10/21/22 2:45, <-3> SQR, rejected due to cause unknown; data exhibit abnormally low values relative to typical measurements at this site during this time of year

Salinity/Conductivity

9/11/22 12:15, <-3> GQR, rejected due to fresh spike, cause unknown; data exhibits abnormally low value outside of measurement trend

Homer Deep (HD)

The Homer Deep sonde was removed on 1/19/2022 14:30 because the deployment tube became detached from its mooring. From 1/4/2022 21:15 to 1/19/2022 14:15 all parameters are marked -3 GSM CWD due to the damage to the site. The tube was discovered missing shortly afterwards. Supply chain issues delayed repair until redeployment on 4/27/2022 15:15. Data missing from this period are not recoverable and have been excused by the CDMO DMC.

Shortly after deployment on 4/27/2022, the Homer Deep sonde experienced a rapid decline in battery voltage, quickly dropping to less than 4-volts over a period of five days. This loss in power resulted in the loss of data from 5/5/2022 8:30 until redeployment on 6/2/2022 11:45. Additionally, from 4/30/2022 18:45 – 05/02/2022 8:15 the Homer Deep sonde experienced turbidity spikes corresponding with voltage spikes that seem to differ from the rest of these data.

Starting 04/27/2022 15:15 until 06/2/2022 11:30 the HD sonde could not be deployed in its normal tube due to station damage. To preserve data collection, the HD sonde was deployed on the H3 anchoring cable, which is about 50 ft away from the HD site. Both the H3 and HD sondes were deployed vertical of one another. With the H3 sonde being deployed at its normal location relative to the surface and the HD sonde at a fixed depth around ~1m from the sea floor. This is like its normal position in the tube. Relative to our reserve size, these ‘separate locations’ are in pretty much the same spot monitoring the same water body.

Missing values from 6/20/22 – 7/17/22 were discovered after sonde retrieval. These were likely caused by sonde power loss due to sensor failure, but exact cause is unknown. Additionally, missing values from 12/22/22 – 12/31/22 were discovered after sonde retrieval. These missing values were later identified to be caused by sonde power loss due to DO sensor failure.

Dissolved Oxygen

8/2/22 4:45, <-3> GQR, rejected due to abnormally low DO spike

pH

8/5/22 22:15, <-3> GQR, rejected due to abnormally low values, cause unknown

8/12/22 12:45, <-3> GQR, rejected due to abnormally high value, cause unknown

Salinity/Conductivity

4/1/2022 0:00 – 4/29/2022 9:30, 5/30/2022 10:00 – 6/20/2022 9:00, <1> CCU, suspect data due to unusually high values that far exceed any salinity ever measured by our SWMP program; however, post calibration values read normally.

11/18/2022, <1> [SIC] (CSM). Suspect data due to conductivity probe not being calibrated before deployment.

Seldovia Surface (SS)

Seldovia Surface site moves up and down on a cable. Sometimes the sonde gets hung-up on the cable, causing out of water events. <1.0-meter and >0.1-meter data are retained.

From 10/14/22 22:00 to 10/24/22 10:30 the SS sonde was impacted by marine debris and vegetation that can get hung up altering the vertical position slightly but not affecting the quality of the readings unless completely blocking the sensors.

From 11/4/22 8:45 – 11/17/22 10:45, the sonde broke from its buoy connector and sank to the seafloor. Data were collected at the wrong depth and laying on the bottom during this period, therefore were not collected according to NERR SWMP SOPS. All parameter data were rejected, <-3> CWD.

Chlorophyll

6/27/22 – 7/20/22, <-3> GQR, data exhibit highly variable “spikey” trend, including abnormally high values; thus, data were rejected

11/17/22 12:00 – 12/21/22 11:15, <-3> SSM, rejected due to sensor malfunction causing negative values during entire deployment, cause unknown

Salinity/Conductivity

9/2/22 5:15, <-3> GQR, rejected due to fresh spike, cause unknown; data exhibits abnormally low value outside of measurement trend

Seldovia Deep (SD)

Depth

9/18/22 21:15, <-3> SSM, rejected due to incorrect depth at zero meters

Dissolved Oxygen

9/18/22 21:15, <-3> SSM, rejected due to NaN values

Salinity/Conductivity

Deployments of sonde Valence were all suspect due to 'borderline' diagnostic at calibrations, i.e., cell constant was 0.52 (acceptable Wiped EXO range 0.419 – 0.519) but KOR QC score appeared OK. This was likely because of a rounding issue in the software, with sensor cell constant close to end of acceptable range. Salinity/conductivity values during deployment of the sensor (sonde Valence) obviously disjointed from previous and following deployments, resulting in suspect data. Data marked <1> (CSM) during following deployments.

01/20/2022

03/18/2022

05/30/2022

07/23/2022

09/13/2022

11/17/2022

8/22/22 18:15, <1> CSM, data suspect due to fresh spike, cause unknown; data exhibits abnormally low value outside of measurement trend