

Wells (WEL) National Estuarine Research Reserve
Meteorological Metadata
January-December 2021
Latest Update: May 15, 2023

I. Data Set & Research Descriptors

1) Principal investigator & contact persons:

Contact Persons:

Dr. Jason Goldstein, Research Coordinator
Email: jgoldstein@wellsnerr.org
Phone: (207)646-1555 ext.136

Jeremy Miller, SWMP Technician / Research Associate
E-mail: jmiller@wellsnerr.org
Phone: (207) 646-1555 ext. 122

Mailing Address:
Wells NERR
342 Laudholm Farm Road
Wells, ME 04090
Phone: (207)646-1555
Fax: (207)646-2930

2) Entry verification:

a) Data Input Procedures:

The meteorological information is sampled every 5 seconds from each instrument on the weather station and stored on a Campbell Scientific CR1000 data logger. The CR1000 has two MB Flash EEPROM that is used to store the Operating System and another 128 K Flash is used to store configuration settings. A minimum of 2 MB SRAM (4 MB optional) is available for program storage (16K), operating system use, and data storage.

Data are uploaded from the CR1000 data logger to a personal computer with a Windows 7 or newer operating system. Files are exported from LoggerNet in a comma-delimited format and uploaded to the CDMO where they undergo automated primary QAQC and become part of the CDMO's online provisional database. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve 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, append files, and export the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database. For more information on QAQC flags and QAQC codes, see Sections 11 and 12. Jeremy Miller is responsible for all aspects of data management.

3) Research Objectives:

The principal objective is to record long-term meteorological data for Wells, in order to supplement SWMP water quality YSI data and research data, and to observe any environmental changes or trends over time.

4) Research Methods:

The CR1000 datalogger samples every 5 seconds continuously and 15 minute averages and totals are produced and recorded as 15 minute data. This data is stored within the CR1000 until it is manually downloaded through LoggerNet and uploaded to the CDMO for initial QA\QC procedures. All data are collected in Eastern Standard Time (EST).

Campbell Scientific data telemetry equipment was installed at the Laudholm Farm Weather station on 07/11/06 and transmits data to the NOAA GOES satellite, NESDIS ID #3B024184. The transmissions are scheduled hourly at 0:02:10 after the hour 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>.

Sensors on the weather station are inspected monthly for damage or debris. Sensors are removed and replaced with recently calibrated sensors approximately every two years, with the exception of the rain gauge and Temp/Humidity probe, which is calibrated approximately every year. Also, once a month on download day, we use regional NWS data, to run a comparative set of observations as a general check on the Campbell station sensors and hardware. The CR1000 data logger is calibrated every 5 years (required beginning 2014, one year initial grace period).

Recommended calibration frequency for the MET station sensors:

- Temperature/Humidity- yearly recalibration
- Precipitation Gauge- yearly recalibration
- Wind Speed/Direction- yearly or every 2 years (depending on the sensor)
- Barometric Pressure- every 2 years recalibration
- PAR- every 2 years recalibration
- CR1000/CR1000X-every 5 years (required beginning 2014)

The 15 minute Data are collected in the following formats for the CR1000:

Averages from 5-second data:

Air Temperature (°C), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), Wind Direction (degrees), and Battery Voltage (volts)

Maximum, Minimum, and their times from 5-second data:

Air Temperature (°C) (these data are available from the Reserve)

Maximum and their times from 5-second data:

Wind Speed, (m/s)

Wind Direction Standard Deviation (degrees) from 5-second data

Totals:

Precipitation (mm), PAR (millimoles/m²), and Cumulative Precipitation (mm) (Cumulative precipitation is no longer available via export from the CDMO. Please contact the Reserve or the CDMO for more information or to obtain these data.)

5) Site location and character:

The Wells National Estuarine Research Reserve (and Laudholm Farm Meteorological station) is located in York County, within the Town of Wells, on the coast of southern Maine and faces the Atlantic Ocean at an elevation of 18.62 meters above sea level. The Wells NERR is approximately 31 km (20 miles) south of Portland, Maine and 110 km (70 miles) north of Boston, Massachusetts. The Reserve encompasses 1,690 acres along the Gulf of Maine coastline of tidally flushed wetlands, riparian and transitional upland fields and forests within the Little River Estuary and the larger Webhannet River Estuary. Both estuaries arise in the sandy glacial outwash plain about eight miles inland. Both rivers empty into Wells Bay, a sandy basin stretching for approximately ten miles along the Atlantic coast. Bordering each river's inlet are double spit barrier beaches attached to the mainland. The backbarrier system is approximately 5 sq. km and is composed of large intertidal marshes (predominantly *S. patens* and *S. alterniflora*), intertidal sand and mud flats, and tidal channels. The watershed for the Webhannet River estuary covers an area of 35 sq. km and has a total of 6 streams, brooks or creeks, which enter the estuary. These tributaries flow across sand and gravel deposits near the headwaters and the impermeable sandy mud of the Presumpscot Formation in the lower reaches. The Webhannet River is connected to the ocean via Wells Inlet, which has a spring tidal prism of 28,200,000 cub. m (Ward 1993). The force and volume of tidal action affect the salinity level of both rivers. In the Wells region, the annual mean wave height is almost 20 inches. The estuarine system is dominated by semi-diurnal tides having a range of 8.5 to 9.8 feet. The volume of freshwater influx into both estuaries is moderate to low (on the order of 0.5 cubic meters/second), especially in the summer, because of the rivers' relatively small drainage areas and the presence of deep glacial deposits. The relatively low flows from these two rivers taken in with the 20 inch per year average runoff of the area surrounding the estuaries combine to form a freshwater flow that is dwarfed by tidal flushing. Twelve-foot tides dwarf the freshwater flow into the Webhannet estuary, which has a drainage area of 14.1 square miles. The Webhannet estuary, fed by both Blacksmith and Depot Brooks, is adjacent to the harbor and greatly developed land. It offers a valuable opportunity for comparison with the relatively pristine Little River estuary. The land use of the Webhannet estuary include a total of 15% for wetland, fresh water, and tidal marsh; a total of 63.7 % for woodland; and a total of 18.6% for developed land (compared to a total of 5.7% development in the Little River estuary) (WNERR RMA 1996; Holden 1997).

The following information on the general climatology of Maine was taken from the "NOAA National Centers for Environmental Information; State Climate Summaries 2022)
(<https://statesummaries.ncics.org/chapter/me/>)

Maine is located on the eastern margin of the North American continent. Its northerly latitude and geographic location expose the state to both the moderating and moistening influence of the Atlantic Ocean and the effects of hot and cold air masses from the interior of the continent. Maine is also located within the primary storm track of the mid-latitudes. Maine's climate is characterized by cold, snowy winters and mild summers. Winter average temperatures range from 25°F in the far south to less than 15°F in the northern and interior portions of the state. Summer average temperatures range from near 60°F in the far north to near 70°F in the south. Maine is approximately 90% forested and has more than 3,500 miles of coastline, making forestry, fishery, hunting and fishing, tourism, and ecosystem services all sensitive to a changing climate.

Temperatures in Maine have risen almost 3.5°F since the beginning of the 20th century. Since the mid-1990s, the amount of winter warming has been approximately twice that of summer warming, with persistently above average temperatures occurring since the 1990s. Winter warming is reflected in the number of very cold nights, which has been below average since the late 1990s. However, the number of hot days has not increased. Winter warming has resulted in earlier lake ice-out dates. On Damariscotta Lake, the average ice-out date during the mid-20th century was mid- to late April; it is now early April. The growing season has also lengthened.

Total annual precipitation in Maine reached a historically high multiyear average during the 2005–2009 period. In the harsh winter months, average accumulated snowfall ranges from 40 to 80 inches across the Southern

Interior and Northern Interior climate divisions, with the northern tip of the state receiving up to 100 inches. The annual number of 2-inch extreme precipitation events has varied over the period of record, but the 10-year interval from 2005 to 2014 had a record number (nearly double the long-term average, similar to the rest of the northeastern United States. Maine has also been experiencing more short-term dry periods, with extreme drought occurring in 2002, 2016, and 2020. Drought conditions in 2020 contributed to more than 900 wildfires, the most Maine has seen in a decade.

Heat and cold waves, droughts, severe rainstorms, nor'easters, ice storms, and tornadoes are all part of Maine's normal climate. In general, nor'easters cause more disruption than any other type of extreme weather. Nor'easters are cold-season coastal storms that can generate a tremendous amount of precipitation (in the form of snow, sleet, or freezing rain), strong winds, coastal flooding, and damage to infrastructure. Observed wind speeds from nor'easters are commonly equal to or greater than those from hurricanes that have reached Maine. Nor'easters are prevalent in most years in winter, spring, and fall, while landfalling hurricanes are very rare. Since 1861, only 3 hurricanes have reached Maine with hurricane-force winds, the last being Gloria in 1985. Since 2007, weather-related disasters have been declared in every county in Maine.

The weather station is located (43 deg 20' 14.52" N, and 70 deg 32' 58.03" W) on a 32' (9.75m) telephone pole surrounded by mowed grass. The temperature and humidity probes are located on the north side of the pole at a height of 10' (3.0m). The PAR sensor is located on the South side of the pole at a height of approx. 15' (4.6m). The Barometric pressure sensor is located within the Campbell Scientific enclosure at a height of approx. 5' (1.5m) and vented to the outside by a small length of aquarium tubing. The wind sensor is located atop the pole at approximately 33 feet (10.1m) above the ground. To the NW of the pole is the Coastal Ecology Center, a 20' high (6.1m), 111' (33.8m) long building, at a distance of 37' (11.3m), running NE/SW. Further to the NW (153' (46.6m) from the pole) is the library, in a 25' (7.6m) high wing of the barn. The barn itself is 223' (68.0m) from the station and runs NE/SW. It is 38' (11.6m) high and is the largest obstruction in the area. The rain gauge is located 9' (2.7m) southeast of the weather station pole and is situated on a post with the top of the funnel is 10' (3.0m) from the ground.

There are two SWMP water quality sampling sites in the Webhannet River estuary, and two stations in the Little River Estuary. These are located at the Webhannet River Head of Tide, at the Webhannet Inlet, at Skinner Mill on the Merriland River and at the mouth of the Little River. The tidal range at each of these sites is 2.6-2.9 meters. The station is approximately .86 KM from welsmwq, .78KM from wellmwq, 2.21 KM from welinwq, and 5.27 KM from welhtwq.

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
wellfmet	P	Laudholm Farm	43 deg 20' 14.52" N, 70 deg 32' 58.03" W	2001-present	NA	NA

6) Data collection period:

1/1/2021 at 00:00 through 12/31/2021 23:45

File Start Date and Time	File End Date and Time
10/29/2020 12:00	01/28/2021 11:30
01/28/2021 11:45	02/26/2021 13:30
02/26/2021 13:45	03/25/2021 12:00
03/25/2021 12:15	04/23/2021 11:15
04/23/2021 11:30	06/16/2021 11:15
06/16/2021 11:30	07/29/2021 09:45

07/29/2021 10:00	08/30/2021 13:30
08/30/2021 13:45	09/30/2021 14:30
09/30/2021 14:45	10/28/2021 13:30
10/28/2021 13:45	11/29/2021 11:30
11/29/2021 11:45	12/23/2021 13:45
12/23/2021 14:00	01/27/2021 17:15

7) Distribution:

According to the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program:

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 2021.

NERR meteorological 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:

As part of the SWMP long-term monitoring program, the Wells NERR also monitors 15-minute water quality along with monthly grab samples and diel sampling for nutrient data which may be correlated with this meteorological dataset. These data are available at www.nerrsdata.org.

RESEARCH AT THE WELLS NATIONAL ESTUARINE RESEARCH RESERVE for 2021:

(Please visit our website: www.wellsreserve.org/research.htm for further information on the Wells NERR research program):

The Research Program at the Wells NERR conducts and supports research, monitoring, workshops, and research/resource management planning of relevance at local, regional and national levels. The overall aim of our work is to produce science-based information needed to sustain and restore Gulf of Maine coastal habitats and resources, especially those found in salt marsh estuaries and watersheds. Many different studies involving scores of scientists, students, staff and volunteers focused on several related themes

Monitoring tracks changes in the composition/phenology of larval fishes & invertebrates

The Research Associate and SWMP Coordinator will continue to conduct plankton monitoring at Wells Harbor (SWMP station; welinwq) four times monthly to better understand the community composition, diversity, long-term temporal dynamics, and phenology of ichthyoplankton and invertebrate assemblages within the Webhannet River Estuary. The SWMP Coordinator and Research Associate will oversee a core group of interns and volunteers who will help support these efforts by conducting sampling in the field, and sorting samples in the laboratory. We have expanded our laboratory processing to include separation and identification of all crab larvae to 1) inform our existing work investigating decapod ecology in estuarine systems; 2) improve our understanding of seasonal patterns of crab spawning in Gulf of Maine estuaries; and 3) monitor the arrival of invasive or range expanding species such as the Blue crab (*Callinectes sapidus*).

Related to this, the SWMP Coordinator and Research Director have begun to integrate SWMP data into a community meta-analysis to better understand the impacts of environmental drivers on fish and crab community structure. The Reserve will work with individuals from NOAA's Southwest Fisheries Science Center and Gulf of Maine Research Institute to bring associated monitoring data into the forefront of the peer-reviewed literature and to expand our efforts to understand shifts in larval fish community dynamics in a rapidly warming Gulf of Maine. The Research Director and SWMP Coordinator will continue to pursue the development of a larger manuscript for peer review and publication, describing changes in the phenology and distribution of larval fishes in the Webhannet River Estuary. This continued work will improve upon our techniques for documenting and reporting changes in both fish and invertebrate larval assemblages in our system.

Monitoring the range expansion of blue crabs (*Callinectes sapidus*) into the Gulf of Maine

The blue crab (*Callinectes sapidus*) has been documented in salt marsh pools in the Webhannet and Little River estuaries at the Wells Reserve since 2020, as well as other locations in the northern New England region, indicating a range expansion of this species into the Gulf of Maine. We will monitor seasonal and spatial dynamics of blue crabs (and opportunistically other potential marsh crab species) that includes their spatio-temporal distribution in our estuarine systems by fishing a series of blue crab traps across a gradient of estuarine and salt marsh habitats in the Little River and Webhannet Estuaries. We will engage interns and volunteers to help monitor weekly changes in catch (CPUE), size distribution, sex ratio, and habitat usage over time (April-November). As opportunities arise, and through the facilitation of the newly-formed Gulf of Maine Blue Crab Network (led by Wells NERR), we will collaborate with other researchers in the New England region to catalyze expanded monitoring of this recent range expander and research into its impacts on Gulf of Maine ecosystems. Combined, these efforts will provide valuable information regarding the distribution, population dynamics, and impacts of blue crabs within this new expanded range.

Improving Business Practices to Reduce Mortality in the Lobster Supply Chain:

After being captured, lobsters (*Homarus americanus*) undergo several rounds of handling and processing prior to reaching consumers. Estimates suggest 3-5% of lobsters do not survive this process; this "shrink" in the supply chain results in tens of millions of dollars of lost revenue annually. This project aims to understand where in the supply chain lobster stress and mortality is greatest, as well as identifying specific causal factors (storage in warm water, rough handling, air exposure, etc.) which could be addressed to reduce lobster mortality. To do this, we are building novel sensor packages capable of monitoring the environmental and handling conditions lobsters are exposed to from the trap all the way to the dealer, and simultaneously measuring lobster viability using heart rate dataloggers coupled with lobster health assessments. The University of Maine is the primary recipient of the grant, but other partners include Saint Joseph's College of Maine and several industry partners. PIs: Ben Gutzler & Jason Goldstein. Funding from NOAA Saltonstall-Kennedy Fisheries Program.

Marine Invader Monitoring and Information Collaborative (MIMIC):

Researcher Associate at the Wells NERR act as State Coordinator for groups of citizen scientist who monitor 12 sites in coastal southern Maine for marine invasive species. Data has been being collected on the presence and absence, and general abundance of 23 priority species as identified by the Massachusetts Office of Coastal Zone Management and MIT SeaGrant.

Salt Marsh Degradation and Restoration

Salt marsh ecosystems in the Gulf of Maine have sustained themselves in the face of sea-level rise and other natural disturbances for nearly five thousand years. Since colonial times large areas of salt marsh (up to half of the total area) have been lost through diking, draining and filling. Today, the remaining marshland is fairly well protected from outright destruction, but during the past 100 years, and especially since the 1950's, salt marshes have been divided into fragments by roads, causeways, culverts and tide gates. Most of these fragments have severely restricted tidal flow, leading to chronic habitat degradation and greatly reduced access for fish and other marine species. Since 1991, the Wells Reserve has been studying the impact of these restrictions on salt marsh functions and values, and the response of salt marshes to tidal restoration. We have been working to promote an awareness of the damage being done and the benefits of salt marsh restoration throughout the Gulf of Maine.

Research Program Update: In addition to the Reserve-sponsored projects outlined above, numerous visiting investigators will be involved in on-site research. Topics include: the effects of land use, sea level, and climate on estuarine productivity; the relationship between soil nutrients and plant community patterns; the influence of soil salinity on plant community interactions; the effect of tidal restriction on marsh peat accretion; the comparative ecology of fringe marshes and back barrier marshes; habitat use by upland birds, impacts of the invasive green Crab on salt marsh communities, and the ecology of lyme disease.

II. Physical Structure Descriptors

9) Sensor specifications, operating range, accuracy, date of last Calibration:

Parameter: Temperature
Units: Celsius
Sensor type: Platinum resistance temperature detector (PRT)
Model #: HC2-S3
Operating Temperature: -40°C to +60°C
Range: -40°C to +60°C
Accuracy: ± 0.2 °C @ 20°C
Serial Number: 61290211
Date of Last Calibration: 10/27/2020
Dates in use: 12/03/2020-12/17/2021
AND
Serial Number: 61115998
Date of Calibration: 12/07/2021
Dates in use: 12-17-2021- current as of 12/31/2021

Parameter: Relative Humidity
Units: Percent
Sensor type: Rotronics HC2-S humidity sensor
Model #: HC2-S3
Range: 0-100% non-condensing
Accuracy at 20°C: $\pm 2\%$ RH (0-90%) and $\pm 3\%$ (90-100%)

Temperature dependence of RH measurement: $\pm 0.05\%$ RH/ $^{\circ}\text{C}$

Serial Number: 61290211

Date of Last Calibration: 10/27/2020

Dates in use: 12/03/2020-12/17/2021

AND

Serial Number: 61115998

Date of Calibration: 12/07/2021

Dates in use: 12-17-2021- current as of 12/31/2021

Parameter: Barometric Pressure

Units: millibars (mb)

Sensor type: Vaisala Barocap $\text{\textcircled{C}}$ silicon capacitive pressure sensor

Model #: CS-105

Operating Range: Pressure: 600 to 1060 mb; Temperature: -40°C to $+60^{\circ}\text{C}$;

Humidity: non-condensing

Accuracy: ± 0.5 mb @ 20°C ; ± 2 mb @ 0°C to 40°C ; ± 4 mb @ -20°C to 45°C ; ± 6 mb @ -40°C to 60°C

Stability: ± 0.1 mb per year

Serial Number: V4920039

Date of Last calibration: 10/21/2020

Dates in Use: 12-03-2020 – current as of 12/31/2021

Parameter: Wind speed

Units: meter per second (m/s)

Sensor type: 18 cm diameter 4-blade helicoids propeller molded of polypropylene

Model #: R.M. Young 05103 Wind Monitor

Range: 0-60 m/s (134 mph); gust survival 100 m/s (220 mph)

Accuracy: ± 0.3 m/s

Serial Number: WM 82868

Date of last calibration: 10/21/2020

Dates in Use: 12-02-2020-current as of 12/31/2021

Parameter: Wind direction

Units: degrees

Sensor type: balanced vane, 38 cm turning radius

Model #: R.M. Young 05103 Wind Monitor

Range: 360° mechanical, 355° electrical (5° open)

Accuracy: ± 3 degrees

Serial Number: WM 82868

Date of last calibration: 10/21/2020

Dates in Use: 12-02-2020- current as of 12/31/2021

Parameter: Apogee SQ-110 Quantum sensor PAR

Units: $\mu\text{moles/s/m}^2$

Sensor type: High stability silicon photovoltaic detector (blue enhanced)

Model #: SQ-110

Light spectrum waveband: 400 to 700 nm

Temperature dependence: 0.15% per $^{\circ}\text{C}$ maximum

Stability: $<\pm 2\%$ change over 1 yr

Operating Temperature: -40°C to 65°C ; Humidity: 0 to 100%

Sensitivity: typically $5 \mu\text{A}$ per $1000 \mu\text{moles s}^{-1} \text{m}^{-2}$

Serial Number: 21242

Multiplier: 0.025 (this does not change)
Date of Last calibration: 10/26/2020
Dates in Use: 12/03/2020 - current as of 12-31-2021

Parameter: Precipitation
Units: millimeters (mm)
Sensor type: Tipping Bucket Rain Gauge (heated)
Model #: TE525
Serial Number: H12182
Rainfall per tip: 0.01 inch
Operating range: Temperature: 0° to 50°C; Humidity: 0 to 100%
Accuracy: +/- 1.0% up to 1 in./hr; +0, -3% from 1 to 2 in./hr; +0, -5% from 2 to 3 in./hr
Date of Last calibration: 08/27/2020 and 08/30/2021
Dates in Use: Current as of 12/31/2021

The CR1000 has 2 MB of Flash EEPROM that is used to store the Operating System. Another 128 K Flash is used to store configuration settings. A minimum of 2 MB SRAM is (4 MB optional upgrade) available for program storage (16K), operating system use, and data storage. Additional storage is available by using a compact flash card in the optional CFM100 Compact Flash Module.

SN: 5244

Date CR1000 Installed: 07/12/2006, removed 08/27/2020 for calibration

Date CR1000 Calibrated: 09/09/2020

Dates in Use: 10/6/2020 – 12/31/2021 current as of 05/16/2022

CR1000 Firmware Version (s): CR1000.Std.32.05 (date of update unknown)

CR1000 Program Version(s): wellfmet_V7.1_042417..CR1

Transmitter: Campbell Scientific TX312
Model Number: TX312
Serial Number: 1341
Date Installed: summer 2006

10) Coded variable code definitions:

Sampling Station: Laudholm Farm
Sampling site code: LF
Station code: wellfmet

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 above or below sensor range, or missing. All remaining data are then flagged 0, as 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	Passed Initial QAQC Checks
1	Suspect Data
2	<i>Open - reserved for later flag</i>
3	<i>Open - reserved for later flag</i>
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 the CR1000/CR1000X, 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

GIM	Instrument malfunction
GIT	Instrument recording error, recovered telemetry data
GMC	No instrument deployed due to maintenance/calibration
GMT	Instrument maintenance
GPD	Power down
GPF	Power failure / low battery
GPR	Program reload
GQR	Data rejected due to QA/QC checks
GSM	See metadata

Sensor Errors

SDG	Suspect due to sensor diagnostics
SIC	Incorrect calibration constant, multiplier or offset
SIW	Incorrect wiring
SMT	Sensor maintenance
SNV	Negative value
SOC	Out of calibration
SQR	Data rejected due to QAQC checks
SSD	Sensor drift
SSN	Not a number / unknown value
SSM	Sensor malfunction
SSR	Sensor removed

Comments

CAF	Acceptable calibration/accuracy error of sensor
CCU	Cause unknown
CDF	Data appear to fit conditions
CML	Snow melt from previous snowfall event
CRE*	Significant rain event
CSM*	See metadata
CVI*	Possible vandalism/tampering
CWE*	Significant weather event

13) Other Remarks/notes:

Data are missing due to equipment or associated specific sensors 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.

Relative Humidity data greater than 100 are within range of the sensor accuracy of +/-3% and are flagged and coded as suspect, <1> (CAF). Values greater than 103 are rejected <-3>.

Data recorded for all parameters (with the exception of cumulative precipitation) at the midnight timestamp (00:00) are the 15 minute averages and totals for the 23:45-23:59 time period of the previous day. Cumulative precipitation data at the midnight timestamp (00:00) are the sum of raw (unrounded) precipitation data from 00:00 to 23:59 of the previous day. Summing each individual 15-minute total precipitation value from the same period will result in small differences from cumulative precipitation due to rounding. It is especially important to note how data at the midnight timestamp are recorded when using January 1st and December 31st data. **Note: Cumulative precipitation is no longer available via export from the CDMO. Please contact the Reserve or the CDMO for more information or to obtain these data.**

*Rapid changes in Relative Humidity and Temperature are quite common at the Wells NERR due to our close proximity to the coast and shifts in wind from the ocean to the land (and vice versa). These shifts in wind direction can dramatically affect both the temperature of the air as well as the amount of moisture there in, causing air temperatures and Relative Humidity to rise and fall sharply.

Precipitation data collected with rain gauges that are not designed specifically for measuring frozen precipitation (snow/ice/hail), including heated gauges and those that use antifreeze to melt frozen precipitation, may not be measured accurately. Blowing wind, sublimation, and rate of snowfall/ice melt all effect the amount of recorded precipitation. The reserve has made attempts to accurately record dates and times when frozen precipitation and subsequent melting has occurred. The heated rain gauge at WEL has been used to collect precipitation data with no additional flagging or coding to the data for melting of frozen precipitation.

08/30/2021 13:25 – 13:45, <0> (CSM) Precipitation gauge was calibrated offline, no adjustments were needed.

12/17/2021 13:00, <-3> [SMT] (CSM) Air temperature and relative humidity were rejected due to sensor swap from HC2-S3 sn61115998 to sn61115998.