Hudson River (HUD) **NERR Meteorological Metadata**
January 1st – December31st, 2021
Latest Update: December 12, 2023

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons –

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2) Entry verification –

Data are uploaded from the CR1000/CR1000X 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.

The Research Assistant is responsible for data verification.

3) Research objectives –

The objective of this study is to monitor the meteorological conditions at the Tivoli Bays component site of the Hudson River National Estuarine Research Reserve. Measurements of air temperature, relative humidity, barometric pressure, precipitation, photosynthetically active radiation, and wind speed and direction are taken throughout the year at the Tivoli Bays Field Station. A water quality-monitoring program has been ongoing since 1991 at this component site, and the meteorological data will help provide ancillary data. This will help us to better understand the relationships between the atmospheric conditions and aquatic environments at this site.

In 2018, a "secondary SWMP" meteorological monitoring station was incorporated into the reserve. This station will provide a secondary source of the above mentioned protocol and parameters in the vicinity around the Norrie Point Environmental Center which is home to HRNERR offices. This station will provide supplemental data in conjunction with a newly established water quality station at the same location. The station has been operational since 2008 and historical data is available upon request. **Secondary SWMP stations do not undergo tertiary review.**

4) Research methods –

Campbell Scientific data telemetry equipment was installed at the Field Station (FS) station on 11/14/2005 and transmits data to the NOAA GOES satellite, NESDIS ID #3B00B4F4. Identical telemetry equipment is installed at the Norrie Point (NP) monitoring station which transmits data to the NOAA GOES satellite, NESDIS ID # 3B01301A The transmissions are scheduled hourly at 0:39:30 after the hour for FS and at 0:35:40 after the hour for NP 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.

Data are collected in Eastern Standard Time (EST) for the entire year.

The 15 minute Data are collected in the following formats for the **CR1000/CR1000X**:

Averages from 5-second data:

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

Maximum and Minimum Air Temperature (°C) and their times from 5-second data (these data are available from the Reserve)

Maximum Wind Speed (m/s) and time from 5-second data

Wind Direction Standard Deviation (degrees)

Totals:

Precipitation (mm), PAR (millimoles/m^2), 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.)

Recommended calibration frequency for the MET station sensors:

- Temperature/Humidity- yearly recalibration
- Rain 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-every 5 years (required beginning 2014)

5) Site location and character –

The Hudson River National Estuarine Research Reserve (HUDNERR) is a multi-component site totaling approximately 5,000 acres. Each component of the reserve is referenced by River Mile (RM) of the Hudson River in New York State proceeding north from the southern tip of Manhattan (RM 0). The reserve includes the following four component sites: Piermont Marsh, Rockland County (RM 24)(41°02'30"N 73°54'15"W), Iona Island, Rockland County (RM 45)(41°18'15"N 73°58'45"W), Tivoli Bays, Dutchess County (RM 98)(42°02'15"N 73°55'10"W), and Stockport Flats, Columbia County (RM 124)(42°02'30"N 73°46'00"W). The Reserve sites are managed at the Norrie Point Environmental Center, the headquarters for the Reserve, in Staatsburg NY, Dutchess County (41°49'53"N, 73°56'32"W). The four component sites include open water, tidal wetland, and adjacent upland buffer habitats and are representative of the diverse plant and animal communities that occupy the salinity gradient within the Hudson River Estuary. Development within the watersheds of the four component sites ranges from predominantly urban/suburban to forested/agricultural.

The weather station (FS) is located at the Tivoli Bays component site in Annandale, NY (42°01'05.46"N 73°55'01.13"W). A 30 foot, aluminum tower is used to elevate some of the weather monitoring equipment. The tower is on the deck of an office building, on the west side, 9 feet (2.7m) off the ground. The wind anemometer, wind speed, and light sensors are located at the top of the tower, 39 feet (11.9m) off the ground. The datalogger and the barometric pressure sensor are enclosed within a fiberglass case attached to the tower, 12 feet (3.7m) off the ground. A heated rain gauge is next to the tower, attached to the building, 16 feet (4.9m) off the ground. The temperature/humidity sensor is next to the tower, attached to the deck handrail, 12 feet (3.7m) off the ground. GOES telemetry equipment includes a larger solar panel and battery, a larger enclosure to house the battery, a Campbell TX-312 transmitter, associated GPS for time synchronization and a Yagi antenna.

Although trees surround the area, the tree line begins approximately 60 feet (18.3m) from the tower in most directions. In past years the trees were at similar heights to the tower, but the sensors were not shaded at the location. However in recent years the surrounding forest canopy height has increased possibly leading to a decline in the accuracy of wind data during leaf-in months (typically May to October). The tower is approximately 1.2 miles (1.9km) southeast of the Tivoli South Bay water quality monitoring station, 2.3 miles (3.7km) southeast of the Tivoli North Bay water quality monitoring station, and 0.2 miles (0.3km) northwest of the Saw Kill Creek water quality monitoring station.

The NP weather station is located at the Norrie Point Environmental Center, the HRNERR headquarters in Staatsburg, NY (41°49'53"N, 73°56'32"W). A 30 foot, aluminum tower is used to elevate all of the weather monitoring equipment. The tower is anchored to the concrete patio, south of the HRNERR offices. It is situated directly adjacent (2 meters) to the Hudson River. The wind anemometer and wind speed sensors are located at the top of the tower, 30 feet off the ground. The datalogger and the barometric pressure sensor are enclosed within a fiberglass case attached to the tower, 6 feet off the ground. A heated rain gauge is attached to the tower, 8 feet off the ground. The temperature/humidity sensor is attached to the tower, 10 feet off the ground. A light sensor is attached to an arm protruding from the tower 12 feet off the ground. GOES telemetry equipment includes a larger solar panel and battery, a larger enclosure to house the battery, a Campbell TX-312 transmitter, associated GPS for time synchronization and a Yagi antenna. The station is surrounded by the Hudson River in all directions but Northeast. The tower is located approximately 60 feet from the building, which should minimize any impact from the structure.

SWMP Station Timeline:

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
FS	P	Field Station	(42°01'05.46"N 73°55'01.13"W)	July 1999-present	NA	NA
NP	S	Norrie Point	(41°49'53"N 73°56'32"W)	Secondary SWMP January 1, 2018 - present		Non-SWMP May 7, 2008-December 31 2017

6) Data collection period –

Weather data have been collected at the Field Station at Tivoli Bays since July 1999. Weather data provided in this document were collected between 01/01/2021 00:00 through 12/31/2021 23:45

Data Retrieval intervals were as follows:

FS

12/30/2020 @11:30	01/22/2021 @ 10:45
01/22/2021 @ 11:00	04/01/2021 @ 11:15
04/01/2021 @ 11:30	07/15/2021 @ 11:00
07/15/2021 @ 11:15	09/29/2021 @ 13:00
09/29/2021 @ 13:15	11/08/2021 @ 11:45
11/08/2021 @ 12:00	11/18/2021 @ 12:45
11/18/2021 @ 14:30	01/13/2022 @ 10:30

NP

12/24/2020 @ 15:15	03/05/2021 11:00
3/5/2021 @ 17:00	3/10/2021 @ 13:30
3/10/2021 @ 15:45	3/11/2021 @ 10:45
3/17/2021 @ 13:30	4/26/2021 @ 11:45
4/26/2021 @ 11:4512:00	6/11/2021 @ 10:3009:15
6/11/2021 @ 10:3009:30	7/9/2021 @ 10:30
7/9/2021 @ 10:3045	8/6/2021 @ 12:4530
8/6/2021 @ 12:4513:30	8/10/2021 @ 14:1500
8/10/2021 @ 14:15	9/15/21 @ 12:3008/11/2021 @ 10:30
08/11/0221 @10:45	09/15/2021 @ 12:15
9/15/2021 @ 12:30	10/19/2021 @ 10:1500
10/19/2021 @ 10:15	12/2/2021 @ 12:3015
12/2/2021 @ 12:30	12/31/21 @ 23:4501/06/2022 @ 12:15

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 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, HUD 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.

II. Physical Structure Descriptors

9) Sensor specifications –

Parameter: Temperature
Units: Celsius
Sensor type: Campbell Scientific 1000 Ω Platinum Resistance Thermometer
Model #: EE-181-L Temperature and Relative Humidity Probe
Operating Temperature: -40°C to +60°C
Range: -40°C to +60°C
Accuracy: ± 0.2 °C @ 23°C

Station	Serial Number	Date of Cal	Dates of Sensor Use
FS	1645160D0139CC	04/02/2019	10/29/2019-11/18/2021
FS	170516000140F8	11/9/2020	11/18/2021 – Current as of 12/31/2021
NP	170516000153DE	12/3/2019	10/6/2020 – Current as of 12/31/2021

Parameter: Relative Humidity
Units: Percent
Sensor type: Campell Scientific Capacitance RH Sensor
Model #: EE-181-L Temperature and Relative Humidity Probe

Range: 0-100% non-condensing
Accuracy: –15 to 40 °C: ≤90% RH ± (1.3 + 0.003 • RH reading) % RH
–15 to 40 °C: >90% RH ± 2.3% RH
–25 to 60 °C: ± (1.4 + 0.01 • RH reading) % RH
–40 to 60 °C: ± (1.5 + 0.015 • RH reading) % RH
Temperature dependence of RH measurement: typically 0.03% RH/°C
Note: This sensor caps relative humidity values at 100%, measured values >100% are altered to 100%

Station	Serial Number	Date of Cal	Dates of Sensor Use
FS	1645160D0139CC	04/02/2019	10/29/2019-11/18/2021
FS	170516000140F8	11/9/2020	11/18/2021 – Current as of 12/31/2021
NP	170516000153DE	12/3/2019	10/06/2020 – Current as of 12/31/2021

Parameter: Barometric Pressure
Units: millibars (mb)
Sensor type: Vaisala Barocap © silicon capacitive pressure sensor
Model #: CS-106
Operating Range: Pressure: 500 to 1100 mb; Temperature: -40°C to +60°C;
Humidity: non-condensing
Accuracy: ± 0.3 mb at +20°C, ± 0.6 mb at 0°C to 40°C, ± 1 mb at -20°C to +45°C, ± 1.5 mb at -40°C to +60°C
Stability: ± 0.1 mb per year

Station	Serial Number	Date of Cal	Dates of Sensor Use
FS	L1430917	4/1/2019	10/29/2019 – 11/18/2021
FS	L1440691	11/9/2020	11/18/2021 – Current as of 12/31/2021
NP	N1230355	12/3/2019	10/06/2020- Current as of 12/31/2021

Parameter: Wind speed
Units: meter per second (m/s)
Sensor type:
Model #: R.M. Young 05103-45 Wind Monitor
Range: 0-100 m/s (224 mph)
Accuracy: +/- 0.3 m/s or 1%

Parameter: Wind direction
Units: degrees
Sensor type: balanced vane, 38 cm turning radius
Range: 360°
Accuracy: +/- 3°

Station	Serial Number	Date of Cal	Dates of Sensor Use
FS	WM125766	4/3/2019	10/29/2019 – 11/18/2021
FS	WM140711	11/9/2020	11/18/2021 – Current as of 12/31/2021
NP	WM125404	12/6/2019	10/06/2020 – Current as of 12/31/2021

Parameter: Photosynthetically Active Radiation
Units: mmoles m-2 (total flux)
Sensor type: High stability silicon photovoltaic detector

Model #: Apogee SQ-110
Light spectrum waveband: 410to 655 nm
Temperature Response: 0.06 ±0.06% per °C
Stability: <±2% change over 1 yr
Operating Temperature: -40°C to 70°C; Humidity: 0 to 100%
Sensitivity: 0.2mV per µmol s-1 m-2
Multiplier: 0.025 (this does not change)

Station	Serial Number	Date of Cal	Dates of Sensor Use
FS	17009	4/1/2019	10/29/2019 – 11/18/2021
FS	17012	11/1/2020	11/18/2021 – Current as of 12/31/2021
NP	17011	12/3/2019	10/06/2020 – Current as of 12/31/2021

Parameter: Precipitation (heated rain gauge)
Units: millimeters (mm)
Sensor type: Tipping Bucket Rain Gauge
Model #: RM52202-L
Rainfall per tip: 0.01 mm
Operating range: -20°C to +50°C (heated); Humidity: 0 to 100%
Accuracy: 2% up to 25 mm/hr, 3% up to 50 mm/hr

*Both Stations were replaced in 2021 on the dates reflected below with the following sensor
Sensor type: Tipping bucket with magnetic reed switch
Model #: RainVue20
Rainfall per tip: 0.01 in
Operating range: 1°C to +70°C; Humidity: 0 to 100%
Accuracy: 1% (0-500 mm/h intensity of rainfall)

Station	Serial Number	Date of Last Cal	Dates of Sensor Use
FS	TB27014-7	07/01/2020 (In field)	10/17/2017 – 11/18/2021
FS	*212610	11/18/2021	11/18/2021 – Current as of 12/31/2021
NP	TB11432	10/06/2020 (In field)	10/06/2020 – 08/06/2021
NP	*203321	08/06/2021	08/06/2021 – Current as of 12/31/2021

GOES Transmitter
Model #: TX321
On-board memory: Non-volatile flash for setup parameters. 16 Kbytes for data.
Data Transmission Rates: 100, 300 and 1200 BPS
Transmit Power: 5.6 Watts for 100 and 300 bps, 11.2 watts for 1200 bps
Frequency range: 401.701 MHz – 402.09850 MHz
Channel bandwidth: 100/300 BPS 1.5 KHz; 1200 BPS 3 KHz
Time Keeping: Initial setting accuracy: ± 100 microseconds synchronized to GPS; Drift ± 10 milliseconds/day over operating temperature range; GPS scheduled updates are 1 at power up and once per day thereafter. Once every 28 hours required for continual operation.
Operating range: -40° to +60°C; Storage -50° to +70°C; 0-99% RH, non-condensing
Power requirements: 10.8 to 16 VDC, 5 mA during GPS fix and 2.6 Amps during transmission

Station	Serial Number	Dates of Transmitter Use
FS		11/18/2021 – Current as of 12/31/2021

NP	1698	05/2008 - 08/06/2021*

* NP upgraded to TX325 transmitter on 08/06/2021, details below.

Model#: TX325
Data Transmission Rates: 300 and 1200 BPS
Transmit Power: 31 dBm for 300 BPS, 37 for 1200 BPS
Frequency range: 401.701 MHz – 402.09925 MHz
Channel bandwidth: 300 BPS 0.75 KHz; 1200 BPS 2.25 KHz
Time Keeping: Initial setting accuracy: ± 100 microseconds synchronized to GPS; Drift ± 40 milliseconds/day without GPS synchronization; GPS scheduled updates are 1 at power up and once per day thereafter. Once every 28 hours required for continual operation.
Operating range: -40° to +60°C; Storage -55° to +75°C
Power requirements: 10.5 to 16 Vdc; < 2.5 A when transmitting (typical 1.8 A at 12 Vdc); > 5 mA standby (typical 2.8 mA at 12 Vdc); < 50 mA during GPS acquisition (typical 25 mA at 12 Vdc)

Station	Serial Number	Dates of Transmitter Use
NP	300001940	08/06/2021 – 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.

The CR1000X has a total onboard memory of 128 MB of flash and 4MB of battery backed SRAM. There is 8 MB of flash memory reserved for loading the operating system and 1MB of flash reserved for configuration settings. SRAM is used for the CRBasic program operating memory, communication memory, and data storage, with 72 MB of flash for extended data storage. Additional data storage expansion is available with a removable microSD flash memory card of up to 16 GB.

Station	Type	Front Serial Number	Rear Serial Number	Date of Cal	Dates of Sensor Use
FS	CR1000x	8215		01/17/2019	10/29/2019-Current as of 12/31/2021
NP	Cr1000	3047	003020		2/9/2015 – 3/17/2021
NP	Cr1000x	23320		12/16/2020	Installed 03/05/2021 but not working correctly until 3/17/2021 – Current as of 12/31/2021

CR1000x Firmware Version (s):

Station	OS	Dates of Use
FS	5.0	03/17/2021-Current as of 12/31/2021
NP	5.0	3/05/2021 – Current as of 12/31/2021

CR1000 Program Version(s):

Station	Program Name	Dates Used
NP	HUDNPMET_6.0.3_092117	09/21/2017 – 3/05/2021*

*Denotes end of Cr1000 use and switch to new CR1000x

CR1000x Program Version(s):

Station	Program Name	Dates Used
FS	HUDFSMET_CR1000x_6.1.1_102919	10/29/2019-Current as of 12/31/2021
NP	HUDNPMET_CR1000x_6.0.0_031721	3/17/2021-Current as of 12/31/2021

10) Coded variable definitions -

Sampling station:	Sampling site code:	Station code:
Field Station	FS	hudfsmet
Norrie Point	NP	hudnpmet

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 *Open - reserved for later flag*
3 *Open - reserved for later flag*
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
CVT*	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.**

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.

Although it is not practical to indicate the exact volume of snowfall and melt, significant rainfall events are cross-referenced with air temperature taken at the simultaneous interval. During months that snowfall is typical, significant rain events (CRE) that coincide with temperatures below 0 C will be recorded as CWE. It is assumed that precipitation fell in the form of ice or snow during these events. Due the non-uniform water content in precipitation in the form of snow and ice, it is assumed that the volume collected is an average and is not indicative of blowing snow or snowdrifts.

The CDMO does not authenticate the data from the Norrie Point station since it is a secondary site in the NERR SWMP. Only primary SWMP sites go through tertiary review by the CDMO.

Field Station

05/30/2021 00:15 – 07/15/2021 11:00 both total and cumulative precipitation are rejected due to a clogged rain bucket. 07/15/2021 11:15 - 11:30 tips are rejected due to maintenance to clear the clog (cumulative data are rejected through the end of the day).

07/15/2021 11:45 – 09/29/2021 13:00 both total and cumulative precipitation are considered suspect due to rain bucket clogging. Rain events were recorded; however, the bucket was found clogged on 09/29/2021. Since there is uncertainty about when the clog occurred, all precipitation for that time period are considered suspect, <1> (CSM), unless otherwise rejected or additional coding used. Tips to clear the clog were rejected on 09/29/2021 13:15 – 13:30, <-3> [SMT](CSM).

01/01/2021 23:15 – 01/02/2021 04:30, 01/03/2021 14:15 – 01/04/20021 09:00, 01/26/2021 15:00 – 01/27/2021 11:00, 02/07/2021 14:30 – 02/08/2021 02:00, 02/16/2021 02:30 – 02/16/2021 11:00, and 02/22/2021 15:30 – 02/23/2021 03:45 all wind data are considered suspect, <1> (CSM). Although not confirmed, it appears as though with below freezing air temperatures and precipitation that the wind sensor may have been frozen for those dates and times.

10/29/2021 00:15 – 11/18/2021 12:45 Both air temperature and relative humidity are considered suspect due to an out of calibration sensor, <1> [SOC](CSM).

11/18/2021 13:00 – 14:15 the station was powered down to swap air temperature/relative humidity, barometric pressure, wind, and PAR sensors and the rain gauge. An updated logger program was uploaded at 14:30.

Data coded CRE GSM (Significant Rain Event) or CWE GSM (Significant Weather Event)
Data are coded CWE when the observed conditions or associated temperatures are indicative of snow/ice events. The CWE code is used because the nature of snow, even utilizing a precipitation gauge with a heating element, is subject to blowing out of the collection device. Snowfall totals calculated using a tipping bucket, likely underestimate the amount of precipitation which actually fell.

Data are coded CRE when the 24 hour rainfall total exceeds 20mm. The data for both CRE and CWE events will be coded until the event ends, and cumulative total for the day reset's at 00:00

The following were observed CRE and CWE events:

Data Flagged CRE or CWE and GSM
Field Station
2/15/2021 @ 9:15 – 2/16/2021 @ 11:15
3/28/2021 @ 9:30 – 3/29/2021 @ 00:00
4/15/2021 @ 13:15 – 4/16/2021 @ 18:30
5/3/2021 @ 15:15 – 5/5/2021 @ 20:30
7/17/2021 @ 16:30 – 7/18/2021 @ 20:00(coded as suspect due to clogged rain gauge)

Norrie Point
3/18/2021 @ 8:45 – 3/18/2021 @ 21:15
3/25/2021 @ 23:15 – 3/26/2021 @ 17:45
3/28/2021 @ 9:15 – 3/28/2021 @ 21:30
5/28/2021 @ 15:00 – 5/30/2021 @ 22:00
7/11/2021 @ 12:30 – 7/12/2021 @ 21:30
7/17/2021 @ 04:00 – 7/17/2021 @ 23:15
8/18/2021 @ 23:45 – 8/19/2021 @14:15
8/22/2021 @ 12:45 – 8/23/2021 @ 16:15
9/1/2021 @ 7:15 – 9/2/2021 @ 00:45
9/23/2021 @ 17:30 – 9/24/2021 @ 3:45
10/3/2021 @ 22:30 – 10/4/2021 @ 21:30
10/24/2021 @ 21:00 – 10/27/2021 @ 00:00

<u>Norrie Point</u>
The CR1000 at Norrie Point was considered out of calibration from 02/09/2020 00:15 through 03/05/2021 11:00 when the logger was swapped with a new CR1000X. Because of the out of calibration logger, all data are considered suspect, {CSM} <1> [SOC].

All parameters are missing 03/05/2021 11:15 – 16:45 and 03/10/2021 13:45 – 15:30, staff were testing out new programs for a CR1000X and TX312 with multiple iterations of programs causing a loss of data, <-2> [GPR] (CSM). Data at 03/05/2021 17:00 and 03/10/2021 15:45 were rejected due to a program upload that resulting in missing 5-second data.

Station maintenance on 03/05/2021 included the replacement of the CR1000 to a CR1000X datalogger and the TX312 to a TX325 transmitter. This also involved the deployment of a new test program. An error occurred during this process, resulting in missing wind data (0 recorded for values), <-3>[SSM](CSM) from 03/05/2021 17:15 - 03/11/2021 10:45. Air temperature, relative humidity, precipitation, and PAR data collected with the CR1000X are considered suspect 03/05/2021 17:00 – 03/11/2021 10:45, <1>[GMT](CSM). In addition to rejected wind data, NAN values for barometric pressure were recorded and were rejected until 03/10/13:30, flagging continued as suspect until 03/11/2021 10:45. All parameters from 03/11/2021 11:00 – 03/17/2021 13:15 are missing as a result of program testing. Staff and Jeff Adams from Campbell Scientific were working on program variations for the logger beginning 03/05/2021 and are not confident that there was a successful working version of the program was uploaded 03/17/2021 13:30.

Precipitation data were rejected due to accidental tips that occurred during station maintenance on 04/26/2021, 12:00 – 12:15 for total and through the end of the day for cumulative.

Precipitation data were marked as suspect from 6/11/2021 00:15 - 7/9/2021 10:30 due to a clogged rain bucket noted on the 7/9/2021 maintenance. Data appears to fit the conditions; however, it is unknown if this clog impacted the accuracy of rainfall data collected. Total precipitation at 10:45 and cumulative through the end of the day were rejected due to maintenance tips to clear the clog.

Precipitation data are missing due to maintenance to install a new rain gauge 08/06/2021 12:45 – 13:15 and were rejected. 8/6/2021 @ 13:30 – 8/11/2021 @ 10:30 <-3>[SMT] (CSM) – Sensor programming needed adjustment.