NOAA Technical Report NOS CO-OPS 026

# A Guide to CO-OPS SHEF and CREX Products

**September, 2001**
**Revised March 2002**
**Revised October 2004**
**Revised October 2013**


**noaa** National Oceanic and Atmospheric Administration

**U.S. DEPARTMENT OF COMMERCE**
**National Ocean Service**
**Center for Operational Oceanographic Products and Services**

## Center for Operational Oceanographic Products and Services

## National Ocean Service
## National Oceanic and Atmospheric Administration
## U.S. Department of Commerce

The National Ocean Service (NOS) Center for Operational Oceanographic Products and Services (CO-OPS) provides the National infrastructure, science, and technical expertise to collect and distribute observations and predictions of water levels and currents to ensure safe, efficient and environmentally sound maritime commerce. The Center provides the set of water level and tidal current products required to support NOS' Strategic Plan mission requirements, and to assist in providing operational oceanographic data/products required by NOAA's other Strategic Plan themes. For example, CO-OPS provides data and products required by the National Weather Service to meet its flood and tsunami warning responsibilities. The Center manages the National Water Level Observation Network (NWLON), a national network of Physical Oceanographic Real-Time Systems (PORTS®) in major U. S. harbors, and the National Current Observation Program consisting of current surveys in near shore and coastal areas utilizing bottom mounted platforms, subsurface buoys, horizontal sensors and quick response real time buoys. The Center: establishes standards for the collection and processing of water level and current data; collects and documents user requirements which serve as the foundation for all resulting program activities; designs new and/or improved oceanographic observing systems; designs software to improve CO-OPS' data processing capabilities; maintains and operates oceanographic observing systems; performs operational data analysis/quality control; and produces/disseminates oceanographic products.

**NOAA Technical Report NOS CO-OPS 026**

# A Guide to CO-OPS SHEF and CREX Products

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# REVISION HISTORY

| Date | Reason For Changes |
|---|---|
| 2001/09 | Initial Draft |
| 2002/03 | Minor revisions |
| 2004/10 | Minor revisions |
| 2013/11 | Major revisions:<br>Title of report changed from "A NWS Guide to the Use of NWLON and PORTS Computer-Based Products." Includes updates to SHEF and CREX products, and implementation of new SHEF and CREX products. |

# 1.0 INTRODUCTION

The Center for Operational Oceanographic Products and Services (CO-OPS) within the National Ocean Service (NOS) provides real-time oceanographic and meteorological information to meet its mission of supporting safe and efficient navigation, coastal hazards preparedness and response, and the understanding of climate change. Many CO-OPS products are web-based, such as data displays on the Tides and Currents website and Web Services, and meet the needs of the general public; however, a separate suite of data products are provided to specialized users who rely on specific formats to automatically ingest the data into their processing systems.

CO-OPS currently disseminates the following data products via the National Weather Service (NWS):

- CREX (Character Form for the Representation and Exchange of Data) Bulletins
  1. Observed Water Level and Meteorological Data
  2. Observed One-minute Water Level Data

- SHEF (Standard Hydrometeorological Exchange Format) Bulletins
  1. Observed Water Level and Meteorological Data
  2. Astronomical Tide Data
  3. Operational Forecast System Water Level Guidance

Both of these product types are human-readable formats that allow users to visually decode a message without the aid of a computer. They also allow for succinct packaging of large data sets.
International sea level community users especially rely on CREX-formatted water level data to monitor sea levels and detect tsunami signals within the high-frequency measurements. Within NOAA, the information disseminated via SHEF is particularly critical to the National Weather Service forecasters, who are responsible for providing marine forecasts and warnings for the protection of life and property along the bays and coasts of the United States.

## 2.0 BACKGROUND

CO-OPS is responsible for the management and operation of a network of observing systems installed along U.S. coastlines, estuaries and bays, and major U.S. harbors. These systems were established using state-of-the-art technology to measure water levels, currents, and meteorological data and they provide the baseline data for activities such as marine navigation and forecasting.

The CO-OPS water level stations are located along the U.S. coasts in major U.S. harbors, the Great Lakes and connecting channels, and the U.S. territories and possessions. Figure 1 shows an installation at Grand Isle, LA. The acoustic water level sensor (within a protective well) is to the right of the white enclosure that contains Data Collection Platforms. The standard configuration of meteorological sensors includes dual anemometers, an air temperature sensor and a barometer. All measurements are reported every six minutes, and at a subset of stations the primary water level sensor is also configured to report one-minute averaged data (excluding the Great Lakes) every minute. For more information on sensors and measurement algorithms, see 'The CO-OPS Sensor Specifications and Measurement Algorithms' [REF 1]. CO-OPS also ingests data from partner stations, such as the Texas Coastal Ocean Observing Network (TCOON). Partner data meet CO-OPS sensor and data collection standards and are treated the same as CO-OPS-owned data.

**Fig.1.** Grand Isle, LA water level station

Figure 2 provides an overview of the data flow originating from a CO-OPS station. Data are transmitted from the station mainly via GOES and/or Phone/IP modem, and a small number of stations transmit via Iridium. Measurements are relayed via the Geostationary Operational Environmental Satellite (GOES) in near real-time to a Direct Readout Ground Station (DRGS). The data are then distributed to various Unix servers where they are made available to users. Additionally, the data are rebroadcasted over the Domestic Communication Satellite System (DOMSAT) for users without access to a DRGS. For a subset of stations, CO-OPS uses a PC-based Data Acquisition System (DAS) running UNIX for data ingestion. The DAS polls installed instruments every six minutes through land line telephone calls, line-of-site radio communications, dedicated leased lines and/or IP modems. Using transfer protocols, data are sent from a central PC data collection platform located at NOAA headquarters via the local NOAA campus network to several CO-OPS special purpose workstations. If a station fails to transmit, data can also be manually downloaded. Once the data reach the Data Ingestion Server they are automatically decoded and quality-controlled before they are inserted into the database. The data also follow data dissemination controls that are manually set by the Continuous Operating Real-Time Monitoring System (CORMS) operators. The SHEF and CREX messages are developed during the ingestion process and then sent to the National Weather Service Telecommunications Gateway (NWSTG) via file transfer protocol (FTP). The NWSTG is the primary data exchange hub for NOAA data and products. SHEF messages are ingested into

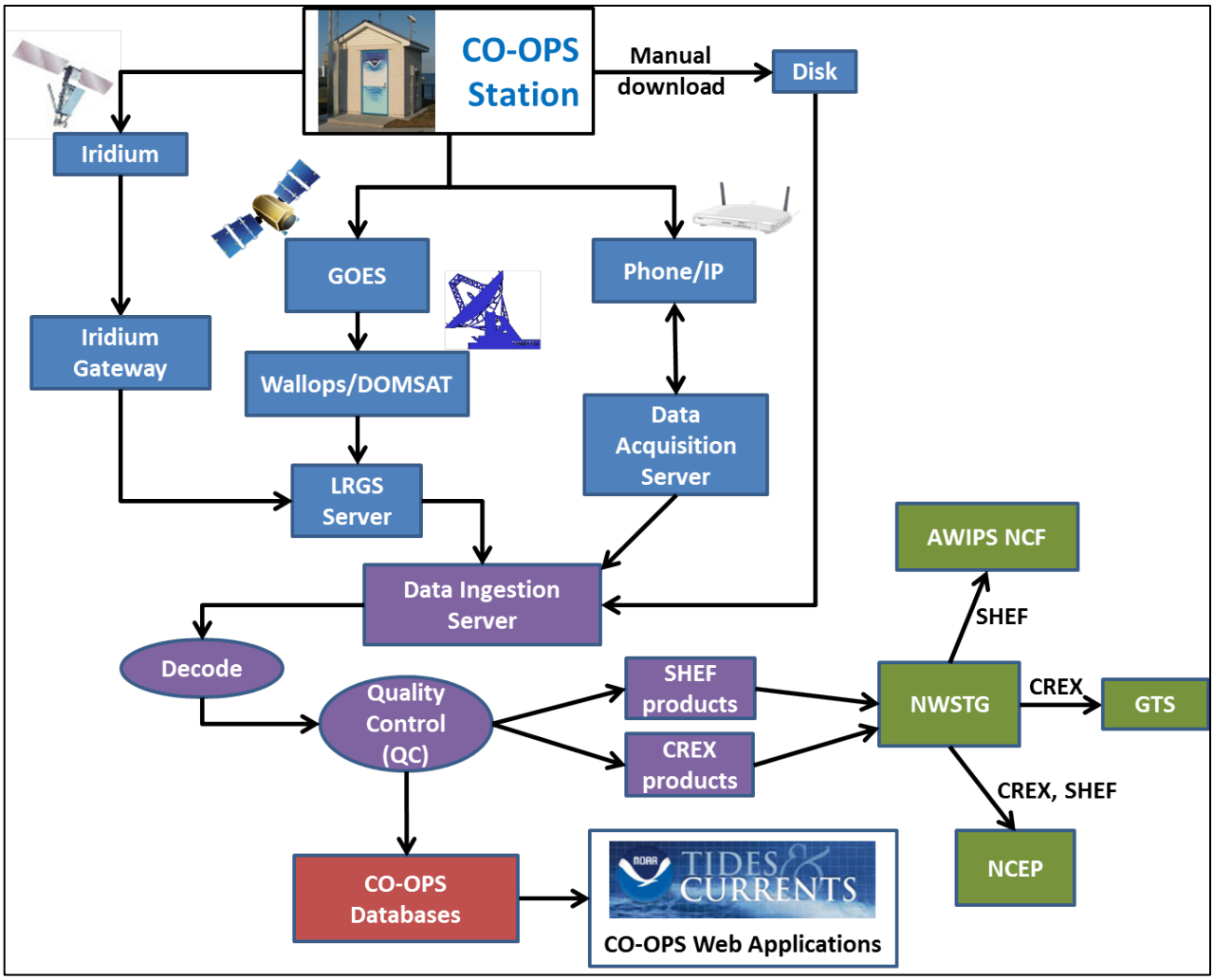


**Fig.2.** Data flow from CO-OPS stations. Boxes indicate hardware or a system, and ovals indicate an action performed on the data. Blue refers to the data acquisition process, purple to the data ingestion process, red to database insertion, and green to distribution through the NWS Telecommunications Gateway.

the Advanced Weather Interactive Processing System (AWIPS) Network Control Facility (NCF), which allows forecasters to view the data in AWIPS, a system heavily used by forecast centers. The NOAA/NWS National Centers for Environmental Prediction (NCEP) also ingests SHEF and CREX messages into their data tanks. CREX messages go through the Global Telecommunications Gateway (GTS) where they are accessible by the international user community. CO-OPS partner data are also included in the CREX and SHEF data products. A subset of these stations report via hourly GOES, however, therefore observations may not always populate the higher-frequency SHEF and CREX bulletins.

Each SHEF and CREX product is assigned a World Meteorological Organization (WMO) header that users require to identify the messages, and the stations data are grouped by geographic region under these headings. Both headers contain data type and geographical designators that allow users to identify the product at a glance. See Appendix 4 for a listing of the WMO and AWIPS headers.

# 3.0 CREX BULLETINS

CREX was developed by the WMO and intended as a temporary solution for countries that are unable to decode Binary Universal Form for the Representation of meteorological data (BUFR), which is the WMO standard format for international data exchange. CREX is a table-driven code form, which means that message elements pertain to a lookup table that describes the data within the message. Overall this format is a simpler, more efficient way to exchange data rather than traditional alphanumeric codes. BUFR is the binary mirror image of CREX, and later versions of CREX tables allow easy conversion from CREX to BUFR using conversion software. CO-OPS plans to develop BUFR messages in the near future, and will disseminate data in both CREX and BUFR until the WMO officially retires CREX.

The following describes each type of CREX bulletin that is available to users: Observed (six-minute) water level and meteorological bulletins, and one-minute water level bulletins.

## 3.1 Observed Water Level and Meteorological Bulletins

### 3.1.1 Water Level

CO-OPS generates CREX water level bulletins containing the most recent six samples of six-minute observed water level data and associated tidal residuals, which are calculated by subtracting astronomical tides from the observed water levels. Great Lakes stations are not tidal, therefore, residual values are not calculated. Bulletins containing the six-minute data are issued every thirty minutes. An example follows, and more detail on the CREX structure is provided in Appendix 2.

KSAA30 KWBC 311844
CREX++
T000119 A001 D01021 D06025++
3237339 -06470331 BEPB6 2013 07 31 17 54 3038 00 07 00 06
00644 -0021 00653 -0023 00669 -0018 00680 -0018 00687 -0020 00693 -0023+
4490460 -06698290 PSBM1 2013 07 31 17 54 2860 00 07 00 06
01263 0105 01343 0111 01426 0116 01511 0119 01596 0119 01685 0121++
7777

In the message header:

- **KSAA30 KWBC** is the WMO header for the North Atlantic CREX message, per Appendix 4.
- **311844**: The bulletin was created on day 31 at 18:44 GMT.

In the Data Description section:

- **D01021**: The message contains latitude and longitude.
- **D06025**: The message contains a station ID, date/time, sea surface temperature, quality control checks, and time increments, and a repeat of six water level values (referenced to chart datum) and associated residuals [REF 3]. Chart datum is Mean Lower Low Water (MLLW) for coastal areas, and Low Water Datum (LWD) for the Great Lakes.

In the Data section:

- **3237339** and **-06470331** are the latitude and longitude respectively, and are provided to 5 decimal places, as described in CREX/BUFR Table D [REF 3]. In this case, the coordinates are 32.37339 N and 64.70331 W. Note that positive latitude/longitude values correspond to North and East, respectively and negative values correspond to South and West, respectively.
- **BEPB6** is the National Weather Service Location Identifier (NWSLI) for Bermuda. Appendix 1 provides a list of the stations and associated NWSLI and NOS station identifiers.
- **2013 07 31 17 54** is the base time (7/31/2013 17:54 GMT) used to calculate the measurement times for the water level values contained in the bulletin for the given station.
- **3038** is the sea surface temperature in Kelvin to the tenths (303.8 K).
- **00 07** are two checks that indicate the overall quality of the data. The first set of digits is the automated water level check and indicates the quality of the data (see Appendix 5 for a list of all automated checks). **00**, per Appendix 5, indicates the data quality is good. The second set of digits is the manual water level check that is presently not used, therefore will always be set to **07**, as defined in WMO Manual on Codes [REF 2].
- **00 06** are time increments applied to the base time to calculate the measurement timestamp of the first and oldest water level value for the given station. **00** indicates the number of minutes that must be added to the first measurement, which is 0. The following **06** indicates the time increment between measurements, and is also added to the base time to determine the timestamp of the first measurement.

In a six-minute water level bulletin, a data record contains six water level values and six associated residuals (except at Great Lakes stations). All data are reported in GMT, and are in millimeters. To determine the time of each 6-minute measurement start with the base time provided in the station header record, which in this case is **7/31/2013 17:54 GMT**. The station header record indicates **00** minutes need to be added to **17:54** to calculate the measurement time for the first and oldest water level value. Then **06** minutes are added to the first value and then each succeeding measurement time. This means for BEPB6 the data listing is:

| Measurement date/time (GMT) | Observed water level (above MLLW) | Residual |
|---|---|---|
| 7/31/2013 18:00 | 0.644 m | -0.021 |
| 7/31/2013 18:06 | 0.653 m | -0.023 |
| 7/31/2013 18:12 | 0.669 m | -0.018 |
| 7/31/2013 18:18 | 0.680 m | -0.018 |
| 7/31/2013 18:24 | 0.687m | -0.020 |
| 7/31/2013 18:30 | 0.693 m | -0.023 |

### 3.1.2 Meteorological

The water level bulletins are supplemented by separate meteorological bulletins every thirty minutes. The meteorological bulletins contain one observation of surface winds, air temperature and barometric pressure (adjusted to mean sea level) for the most recent thirty-

minute transmission. Not all stations have all sensors, so it is possible to have meteorological bulletins that do not contain information for all of the given data types. Wind observations are at the height of the installed anemometer, which is typically 8-10 meters. Meteorological sensor elevations are available on the CO-OPS website, on the station information page for each station [REF 4]. The following is an example of a meteorological message:

KSAA30 KWBC 311844 RRA
CREX++
T000119 A001 D01021 D06021++
3237339 -06470331 BEPB6 2013 07 31 18 00 00 07 285 10218 315 0020+
4490460 -06698290 PSBM1 2013 07 31 18 00 00 07 180 10157 157 0048+
2455570 -08180790 KYWF1 2013 07 31 18 00 00 07 329 10176 /// ////++
7777

WMO headers for meteorological CREX bulletins are the same as the six-minute water level bulletins. The **RRA** indicates that this bulletin is supplemental to the water level bulletin.

In the Data Description section the only difference from the 6-minute water level message is the sequence **D06021**, which indicates the message contains a station ID, date/time (GMT), data checks, air temperature (°C), barometric pressure adjusted to Mean Sea Level (mb), wind direction (degrees true), and wind speed (m/s) [REF 3].

In the Data section, the data provided are for the time stamp within the message. In this case, for **BEPB6**, the date of the measurements is **7/31/2013 18:00** GMT. The following values are listed in the order of the **D06021** parameters. All data are provided to the nearest tenth, except wind direction. In this example, for BEPB6 at 7/31/2013 18:00 GMT:

| | | |
|---|---|---|
| Air temperature | **285** | 28.5 °C |
| Barometric pressure | **10218** | 1021.8 mb |
| Wind direction | **315** | 315 degrees |
| Wind speed | **0020** | 2.0 m/s. |

Not all stations contain every meteorological sensor, and any missing values will be presented as ////.

### 3.2 Observed One-minute Water Level Bulletins

In addition to the routine six-minute data bulletins, CO-OPS also generates one-minute water level bulletins containing the most recent six samples of one-minute water level data. Tidal residuals are not produced for one-minute observations, therefore are not included. These bulletins are issued every three minutes. One-minute data are not collected at Great Lakes stations or stand-alone meteorological stations. See Appendix A for a list of stations that collect one-minute water levels. These bulletins are similar to the six-minute CREX bulletins but contain different sequences in the data description section, explained below:

SZAK35 KWBC 311848
CREX++
T000119 A001 D01021 D06019 R01006 B22038++

5533183 -13162619 KECA2 2013 07 31 18 31 2868 00 07 00 01
02666 02660 02654 02647 02641 02635+
5624670 -13464700 PLXA2 2013 07 31 18 31 2838 00 07 00 01
01787 01792 01793 01785 01772 01760++
7777

In the message header:

- **SZAK35 KWBC** is the WMO header for the Alaska Region CREX message, per Appendix 4.
- **311848**: The bulletin was created on day 31 at 18:48 GMT.

In the Data Description section:

- **D01021**: The message contains latitude and longitude.
- **D06019**: The message contains a station ID, date/time, sea surface temperature, quality control checks, and time increments [REF 3].
- **R01006** is a replicator and is applied to the following **1** element repeated **6** times.
- **B22038** refers to "tidal elevation with respect to local chart datum." Since only coastal stations measure 1-minute water levels, the chart datum is MLLW. Therefore, 6 tidal elevation values are provided, as specified by the R01006.

In the Data section:

- **55333183** and **-13162619** are the latitude and longitude respectively, and are provided to 5 decimal places. In this case, the coordinates are 55.33183 N and 131.62619 W. Note that positive latitude/longitude values correspond to North and East, respectively and negative values correspond to South and West, respectively.
- **KECA2** is the NWSLI for Ketchikan, AK. Appendix 1 provides a list of the CO-OPS and partner stations and associated NWSLI and NOS stations.
- **2013 07 31 18 31** is the base time (07/31/2013 18:31 GMT) used to calculate the measurement times for the water level values contained in the bulletin for the given station. All data are in GMT.
- **2868** is the sea surface temperature in Kelvin to the tenths (286.8 K).
- **00 07** are two checks that indicate the overall quality of the data. The first set of digits is the automated water level check and indicates the quality of the data (see Appendix 5 for a list of all automated checks). **00**, per Appendix 5, indicates the data quality is good. The second set of digits is the manual water level check that is presently not used, therefore will always be set to **07**, as defined in WMO Manual on Codes [REF 2].
- **00 01** are time increments applied to the base time to calculate the measurement time of the first and oldest water level value for the given station. **00** indicates the number of minutes that must be added to the first measurement, which is 0. The following **01** indicates the time increment between measurements, which is also applied to the first measurement.

In a 1-minute water level bulletin, a data record contains six water level values reported in millimeters. To determine the time of each 1-minute measurement start with the time provided in the station header record, which in this case is **7/31/2013 18:31 GMT**. The station header record indicates **00** minutes need to be added to **18:31** to calculate the measurement time for the first and oldest water level value. Then **01** minutes are applied to

the first value to determine each succeeding measurement time. This means for KECA2 the data listing is:

| Measurement date/time (GMT) | Observed water level |
|---|---|
| **7/31/2013 18:32** | 2.666 m |
| **7/31/2013 18:33** | 2.660 m |
| **7/31/2013 18:34** | 2.654 m |
| **7/31/2013 18:35** | 2.647 m |
| **7/31/2013 18:36** | 2.641 m |
| **7/31/2013 18:37** | 2.635 m |

# 4.0 SHEF BULLETINS

SHEF was originally designed by the NWS for interagency sharing of hydrometeorological information. This standard format allows different agencies to use the same decoder to process the data, and the format also allows for flexibility when adding new data sources. Data in these formats are easily ingested into processing systems for easy comparison of CO-OPS observed water levels to astronomical tides and coastal marine meteorological observations.

Currently, three types of SHEF bulletins are distributed to the NWS: observed water level and meteorological data, OFS water level model guidance, and astronomical tide data. Appendix 3 (SHEF Bulletin Descriptions) describes SHEF bulletin syntax in more detail.

## 4.1 Observed Water Level and Meteorological Bulletins

CO-OPS generates SHEF bulletins every ten minutes beginning at nine minutes past the hour. These bulletins contain the six-minute observations reported from stations, and do not include residuals or astronomical tides.

**Water level**

SOUS41 KWBC 282109
TIDNT
:SHEF ENCODED 6 MINUTE NOS WATER LEVEL DATA
:NATIONAL WATER LEVEL OBSERVATION NETWORK (NWLON)
:WATER LEVEL VALUES REFERENCED TO MLLW IN FEET
:PROVIDED BY DOC/NOAA/NOS/CO-OPS
:corms@noaa.gov 301-713-2540
.E PSBM1 20130828 Z DH2048/HMIRG/DIN06/ 17.89 / 17.98
.E ATGM1 20130828 Z DH2054/HMIRG/DIN06/ 10.85
.E CASM1 20130828 Z DH2048/HMIRG/DIN06/ 9.35 / 9.40
.E WELM1 20130828 Z DH2054/HMIRG/DIN06/ 9.05

Message header:

- **SOUS41 KWBC** is the WMO header for surface observations in the North Atlantic, per Appendix 4.
- **282109**: The bulletin was created on day 28 at 21:09 GMT.
- **TIDNT** is the AWIPS header for water level data in the North Atlantic Region, per Appendix 4.

Positional Fields:

- The **.E** format is used (single station, single parameter time-series).
- **PSBM1** is the NWSLI for Eastport, ME. Appendix 1 provides a list of stations and associated NWSLI and NOS station identifiers.
- **20130828** (year/month/day) is the observation date that is to be associated with the first water level value.
- **Z** indicates that the time zone is GMT. If the data are from a Great Lakes station, the time zone will be **CS** (Central Standard) or **ES** (Eastern Standard).

Data string:

- **DH2048** indicates that the observation time associated with the initial water level value is 20:48 GMT, and is in the hour/minute format.
- **HMIRG** are the parameter codes, which in this example indicates observed tide data referenced to MLLW and received via GOES.
  - The **HM** designates water level data that have been corrected to MLLW (Mean Lower Low Water). An **HH** in this position indicates the water level data are corrected to Mean Sea Level (MSL) and an **HG** in this position refers to height above river stage.
  - The **I** indicates the data are instantaneous.
  - All observed water level values will have either **RG** to indicate the value is received via GOES, or **RP** to indicate the value is received via phone or IP. Oftentimes, stations are set up with redundant modes of communication, and the SHEF messages will contain two lines of duplicate data values from each data source (e.g. HMIRG and HMIRP).
- The time interval, **DIN06**, indicates a time increment unit of minutes (**N**) and the interval is **6**. Therefore, the data are 6-minute observations.

The remaining values in the .E records associated with the given station are the water level data reported in feet. To determine the date and time of each measurement, start with the observation date and time, which in this case is **8/28/2013 20:48 GMT**. This is the date and time for the first measurement. Since Data Interval designator indicates there is a 6-minute increment between each data measurement, 6 minutes are to be added to this time to determine the next measurement time, and so on. Therefore, the water level values for Eastport in this example are:

| **Measurement date/time (GMT)** | **Observed water level (MLLW)** |
|---|---|
| **8/28/2013 20:48** | 17.89 ft |
| **8/28/2013 20:54** | 17.98 ft |

## Meteorological

If meteorological data exists for a station, a meteorological SHEF bulletin is generated at the same time that the SHEF water level bulletin is generated, but under a different WMO header so that the bulletins are not overwritten. Currently, the meteorological parameters that can be included in the bulletin are air temperature, barometric pressure (sea level), wind speed, wind direction, wind gusts, water conductivity, and water temperature (sea surface). Not all stations have all sensors, so it is possible to have meteorological bulletins that do not contain information for all of the given data types. Should a new type of meteorological sensor be installed at a station, the data collected from that sensor for the given station would be added to the bulletin. Each meteorological bulletin includes the six-minute meteorological data value for each data type from the most recent transmission.

SXUS51 KWBC 161839
OSONT
:SHEF ENCODED 6-MINUTE NOS MET DATA
:NATIONAL WATER LEVEL OBSERVATION NETWORK (NWLON)
:TA(AIR TEMP DEG F)  SLP(SEA LEVEL PRESSURE INCHES)
:UD(WIND DIRECTION WHOLE DEGREES) US (WIND SPEED MPH)
:TW(WATER TEMP DEG F) UG(WIND GUSTS MPH) WC(CONDUCTIVITY uMHOS/CM)
:-9999 (MISSING VALUES)
:PROVIDED BY DOC/NOAA/NOS/CO-OPS, (301) 713-2540
:corms@noaa.gov
.A NWPR1 20130916 Z DH1830/TAIRP -9999/UGIRP 6/PLIRP 30.01/UDIRP 324/USIRP 5/TWIRP 65/WCIRP -9999
.E CPTR1 20130916 Z DH1824/TAIRG/DIN06/  61/  61/-9999
.E CPTR1 20130916 Z DH1824/PLIRG/DIN06/30.03/30.02/-9999
.E CPTR1 20130916 Z DH1824/USIRG/DIN06/  7/  6/-9999
.E CPTR1 20130916 Z DH1824/UDIRG/DIN06/  294/  297/-9999
.E CPTR1 20130916 Z DH1824/UGIRG/DIN06/  9/  8/-9999
.E CPTR1 20130916 Z DH1824/TWIRG/DIN06/  70/  70

Message header:

- **SXUS51 KWBC** is the WMO header for meteorological surface data in the North Atlantic, per Appendix 4.
- **161839**: The bulletin was created on day 16 at 18:39 GMT.
- **OSONT** is the AWIPS header for meteorological data in the North Atlantic Region, per Appendix 4.

Positional Fields:

- Both .A and .E formats are used within the bulletin.  On the first data line in the above example, the meteorological data for the given station is reported using the .A format (single station, multiple parameters).
- **NWPR1** is the NWSLI for Newport, Rhode Island.  Appendix 1 provides a list of stations and associated NWSLI and NOS station identifiers.
- **20130916** (year/month/day) is the observation date that is to be associated with the meteorological value(s).
- **Z** specifies that the data are being reported in GMT. If the data are from a Great Lakes station, this time is local standard time (**CS** for Central Standard or **ES** for Eastern Standard).

Data string:

- **DH1830** indicates that the observation time is 18:30 GMT.
- There are several parameter codes included in the meteorological bulletins, as seen in the above example, e.g. **TAIRG**, **UGIRG**, etc.  These differentiate the sensor reported.
    - Physical elements:
        - **TA**  for air temperature (degrees Fahrenheit),
        - **UG**  for wind gusts (miles per hour),
        - **PL**  for barometric pressure (sea level, inches),
        - **UD**  for wind direction (degrees),

- **US** for wind speed (miles per hour),
- **TW** for water temperature (sea surface, degrees Fahrenheit),
- **WC** for water conductivity (uMHOS/CM).

- The **I** indicates the data are instantaneous.
- All observed water level values will have either **RG** to indicate the value is received via GOES, or **RP** to indicate the value is received via phone or IP.

Therefore, the data for Newport, RI in this example are:

| Measurement date/time (GMT) | Parameter | Observed data |
|---|---|---|
| **9/16/2013 18:30** | Air temperature | Not reported |
| | Wind gust | 6 mph |
| | Barometric pressure | 30.01 in |
| | Wind direction | 324 deg |
| | Wind speed | 5 mph |
| | Water temperature | 65 F |
| | Conductivity | Not reported |

The meteorological data for the next station are reported using the .E format, meaning only one data type is provided as a time-series. The NWSLI is **CPTR1** for Conimicut Light, RI. The observation date and time associated with the first meteorological value is 9/16/2013 18:24 GMT. The parameter codes are interpreted in the same manner as described previously for the .A-formatted records. TAIRG indicates the data are air temperature observations, transmitted via GOES. Since these are a time-series format, the first air temperature value at 18:24 GMT is 61 F, and the next value increments six minutes (18:30 GMT) and is 61 F.

### 4.2 Astronomical Tide Bulletins

CO-OPS generates SHEF astronomical tide (also referred to as predicted tide) bulletins once per day at twenty minutes after midnight (GMT). Each bulletin contains ninety-six hourly water level predictions for each station within the given region, starting with 00:00 GMT of the day the report is run and ending with 23:00 GMT four days into the future. Since Great Lakes stations do not have tides, predictions are not calculated for these stations.

```
SOUS61 KWBC 160120
TIDNT
:SHEF ENCODED 1 HOUR NOS WATER LEVEL PREDICTED DATA
:NATIONAL WATER LEVEL OBSERVATION NETWORK (NWLON)
:WATER LEVEL VALUES REFERENCED TO MLLW IN FEET (HMIFA)
:AND MSL IN FEET (HHIFA) PROVIDED BY DOC/NOAA/NOS/CO-OPS
:(301)713-2540, corms@noaa.gov
.E PSBM1 20130916 Z DH0000/DC09160000/HMIFA/DIH1/ 19.52/ 18.07/ 14.88/ 10.79
.E1   6.35/  2.28/ -0.17/  0.06/  2.75/  6.88/ 11.61/ 15.96/ 18.53/ 18.51
.E2  16.31/ 12.80/  8.64/  4.37/  1.04/  0.04/  1.78/  5.50/ 10.24/ 15.15
.E3  18.85/ 20.05/ 18.61/ 15.33/ 11.00/  6.20/  1.78/ -0.80/ -0.51/  2.35
```

.E4 6.80/ 11.99/ 16.70/ 19.37/ 19.27/ 16.88/ 13.08/ 8.50/ 3.79/ 0.23
.E5 -0.77/ 1.15/ 5.15/ 10.31/ 15.60/ 19.45/ 20.56/ 18.94/ 15.42/ 10.79
.E6 5.65/ 1.04/ -1.45/ -0.87/ 2.37/ 7.25/ 12.84/ 17.71/ 20.24/ 19.82
.E7 17.08/ 12.89/ 7.90/ 2.90/ -0.67/ -1.39/ 0.90/ 5.29/ 10.83/ 16.33
.E8 20.05/ 20.84/ 18.87/ 15.04/ 10.11/ 4.78/ 0.24/ -1.88/ -0.78/ 2.93
.E9 8.22/ 14.04/ 18.79/ 20.88/ 19.96/ 16.77/ 12.21/ 6.94/ 1.88/ -1.40
.E10 -1.61/ 1.17

Message header:

- **SOUS61 KWBC** is the WMO header for data generated in the North Atlantic, per Appendix 4.
- **160120**: The bulletin was created on day 16 at 01:20 GMT.
- **TIDNT** is the AWIPS header for tide data in the North Atlantic Region, per Appendix 4.

Positional Fields:

- Only the **.E** format is used (single station, single parameter time-series).
- On the first .E line in the example, **PSBM1** is the NWSLI for Eastport, ME. Appendix 1 provides a list of stations and associated NWSLI and NOS station identifiers.
- **20130916** (year/month/day) is the date associated with the first astronomical tide value.
- **Z** specifies that the data are being reported in GMT.

Data string:

- **DH0000** indicates that the time of the first astronomical tide value is 00:00 GMT.
- **DC09160000** (month/day/time) is the creation date of 09/16 00:00 GMT. Although this information is already included within the bulletin, and thus may seem redundant, the creation date is included to avoid generating a 'nonfatal SHEF error' in decoders. Therefore, CO-OPS has chosen to include this DC field with the same month/day/hour/minute information contained in **20130916** and **DH0000**.
- **HMIFA** is the parameter code for the predicted tide data. (Note: In previous versions, HMIFZ was used but has been changed to FA as of Dec. 2012.).
    - **HM:** Water level data that have been corrected to MLLW. An **HH** in this position would designate water level data that have been corrected to MSL.
    - **I** indicates the data are instantaneous.
    - **FA** indicates adjusted forecast model data, per the NWS SHEF Code Manual [REF 5].
    - The final set of characters in the header, **DIH1**, indicates a time increment of 1 hour between each data measurement.

The remaining values are astronomical tides above MLLW, reported in feet. The date and time for the first measurement is 09/16/2013 00:00 GMT, and the Data Interval designator indicates 1 hour is to be added to this time to determine the next value timestamp, and so on. Therefore, the tide predictions for Eastport in this example are:

| Date/time (GMT) | Astronomical tide (MLLW) |
|---|---|
| **9/16/2013 00:00** | 19.52 ft |
| **9/16/2013 01:00** | 18.07 ft |

| | |
|---|---|
| **9/16/2013 02:00** | **14.88 ft** |
| . | |
| . | |
| . | |
| **9/19/2013 21:00** | -1.40 ft |
| **9/19/2013 22:00** | -1.61 ft |
| **9/19/2013 23:00** | 1.17 ft |

### 4.3 OFS Water Level Guidance Bulletins

In December 2012, CO-OPS released new SHEF bulletins containing Operational Forecast System (OFS) water level model guidance from the OFS models. Ten OFS models (Chesapeake Bay, Delaware Bay, Tampa Bay, Northern Gulf of Mexico, Columbia River Estuary, and the five Great Lakes models) produce 48-hour model guidance of time series data updated every 6 hours, and two models (New York/New Jersey and St. Johns River) provide 24-hour model guidance updated every 6 hours. Modeled water levels are total water levels (astronomical tide plus surge). CO-OPS models are not designed as a storm surge model, although meteorological conditions are taken into account. Model guidance is only provided at the location of active and historical water level station locations (Appendix 1). Historical stations are stations that have been physically removed and are no longer used. Model grid points outside these locations are not included. Thus, the OFS Water Level SHEF bulletins contain the full 48-hour or 24-hour model guidance of 30-minute data, and are issued every 6 hours to remain consistent with the OFS output. More information on the OFS models can be found on the CO-OPS website [REF 4].

```
SOUS41 KWBC 191630
TIDCB
:SHEF ENCODED 30 MINUTE WATER LEVEL MODEL GUIDANCE
:WATER LEVEL VALUES REFERENCED TO MLLW IN FEET (HMIFU)
:TIME ZONE IS UTC
:WATER LEVEL MODEL GUIDANCE IS FOR TOTAL WATER LEVELS
:PROVIDED BY DOC/NOAA/NOS/CO-OPS
:corms@noaa.gov 301-713-2540
.E SWPV2 20121119 Z DH1200/DC11191200/HMIFU/DIN30/  1.537 /  1.644 /  1.809 /  2.064 /  2.433
.E1   3.254/  3.571 /  3.819 /  4.057 /  4.245 /  4.346 /  4.386 /  4.328 /  4.187 /  3.972 /  3.768 /  3.555
.E2   3.257/  2.910 /  2.537 /  2.212 /  1.941 /  1.781 /  1.716 /  1.716 /  1.759 /  1.872 /  2.058 /  2.321
.E3   2.641/  2.992 /  3.321 /  3.600 /  3.810 /  3.955 /  4.019 /  4.013 /  3.956 /  3.848 /  3.696 /  3.515
.E4   3.300/  3.037 /  2.723 /  2.396 /  2.110 /  1.895 /  1.773 /  1.737 /  1.773 /  1.859 /  2.004 /  2.214
.E5   2.489/  2.813 /  3.154 /  3.484 /  3.763 /  3.975 /  4.102 /  4.140 /  4.115 /  4.027 /  3.890 /  3.709
.E6   3.505/  3.256 /  2.940 /  2.577 /  2.218 /  1.908 /  1.678 /  1.536 /  1.471 /  1.469 /  1.524 /  1.636
.E7   1.818/  2.071 /  2.382 /  2.731 /  3.060 /  3.350 /  3.579 /  3.734 /  3.812 /  3.811 /  3.762 /  3.665
.E8   3.523/  3.342 /  3.119 /  2.853 /  2.548 /  2.246 /  1.987
```

Message header:

- **SOUS41 KWBC** is the WMO header for surface data in the North Atlantic, per Appendix 4.
- **191630**: The bulletin was created on day 19 at 16:30 GMT.
- **TIDCB** is the AWIPS header, and pertains to the Chesapeake Bay OFS, per Appendix 4.

Positional Fields:

- Only the.E format is used (single station, single parameter time-series).
- On the first .E line in the above example, **SWPV2** is the NWSLI for Sewells Point, VA. Appendix 1 provides a list of active and historical stations that may be used in the OFS bulletins.
- **20121119** (year/month/day) is the date that is to be associated with the first model guidance value.
- **Z** specifies that the data are being reported in GMT.

Data string:

- **DH1200** indicates that the time of the first value is 12:00 GMT.
- **DC11191200** is the creation date of 11/19 at 12:00 GMT, which is the date and time that the model guidance is valid. In this case, the Chesapeake Bay OFS model was run on 11/19 at 12:00 GMT.
- **HMIFU** is the parameter code for the model guidance data.
    - **HM** designates the generation of forecast water level data that has been corrected to MLLW (Mean Lower Low Water). An **HH** in this position would designate water level data that have been corrected to MSL (Mean Sea Level) and an **HG** in this position refers to height above river stage.
    - The **I** indicates the data are instantaneous.
    - **FU** indicates unadjusted forecast model data, per the NWS SHEF Code Manual [REF 5].
- The final set of characters in the header, **DIN30**, indicates a time increment of thirty minutes between each data measurement.

The remaining values are the water level guidance reported in feet. The date and time of the first value is **11/19/2012 12:00**. Thirty minutes needs to be added to this time to determine the timestamp of the next value, and so on. Therefore, the model guidance for Sewells Point in this example is:

| Date/time (GMT) | Water Level Guidance (MLLW) |
|---|---|
| **11/19/2012 12:00** | 1.537 ft |
| **11/19/2012 12:30** | 1.644 ft |
| **11/19/2012 13:00** | 1.809 ft |
| . | |
| . | |
| . | |
| **11/21/2012 10:30** | 2.548 ft |
| **11/21/2012 11:00** | 2.246 ft |
| **11/21/2012 11:30** | 1.987 ft |

# 5.0 INFORMATION

## 5.1 Station Status

CO-OPS maintains an interface on its Web Services home page that provides a convenient view of the sensor dissemination status for each CO-OPS and CO-OPS partner station. This sensor status display is located at http://opendap.co-ops.nos.noaa.gov/stations/index.jsp. If dissemination of a sensor is stopped by the CORMS quality control operators, then the data will not be included in the SHEF and CREX bulletins. Dissemination will be turned off if stations or sensors are not transmitting data, are malfunctioning, are undergoing maintenance, or an event has temporarily or permanently impacted the operation of the station. If an entire station is not operating, the station will not be listed in the CREX and SHEF bulletins. Stations are listed by a seven-digit NOS identifier. To determine the associated NWS Location Identifier (NWSLI, or sometimes referred to as a SHEF ID) associated with the station, see Appendix 1, or the Web Services XML file of active water level/meteorological stations located here: http://opendap.co-ops.nos.noaa.gov/axis/webservices/activestations/response.jsp?v=2&format=xml&Submit=Submit

## 5.2 Product Changes/Updates

Any changes to CREX or SHEF products will be communicated through a Service Change Notice (SCN), per NWS Directive 10-1805 [REF 7], which will be posted on the NWS Office of Climate, Water and Weather Services website: http://www.nws.noaa.gov/om/notif.htm. The SCN will provide a thirty-day lead time for users to adjust their decoders or applications. Users who subscribe to these notices will automatically receive the updates, and they are also ingested into AWIPS. In addition to the SCN, CREX changes will be posted to the GTS thirty days ahead of time. All notifications will include the product WMO header, and if applicable, AWIPS header, as well as an implementation date.

## 5.3 Reporting Problems

It is expected that from time to time there may be questions regarding the operation of these various products or suggestions for improvement. Users should contact CO-OPS User Services (Tide.Predictions@noaa.gov, 301-713-2890) for any questions related to the data or products.

## REFERENCES


1. CO-OPS Sensor Specifications and Measurement Algorithms, July 2013
   http://tidesandcurrents.noaa.gov/publications/CO-OPS_Measure_Spec_07_July_2013.pdf

2. World Meteorological Organization Manual on Codes (WMO-No. 306)
   http://www.wmo.int/pages/prog/www/WMOCodes.html

3. World Meteorological Organization BUFR/CREX Tables
   http://www.wmo.int/pages/prog/www/WMOCodes/WMO306_vI2/PrevVERSIONS/20121107/20121107.html

4. CO-OPS website: http://tidesandcurrents.noaa.gov/

5. NWS SHEF Code Manual
   http://www.nws.noaa.gov/om/water/resources/SHEF_CodeManual_5July2012.pdf

6. World Meteorological Organization Manual on the Global Telecommunication System (WMO – No. 386)
   http://www.wmo.int/pages/prog/www/ois/Operational_Information/Publications/WMO_386/WMO_386_Vol_I_2009_en.pdf

7. National Weather Service Directive 10-1805 National Service Change and Technical Implementation Notices
   http://www.nws.noaa.gov/directives/sym/pd01018005curr.pdf

8. National Weather Service Directive 10-101 Change Management Process
   http://www.nws.noaa.gov/directives/sym/pd01001001curr.pdf

# APPENDIX 1: STATION LIST

Below is a list of the stations included in the CREX and SHEF messages. Both the NOS and NWS identifiers are given, along with the common station name, and its latitude and longitude. NOS station identifiers have been assigned by NOS, and are always 7 digits in length. The NWS Location Identifiers are assigned by NWS and are 5 alphanumeric characters in length. Latitude and Longitude (decimal degrees) are the historical positions identified when the station was first established, and were used to determine the NOS ID. However, some stations that were destroyed and rebuilt, or relocated, might have different positions than what is listed below. Please contact tide.predictions@noaa.gov with any questions.

To see any changes made to this listing between revision releases of this document, connect to CO-OPS Web Services Data Inventory page and select an NOS ID:
**http://opendap.co-ops.nos.noaa.gov/axis/webservices/datainventory/index.jsp**

## Active stations:

| NOS ID | NWSLI | LAT | LON | LOCATION | Has 1-min WL Data |
|---|---|---|---|---|---|
| 1611400 | NWWH1 | 21.95440 | -159.35610 | Nawiliwili, HI | ✓ |
| 1612340 | OOUH1 | 21.30669 | -157.86700 | Honolulu, HI | ✓ |
| 1612480 | MOKH1 | 21.43303 | -157.78989 | Mokuoloe, HI | ✓ |
| 1615680 | KLIH1 | 20.89500 | -156.47669 | Kahului, HI | ✓ |
| 1617433 | KWHH1 | 20.03660 | -155.82940 | Kawaihae, HI | ✓ |
| 1617760 | ILOH1 | 19.73031 | -155.05589 | Hilo, HI | ✓ |
| 1619910 | SNDP5 | 28.21170 | -177.36000 | Sand Island, Midway Islands | ✓ |
| 1630000 | APRP7 | 13.44310 | 144.65560 | Apra Harbor, Guam | ✓ |
| 1631428 | PGBP7 | 13.42830 | 144.79890 | Pago Bay, Guam | ✓ |
| 1770000 | NSTP6 | -14.27661 | -170.68931 | Pago Pago, American Samoa | ✓ |
| 1820000 | KWJP8 | 8.73200 | 167.73439 | Kwajalein, Marshall Islands | ✓ |
| 1890000 | WAKP8 | 19.29067 | 166.61758 | Wake Island, Pacific Ocean | ✓ |
| 2695540 | BEPB6 | 32.37331 | -64.70331 | Bermuda Esso Pier | ✓ |
| 8311030 | OBGN6 | 44.70286 | -75.49444 | Ogdensburg, NY | |
| 8311062 | ALXN6 | 44.33111 | -75.93453 | Alexandria Bay, NY | |
| 8410140 | PSBM1 | 44.90331 | -66.98500 | Eastport, ME | ✓ |
| 8411060 | CFWM1 | 44.65703 | -67.20467 | Cutler Farris Wharf, ME | ✓ |
| 8413320 | ATGM1 | 44.39219 | -68.20428 | Bar Harbor, ME | ✓ |
| 8418150 | CASM1 | 43.65670 | -70.24670 | Portland, ME | ✓ |
| 8419317 | WELM1 | 43.32000 | -70.56331 | Wells, ME | ✓ |
| 8423898 | FTPN3 | 43.07170 | -70.71170 | Fort Point, NH | |
| 8443970 | BHBM3 | 42.35480 | -71.05340 | Boston, MA | ✓ |
| 8447386 | FRVM3 | 41.70430 | -71.16410 | Fall River, MA | ✓ |
| 8447387 | BLTM3 | 41.70500 | -71.17330 | Borden Flats Light, MA | |

| | | | | | |
|---|---|---|---|---|---|
| 8447930 | BZBM3 | 41.52330 | -70.67170 | Woods Hole, MA | ✓ |
| 8449130 | NTKM3 | 41.28500 | -70.09670 | Nantucket Island, RI | ✓ |
| 8452660 | NWPR1 | 41.50500 | -71.32670 | Newport, RI | ✓ |
| 8452944 | CPTR1 | 41.71670 | -71.34330 | Conimicut Light, RI | ✓ |
| 8452951 | PTCR1 | 41.63717 | -71.33928 | Potter Cove, RI | |
| 8454000 | FOXR1 | 41.80710 | -71.40120 | Providence, RI | ✓ |
| 8454049 | QPTR1 | 41.58680 | -71.41100 | Quonset Point, RI | ✓ |
| 8461490 | NLNC3 | 41.36139 | -72.08997 | New London, CT | ✓ |
| 8465705 | NWHC3 | 41.28330 | -72.90830 | New Haven, CT | ✓ |
| 8467150 | BRHC3 | 41.17330 | -73.18170 | Bridgeport, CT | ✓ |
| 8510560 | MTKN6 | 41.04830 | -71.96000 | Montauk, NY | ✓ |
| 8516945 | KPTN6 | 40.81030 | -73.76490 | Kings Point, NY | ✓ |
| 8518750 | BATN6 | 40.70060 | -74.01420 | The Battery, NY | ✓ |
| 8519483 | BGNN4 | 40.63670 | -74.14170 | Bergen Point West Reach, NY | |
| 8530973 | ROBN4 | 40.65670 | -74.06500 | Robbins Reef, NJ | |
| 8531680 | SDHN4 | 40.46690 | -74.00940 | Sandy Hook, NJ | ✓ |
| 8534720 | ACYN4 | 39.35500 | -74.41830 | Atlantic City, NJ | ✓ |
| 8536110 | CMAN4 | 38.96833 | -74.96000 | Cape May, NJ | ✓ |
| 8537121 | SJSN4 | 39.30500 | -75.37500 | Ship John Shoal, NJ | ✓ |
| 8538886 | TPBN4 | 40.01194 | -75.04300 | Tacony-Palmyra Bridge, NJ | ✓ |
| 8539094 | BDRN4 | 40.08170 | -74.86970 | Burlington, NJ | ✓ |
| 8540433 | MRCP1 | 39.81170 | -75.41000 | Marcus Hook, PA | ✓ |
| 8545240 | PHBP1 | 39.93333 | -75.14167 | Philadelphia, PA | ✓ |
| 8548989 | NBLP1 | 40.13670 | -74.75170 | Newbold, PA | ✓ |
| 8551762 | DELD1 | 39.58170 | -75.58830 | Delaware City, DE | ✓ |
| 8551910 | RDYD1 | 39.55831 | -75.57331 | Reedy Point, DE | ✓ |
| 8557380 | LWSD1 | 38.78169 | -75.12000 | Lewes, DE | ✓ |
| 8570283 | OCIM2 | 38.32833 | -75.09167 | Ocean City Inlet, MD | ✓ |
| 8571421 | BISM2 | 38.22000 | -76.03830 | Bishops Head, MD | ✓ |
| 8571892 | CAMM2 | 38.57330 | -76.06830 | Cambridge, MD | ✓ |
| 8573364 | TCBM2 | 39.21333 | -76.24500 | Tolchester Beach, MD | ✓ |
| 8573927 | CHCM2 | 39.52670 | -75.81000 | Chesapeake City, MD | ✓ |
| 8574680 | BLTM2 | 39.26667 | -76.57833 | Baltimore, MD | ✓ |
| 8574728 | FSKM2 | 39.22000 | -76.52830 | Francis Scott Key Bridge, MD | |
| 8575512 | APAM2 | 38.98328 | -76.48156 | Annapolis, MD | ✓ |
| 8577018 | COVM2 | 38.40436 | -76.38550 | Cove Point LNG Pier, MD | |
| 8577330 | SLIM2 | 38.31667 | -76.45167 | Solomons Island, MD | ✓ |
| 8578240 | PPTM2 | 38.13330 | -76.53330 | Piney Point, MD | |
| 8594900 | WASD2 | 38.87333 | -77.02167 | Washington, DC | ✓ |
| 8631044 | WAHV2 | 37.60778 | -75.68583 | Wachapreague, VA | ✓ |
| 8632200 | KPTV2 | 37.16519 | -75.98844 | Kiptopeke, VA | ✓ |
| 8632837 | RPLV2 | 37.53830 | -76.01500 | Rappahannock Light, VA | |
| 8635750 | LWTV2 | 37.99611 | -76.46444 | Lewisetta, VA | ✓ |

| | | | | | |
|---|---|---|---|---|---|
| 8636580 | WNDV2 | 37.61620 | -76.29000 | Windmill Point, VA | ✓ |
| 8637611 | YKRV2 | 37.25000 | -76.33330 | York River East Rear Range Light, VA | |
| 8637689 | YKTV2 | 37.22667 | -76.47833 | Yorktown USCG Training Center, VA | ✓ |
| 8638511 | DOMV2 | 36.96232 | -76.42421 | Dominion Terminal Associates, VA | |
| 8638595 | CRYV2 | 36.88830 | -76.33830 | South Craney Island, VA | |
| 8638610 | SWPV2 | 36.94667 | -76.33000 | Sewells Point, VA | ✓ |
| 8638614 | WDSV2 | 36.98170 | -76.32170 | Willoughby Degaussing Station, VA | |
| 8638863 | CBBV2 | 36.96667 | -76.11333 | Chesapeake Bay Bridge Tunnel, VA | ✓ |
| 8638999 | CHYV2 | 36.93000 | -76.00670 | Cape Henry, VA | |
| 8639348 | MNPV2 | 36.77830 | -76.30170 | Money Point, VA | ✓ |
| 8651370 | DUKN7 | 36.18331 | -75.74669 | Duck, NC | ✓ |
| 8652587 | ORIN7 | 35.79500 | -75.54830 | Oregon Inlet Marina, NC | ✓ |
| 8654467 | HCGN7 | 35.20864 | -75.70417 | USCG Station Hatteras, NC | ✓ |
| 8656483 | BFTN7 | 34.72000 | -76.67000 | Beaufort, NC | ✓ |
| 8658120 | WLON7 | 34.22670 | -77.95330 | Wilmington, NC | ✓ |
| 8658163 | JMPN7 | 34.21330 | -77.78670 | Wrightsville Beach, NC | ✓ |
| 8661070 | MROS1 | 33.65500 | -78.91830 | Springmaid Pier, SC | ✓ |
| 8662245 | NITS1 | 33.35170 | -79.18670 | Oyster Landing, SC | ✓ |
| 8665530 | CHTS1 | 32.78170 | -79.92500 | Charleston, SC | ✓ |
| 8670870 | FPKG1 | 32.03330 | -80.90170 | Fort Pulaski, GA | ✓ |
| 8720030 | FRDF1 | 30.67170 | -81.46500 | Fernandina Beach, FL | ✓ |
| 8720218 | MYPF1 | 30.39670 | -81.43000 | Mayport (Bar Pilots Dock), FL | ✓ |
| 8720357 | BKBF1 | 30.19170 | -81.69170 | I-295 Bridge, St Johns River, FL | |
| 8721604 | TRDF1 | 28.41580 | -80.59310 | Trident Pier, FL | ✓ |
| 8722670 | LKWF1 | 26.61170 | -80.03330 | Lake Worth Pier, FL | ✓ |
| 8723214 | VAKF1 | 25.73140 | -80.16180 | Virginia Key, FL | ✓ |
| 8723970 | VCAF1 | 24.71170 | -81.10500 | Vaca Key, FL | ✓ |
| 8724580 | KYWF1 | 24.55570 | -81.80790 | Key West, FL | ✓ |
| 8725110 | NPSF1 | 26.13170 | -81.80750 | Naples, FL | ✓ |
| 8725520 | FMRF1 | 26.64770 | -81.87120 | Fort Myers, FL | ✓ |
| 8726384 | PMAF1 | 27.63870 | -82.56210 | Port Manatee, FL | |
| 8726413 | CCUF1 | 27.66330 | -82.61830 | C-Cut, FL | |
| 8726520 | SAPF1 | 27.76060 | -82.62690 | St. Petersburg, FL | ✓ |
| 8726607 | OPTF1 | 27.85778 | -82.55269 | Old Port Tampa, FL | |
| 8726667 | MCYF1 | 27.91333 | -82.42500 | Mckay Bay Entrance, FL | |
| 8726669 | ERTF1 | 27.91720 | -82.44380 | Berth 223, FL | |
| 8726673 | SBLF1 | 27.92330 | -82.44500 | Seabulk, FL | |
| 8726679 | TSHF1 | 27.92889 | -82.42575 | East Bay Causeway, FL | |
| 8726694 | TPAF1 | 27.93330 | -82.43330 | TPA Cruise Terminal 2, FL | |
| 8726724 | CWBF1 | 27.97830 | -82.83170 | Clearwater Beach, FL | ✓ |
| 8727520 | CKYF1 | 29.13500 | -83.03170 | Cedar Key, FL | ✓ |
| 8728690 | APCF1 | 29.72670 | -84.98170 | Apalachicola, FL | ✓ |
| 8729108 | PACF1 | 30.15228 | -85.66694 | Panama City, FL | ✓ |

| | | | | | |
|---|---|---|---|---|---|
| 8729210 | PCBF1 | 30.21330 | -85.87830 | Panama City Beach, FL | ✓ |
| 8729840 | PCLF1 | 30.40440 | -87.21120 | Pensacola, FL | ✓ |
| 8732828 | WBYA1 | 30.41670 | -87.82500 | Weeks Bay, AL | ✓ |
| 8734673 | FMOA1 | 30.22830 | -88.02500 | Fort Morgan, AL | |
| 8735180 | DILA1 | 30.25000 | -88.07500 | Dauphin Island, AL | ✓ |
| 8735391 | BYSA1 | 30.56517 | -88.08800 | Dog River Bridge, AL | ✓ |
| 8735523 | EFRA1 | 30.44369 | -88.11392 | East Fowl River Bridge, AL | ✓ |
| 8736163 | MBPA1 | 30.52711 | -88.08656 | Middle Bay Port, AL | |
| 8736897 | MCGA1 | 30.64830 | -88.05830 | Coast Guard Sector Mobile, AL | ✓ |
| 8737005 | PTOA1 | 30.67114 | -88.03106 | Pinto Island, AL | |
| 8737048 | OBLA1 | 30.70830 | -88.04330 | Mobile State Docks, AL | ✓ |
| 8737138 | CIKA1 | 30.78189 | -88.07361 | Chickasaw Creek, AL | |
| 8738043 | WFRA1 | 30.37664 | -88.15856 | West Fowl River Bridge, AL | ✓ |
| 8739803 | BLBA1 | 30.40567 | -88.24769 | Bayou La Batre Bridge, AL | |
| 8741003 | PTBM6 | 30.21330 | -88.50000 | Petit Bois Island, MS | |
| 8741041 | ULAM6 | 30.34770 | -88.50540 | Dock E, MS | ✓ |
| 8741094 | RARM6 | 30.34330 | -88.51170 | Range A Rear, MS | |
| 8741501 | DKCM6 | 30.35500 | -88.56670 | Dock C, MS | |
| 8741533 | PNLM6 | 30.36790 | -88.56300 | Pascagoula NOAA Lab, MS | ✓ |
| 8747437 | WYCM6 | 30.32639 | -89.32578 | Bay Waveland Yacht Club, MS | ✓ |
| 8760721 | PILL1 | 29.17830 | -89.25830 | Pilottown, LA | |
| 8760922 | PSTL1 | 28.93220 | -89.40750 | Pilots Station East, SW Pass, LA | ✓ |
| 8761305 | SHBL1 | 29.86811 | -89.67325 | Shell Beach, LA | ✓ |
| 8761724 | GISL1 | 29.26333 | -89.95667 | Grand Isle, LA | ✓ |
| 8761927 | NWCL1 | 30.02717 | -90.11342 | New Canal Station, LA | ✓ |
| 8761955 | CARL1 | 29.93289 | -90.13547 | Carrollton, LA | ✓ |
| 8762075 | PTFL1 | 29.11425 | -90.19925 | Port Fourchon, LA | |
| 8762482 | BYGL1 | 29.78856 | -90.42019 | West Bank, Bayou Gauche, LA | ✓ |
| 8764044 | TESL1 | 29.66750 | -91.23761 | Berwick, LA | ✓ |
| 8764227 | AMRL1 | 29.44958 | -91.33811 | LAWMA, Amerada Pass, LA | ✓ |
| 8766072 | FRWL1 | 29.55500 | -92.30500 | Freshwater Canal Locks, LA | ✓ |
| 8767816 | LCLL1 | 30.22364 | -93.22167 | Lake Charles, LA | ✓ |
| 8767961 | BKTL1 | 30.19031 | -93.30069 | Bulk Terminal, LA | ✓ |
| 8768094 | CAPL1 | 29.76817 | -93.34289 | Calcasieu Pass, LA | ✓ |
| 8770475 | PORT2 | 29.86670 | -93.93000 | Port Arthur, TX | |
| 8770520 | RBBT2 | 29.98000 | -93.88170 | Rainbow Bridge, TX | |
| 8770570 | SBPT2 | 29.72840 | -93.87010 | Sabine Pass North, TX | ✓ |
| 8770613 | MGPT2 | 29.68170 | -94.98500 | Morgans Point, TX | |
| 8770777 | NCHT2 | 29.72628 | -95.26581 | Manchester, TX | |
| 8770822 | TXPT2 | 29.67806 | -93.83694 | Texas Point, Sabine Pass, TX | ✓ |
| 8770971 | RLOT2 | 29.51500 | -94.51330 | Rollover Pass, TX | |
| 8771013 | EPTT2 | 29.48000 | -94.91830 | Eagle Point, TX | ✓ |
| 8771341 | GNJT2 | 29.35733 | -94.72483 | Galveston Bay Entrance, North Jetty, TX | ✓ |

| | | | | | |
|---|---|---|---|---|---|
| 8771450 | GTOT2 | 29.31000 | -94.79330 | Galveston Pier 21, TX | ✓ |
| 8772447 | FCGT2 | 28.94331 | -95.30250 | USCG Freeport, TX | ✓ |
| 8773037 | SDRT2 | 28.40830 | -96.71170 | Seadrift, TX | |
| 8773259 | VCAT2 | 28.64000 | -96.59500 | Port Lavaca, TX | |
| 8773701 | PCNT2 | 28.45170 | -96.38830 | Port O'Connor, TX | |
| 8774513 | CPNT2 | 28.11830 | -97.02170 | Copano Bay, TX | |
| 8774770 | RCPT2 | 28.02170 | -97.04670 | Rockport, TX | ✓ |
| 8775237 | RTAT2 | 27.83830 | -97.07330 | Port Aransas, TX | |
| 8775283 | NGLT2 | 27.82170 | -97.20330 | Port Ingleside, TX | |
| 8775296 | TAQT2 | 27.81170 | -97.39000 | USS Lexington, TX | |
| 8775792 | PACT2 | 27.63330 | -97.23670 | Packery Channel, TX | |
| 8775870 | MQTT2 | 27.58000 | -97.21670 | Bob Hall Pier, TX | ✓ |
| 8776139 | IRDT2 | 27.48000 | -97.32170 | S. Bird Island, TX | |
| 8776604 | BABT2 | 27.29500 | -97.40500 | Baffin Bay, TX | |
| 8777812 | RSJT2 | 26.82500 | -97.49170 | Rincon Del San Jose, TX | |
| 8779748 | PCGT2 | 26.07670 | -97.17670 | South Padre Island, TX | |
| 8779770 | PTIT2 | 26.06000 | -97.21500 | Port Isabel, TX | ✓ |
| 9014070 | AGCM4 | 42.62100 | -82.52690 | Algonac, MI | |
| 9014080 | SCRM4 | 42.81240 | -82.48581 | St Clair State Police, MI | |
| 9014087 | PHXM4 | 42.94530 | -82.44350 | Dry Dock, MI | |
| 9014090 | MBRM4 | 42.97380 | -82.42040 | Mouth of the Black River, MI | |
| 9014096 | DUPM4 | 43.00250 | -82.42240 | Dunn Paper, MI | |
| 9014098 | FTGM4 | 43.00690 | -82.42250 | Fort Gratiot, MI | |
| 9034052 | SCSM4 | 42.47322 | -82.87925 | St Clair Shores, MI | |
| 9044020 | GRTM4 | 42.09090 | -83.18600 | Gibraltar, MI | |
| 9044030 | WDTM4 | 42.20240 | -83.14750 | Wyandotte, MI | |
| 9044036 | FWNM4 | 42.29894 | -83.09258 | Fort Wayne, MI | |
| 9044049 | WMPM4 | 42.35778 | -82.92994 | Windmill Point, MI | |
| 9052000 | CAVN6 | 44.13019 | -76.33197 | Cape Vincent, NY | |
| 9052030 | OSGN6 | 43.46417 | -76.51183 | Oswego, NY | |
| 9052058 | RCRN6 | 43.26903 | -77.62575 | Rochester, NY | |
| 9052076 | OCTN6 | 43.33839 | -78.72733 | Olcott, NY | |
| 9063007 | NGAN6 | 43.09992 | -79.05992 | Ashland Ave., NY | |
| 9063009 | AMFN6 | 43.08106 | -79.06136 | American Falls, NY | |
| 9063012 | NIAN6 | 43.07692 | -79.01389 | Niagara Intake, NY | |
| 9063020 | BUFN6 | 42.87744 | -78.89047 | Buffalo, NY | |
| 9063028 | PSTN6 | 42.69131 | -79.04733 | Sturgeon Point, NY | |
| 9063038 | EREP1 | 42.15400 | -80.09250 | Erie, PA | |
| 9063053 | FAIO1 | 41.75975 | -81.28106 | Fairport, OH | |
| 9063063 | CNDO1 | 41.54086 | -81.63547 | Cleveland, OH | |
| 9063079 | MRHO1 | 41.54364 | -82.73139 | Marblehead, OH | |
| 9063085 | THRO1 | 41.69356 | -83.47228 | Toledo, OH | |
| 9063090 | FPPM4 | 41.96010 | -83.25690 | Fermi Power Plant, OH | |

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|---|---|---|---|---|---|
| 9075002 | LKPM4 | 43.14039 | -82.49389 | Lakeport, MI | |
| 9075014 | HRBM4 | 43.84619 | -82.64311 | Harbor Beach, MI | |
| 9075035 | ESVM4 | 43.64040 | -83.84680 | Essexville, MI | |
| 9075065 | LPNM4 | 45.06300 | -83.42860 | Alpena, MI | |
| 9075080 | MACM4 | 45.77789 | -84.72533 | Mackinaw City, MI | |
| 9075099 | DTLM4 | 45.99250 | -83.89820 | De Tour Village, MI | |
| 9076024 | RCKM4 | 46.26480 | -84.19120 | Rock Cut, MI | |
| 9076027 | WNEM4 | 46.28469 | -84.20981 | West Neebish Island, MI | |
| 9076033 | LTRM4 | 46.48572 | -84.30183 | Little Rapids, MI | |
| 9076060 | USSM4 | 46.50100 | -84.34030 | U.S. Slip, MI | |
| 9076070 | SWPM4 | 46.50111 | -84.37261 | S.W. Pier, MI | |
| 9087023 | LDTM4 | 43.94736 | -86.44161 | Ludington, MI | |
| 9087031 | HLNM4 | 42.76811 | -86.20119 | Holland, MI | |
| 9087044 | CMTI2 | 41.72986 | -87.53839 | Calumet Harbor, IL | |
| 9087057 | MLQW3 | 43.00200 | -87.88760 | Milwaukee, WI | |
| 9087068 | KWNW3 | 44.46397 | -87.50103 | Kewaunee, WI | |
| 9087069 | KWNW3 | 44.46500 | -87.49572 | Kewaunee MET, WI | |
| 9087072 | SBCW3 | 44.79558 | -87.31433 | Sturgeon Bay Canal, WI | |
| 9087079 | GBWW3 | 44.54106 | -88.00719 | Green Bay, WI | |
| 9087088 | MNMM4 | 45.09589 | -87.58994 | Menominee, MI | |
| 9087096 | PNLM4 | 45.96989 | -85.87150 | Port Inland, MI | |
| 9099004 | PTIM4 | 46.48450 | -84.63089 | Point Iroquois, MI | |
| 9099018 | MCGM4 | 46.54558 | -87.37908 | Marquette C.G., MI | |
| 9099044 | OGOM4 | 46.87433 | -89.32417 | Ontonagon, MI | |
| 9099064 | DULM5 | 46.77570 | -92.09200 | Duluth, MN | |
| 9099090 | GDMM5 | 47.74783 | -90.34133 | Grand Marais, MN | |
| 9410170 | SDBC1 | 32.71419 | -117.17358 | San Diego, CA | ✓ |
| 9410172 | IIWC1 | 32.71394 | -117.17533 | USS Midway, CA | |
| 9410230 | LJAC1 | 32.86670 | -117.25800 | La Jolla, CA | ✓ |
| 9410647 | AGXC1 | 33.71583 | -118.24611 | Angels Gate, CA | |
| 9410660 | OHBC1 | 33.72000 | -118.27200 | Los Angeles, CA | ✓ |
| 9410665 | PRJC1 | 33.73300 | -118.18569 | Los Angeles Pier J, CA | |
| 9410666 | PFDC1 | 33.73519 | -118.24131 | Los Angeles Pier 400, CA | |
| 9410670 | PFXC1 | 33.74830 | -118.26800 | Los Angeles Pier F, CA | |
| 9410690 | PXAC1 | 33.76361 | -118.26542 | Los Angeles Berth 161, CA | |
| 9410691 | BAXC1 | 33.76631 | -118.24011 | Los Angeles Badger Ave Bridge, CA | |
| 9410692 | PSXC1 | 33.76831 | -118.22569 | Los Angeles Pier S, CA | |
| 9410840 | ICAC1 | 34.00830 | -118.50000 | Santa Monica, CA | ✓ |
| 9411340 | NTBC1 | 34.40830 | -119.68500 | Santa Barbara, CA | ✓ |
| 9411406 | HRVC1 | 34.46830 | -120.67300 | Oil Platform Harvest, CA | |
| 9412110 | PSLC1 | 35.17670 | -120.76000 | Port San Luis, CA | ✓ |
| 9413450 | MTYC1 | 36.60500 | -121.88800 | Monterey, CA | ✓ |
| 9414290 | FTPC1 | 37.80669 | -122.46500 | San Francisco, CA | ✓ |

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|---|---|---|---|---|---|
| 9414311 | PXOC1 | 37.79800 | -122.39297 | San Francisco Pier 1, CA | |
| 9414523 | RTYC1 | 37.50670 | -122.21000 | Redwood City, CA | ✓ |
| 9414750 | AAMC1 | 37.77167 | -122.29833 | Alameda, CA | ✓ |
| 9414763 | LNDC1 | 37.79500 | -122.28300 | Oakland Berth 67, CA | |
| 9414769 | OMHC1 | 37.80000 | -122.33000 | Oakland Middle Harbor, CA | |
| 9414776 | OKXC1 | 37.81061 | -122.33311 | Oakland Berth 34, CA | |
| 9414797 | OBXC1 | 37.80444 | -122.34167 | Oakland Berth 38, CA | |
| 9414847 | PPXC1 | 37.90581 | -122.36503 | Point Potrero Richmond, CA | |
| 9414863 | RCMC1 | 37.92830 | -122.40000 | Richmond, CA | ✓ |
| 9415020 | PRYC1 | 37.99610 | -122.97670 | Point Reyes, CA | ✓ |
| 9415102 | MZXC1 | 38.03464 | -122.12519 | Martinez-Amorco Pier, CA | |
| 9415115 | PSBC1 | 38.04156 | -121.88667 | Pittsburg, CA | |
| 9415118 | UPBC1 | 38.03828 | -122.12053 | Union Pacific Rail Road Bridge, CA | |
| 9415141 | DPXC1 | 38.05669 | -122.25961 | Davis Point, CA | |
| 9415144 | PCOC1 | 38.05600 | -122.03950 | Port Chicago, CA | ✓ |
| 9416841 | ANVC1 | 38.91330 | -123.70800 | Arena Cove, CA | ✓ |
| 9418767 | HBYC1 | 40.76670 | -124.21700 | North Spit, CA | ✓ |
| 9419750 | CECC1 | 41.74500 | -124.18300 | Crescent City, CA | ✓ |
| 9431647 | PORO3 | 42.73897 | -124.49828 | Port Orford, OR | ✓ |
| 9432780 | CHAO3 | 43.34500 | -124.32200 | Charleston, OR | ✓ |
| 9435380 | SBEO3 | 44.62500 | -124.04300 | South Beach, OR | ✓ |
| 9437540 | TLBO3 | 45.55453 | -123.91894 | Garibaldi, OR | ✓ |
| 9439011 | HMDO3 | 46.20170 | -123.94500 | Hammond, OR | ✓ |
| 9439040 | ASTO3 | 46.20731 | -123.76831 | Astoria, OR | ✓ |
| 9439099 | WAUO3 | 46.16000 | -123.40500 | Wauna, OR | ✓ |
| 9439201 | SHNO3 | 45.86500 | -122.79700 | St. Helens, OR | ✓ |
| 9440083 | VAPW1 | 45.63170 | -122.69700 | Vancouver, WA | ✓ |
| 9440422 | LOPW1 | 46.10611 | -122.95417 | Longview, WA | ✓ |
| 9440569 | SKAW1 | 46.26670 | -123.45200 | Skamokawa, WA | ✓ |
| 9440910 | TOKW1 | 46.70747 | -123.96692 | Toke Point, WA | ✓ |
| 9441102 | WPTW1 | 46.90431 | -124.10508 | Westport, WA | ✓ |
| 9442396 | LAPW1 | 47.91330 | -124.63700 | La Push, WA | ✓ |
| 9443090 | NEAW1 | 48.36667 | -124.61167 | Neah Bay, WA | ✓ |
| 9444090 | PTAW1 | 48.12500 | -123.44000 | Port Angeles, WA | ✓ |
| 9444900 | PTWW1 | 48.11170 | -122.75800 | Port Townsend, WA | ✓ |
| 9446482 | TCMW1 | 47.27583 | -122.41778 | Tacoma MET, WA | |
| 9446484 | TCNW1 | 47.26667 | -122.41333 | Tacoma, WA | ✓ |
| 9447130 | EBSW1 | 47.60264 | -122.33931 | Seattle, WA | ✓ |
| 9449424 | CHYW1 | 48.86330 | -122.75800 | Cherry Point, WA | ✓ |
| 9449880 | FRDW1 | 48.54667 | -123.01000 | Friday Harbor, WA | ✓ |
| 9450460 | KECA2 | 55.33183 | -131.62619 | Ketchikan, AK | ✓ |
| 9451054 | PLXA2 | 56.24670 | -134.64700 | Port Alexander, AK | ✓ |
| 9451600 | ITKA2 | 57.05170 | -135.34200 | Sitka, AK | ✓ |

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|---|---|---|---|---|---|
| 9452210 | JNEA2 | 58.29830 | -134.41200 | Juneau, AK | ✓ |
| 9452400 | SKTA2 | 59.45000 | -135.32700 | Skagway, AK | ✓ |
| 9452634 | ELFA2 | 58.19472 | -136.34694 | Elfin Cove, AK | ✓ |
| 9453220 | YATA2 | 59.54850 | -139.73340 | Yakutat, AK | ✓ |
| 9454050 | CRVA2 | 60.55830 | -145.75300 | Cordova, AK | ✓ |
| 9454240 | VDZA2 | 61.12500 | -146.36200 | Valdez, AK | ✓ |
| 9455090 | SWLA2 | 60.12000 | -149.42667 | Seward, AK | ✓ |
| 9455500 | OVIA2 | 59.44053 | -151.71994 | Seldovia, AK | ✓ |
| 9455760 | NKTA2 | 60.68330 | -151.39800 | Nikiski, AK | ✓ |
| 9455920 | ANTA2 | 61.23831 | -149.89000 | Anchorage, AK | ✓ |
| 9457292 | KDAA2 | 57.73170 | -152.51200 | Kodiak Island, AK | ✓ |
| 9457804 | ALIA2 | 56.89830 | -154.24700 | Alitak, AK | ✓ |
| 9459450 | SNDA2 | 55.33669 | -160.50200 | Sand Point, AK | ✓ |
| 9459881 | KGCA2 | 55.06170 | -162.32700 | King Cove, AK | ✓ |
| 9461380 | ADKA2 | 51.86330 | -176.63200 | Adak Island, AK | ✓ |
| 9461710 | ATKA2 | 52.23170 | -174.17300 | Atka, AK | ✓ |
| 9462450 | OLSA2 | 52.94061 | -168.87131 | Nikolski, AK | ✓ |
| 9462620 | UNLA2 | 53.88000 | -166.53700 | Unalaska, AK | ✓ |
| 9463502 | PMOA2 | 55.99000 | -160.56200 | Port Moller, AK | ✓ |
| 9464212 | VCVA2 | 57.12531 | -170.28517 | Village Cove, AK | ✓ |
| 9468756 | NMTA2 | 64.50000 | -165.43000 | Nome, AK | ✓ |
| 9491094 | RDDA2 | 67.57670 | -164.06500 | Red Dog Dock, AK | ✓ |
| 9497645 | PRDA2 | 70.40000 | -148.52700 | Prudhoe Bay, AK | ✓ |
| 9751364 | CHSV3 | 17.75000 | -64.70500 | Christiansted Harbor, VI | ✓ |
| 9751381 | LAMV3 | 18.31825 | -64.72422 | Lameshur Bay, VI | ✓ |
| 9751401 | LTBV3 | 17.69472 | -64.75381 | Lime Tree Bay, VI | ✓ |
| 9751639 | CHAV3 | 18.33583 | -64.92000 | Charlotte Amalie, VI | ✓ |
| 9752619 | VQSP4 | 18.15253 | -65.44381 | Isabel Segunda, PR | ✓ |
| 9752695 | ESPP4 | 18.09386 | -65.47136 | Esperanza, PR | ✓ |
| 9753216 | FRDP4 | 18.33522 | -65.63111 | Fajardo, PR | ✓ |
| 9754228 | YABP4 | 18.05508 | -65.83300 | Yabucoa Harbor, PR | ✓ |
| 9755371 | SJNP4 | 18.45894 | -66.11642 | San Juan, PR | ✓ |
| 9757809 | AROP4 | 18.48053 | -66.70236 | Arecibo, PR | ✓ |
| 9758053 | PLSP4 | 17.97253 | -66.76178 | Penuelas, PR | ✓ |
| 9759110 | MGIP4 | 17.97008 | -67.04642 | Magueyes Island, PR | ✓ |
| 9759394 | MGZP4 | 18.22000 | -67.16000 | Mayaguez, PR | ✓ |
| 9759938 | MISP4 | 18.08992 | -67.93850 | Mona Island, PR | ✓ |
| 9761115 | BARA9 | 17.59069 | -61.82056 | Barbuda | ✓ |

## Historical stations used only in OFS bulletins:

| NOS ID | NWSLI | LAT | LON | LOCATION |
|---|---|---|---|---|
| 8517276 | CLGN6 | 40.78331 | 73.85669 | College Point, NY |
| 8518668 | HHKN6 | 40.77669 | 73.94169 | Horns Hook, NY |
| 8518905 | RIVN6 | 40.90331 | 73.91669 | Riverdale, NY |
| 8519024 | FTWN6 | 40.60669 | 74.05500 | Fort Wadsworth, NY |
| 8530528 | CARN4 | 40.80669 | 74.06000 | Carlstadt, NJ |
| 8530882 | LIZN4 | 40.67331 | 74.14000 | Port Elizabeth, NJ |
| 8530985 | CHKN4 | 40.65500 | 74.08500 | Constable Hook, NJ |
| 8531232 | SMBN4 | 40.49169 | 74.28169 | South Amboy, NJ |
| 8720219 | DMSF1 | 30.38669 | 81.55831 | Dames Point, FL |
| 8720226 | MSBF1 | 30.32000 | 81.65831 | Main Street Bridge, FL |
| 8720242 | LNBF1 | 30.36000 | 81.62000 | Longbranch, FL |
| 8720503 | GCVF1 | 29.97831 | 81.62831 | Red Bay Point, FL |
| 8720625 | RCYF1 | 29.80169 | 81.54831 | Racy Point, FL |
| 8720767 | BUFF1 | 29.59500 | 81.68169 | Buffalo Bluff, FL |
| 8720774 | PLQF1 | 29.64331 | 81.63169 | Palatka, FL |
| 8725858 | VENF1 | 27.07169 | 82.45331 | Venice Pier, FL |
| 8726217 | CTZF1 | 27.46669 | 82.68831 | Cortez, FL |
| 8726243 | AMOF1 | 27.49669 | 82.71331 | Anna Maria Outside, FL |
| 8726347 | EGMF1 | 27.60169 | 82.76000 | Egmont Key, FL |
| 8726364 | MUQF1 | 27.61500 | 82.72669 | Mullet Key, FL |
| 8726428 | TRVF1 | 27.68831 | 82.71831 | Tierra Verde, FL |
| 8726537 | ALOF1 | 27.78669 | 82.42669 | Apollo Beach, FL |
| 8726641 | GNDF1 | 27.89331 | 82.53831 | Gandy Bridge, FL |
| 8726657 | DVSF1 | 27.90831 | 82.45169 | Davis Island, FL |
| 8726689 | BAVF1 | 27.94169 | 82.72000 | Bay Aristocrat Village, FL |
| 8726738 | SFHF1 | 27.98831 | 82.68500 | Safety Harbor, FL |
| 8745557 | GHBM6 | 30.36000 | 89.08169 | Gulfport Harbor, MS |
| 8770743 | BTLT2 | 29.75669 | 95.09000 | Battleship Texas S.P, TX |
| 9075059 | HSVM4 | 44.66000 | 83.28669 | Harrisville, MI |
| 9439011 | HMDO3 | 46.20453 | 123.95081 | Hammond NMFS Pier, OR |
| 9440571 | ALTW1 | 46.26500 | 123.65300 | Altoona, WA |
| 9440572 | ILWW1 | 46.26831 | 124.03700 | Jetty A, WA |
| 9440574 | NJYW1 | 46.27331 | 124.07200 | North Jetty, WA |

# APPENDIX 2: CREX BULLETIN DESCRIPTIONS

One of the formats used for the relay of CO-OPS data to the Global Telecommunications System is called CREX (Character Form for the Representation and EXchange of data). A formal description of CREX code is available in the WMO FM 95 CREX edition 1 Manual on Codes [REF 2]. The major component of CREX messages is a series of elements (or sequences, which are composed of elements) that reference a lookup table. The referenced table provides the element name, units, scale, and data width. The following is a CREX message example for a single station, and Figure 3 describes each section.

SZPA37 KWBC 091500
CREX++
T000119 A001 D01021 D06019 R01006 B22038++
1343872 14465394 APRP7 2013 08 09 14 46 3033 00 07 00 01
00780 00776 00771 00767 00760 00758++
7777

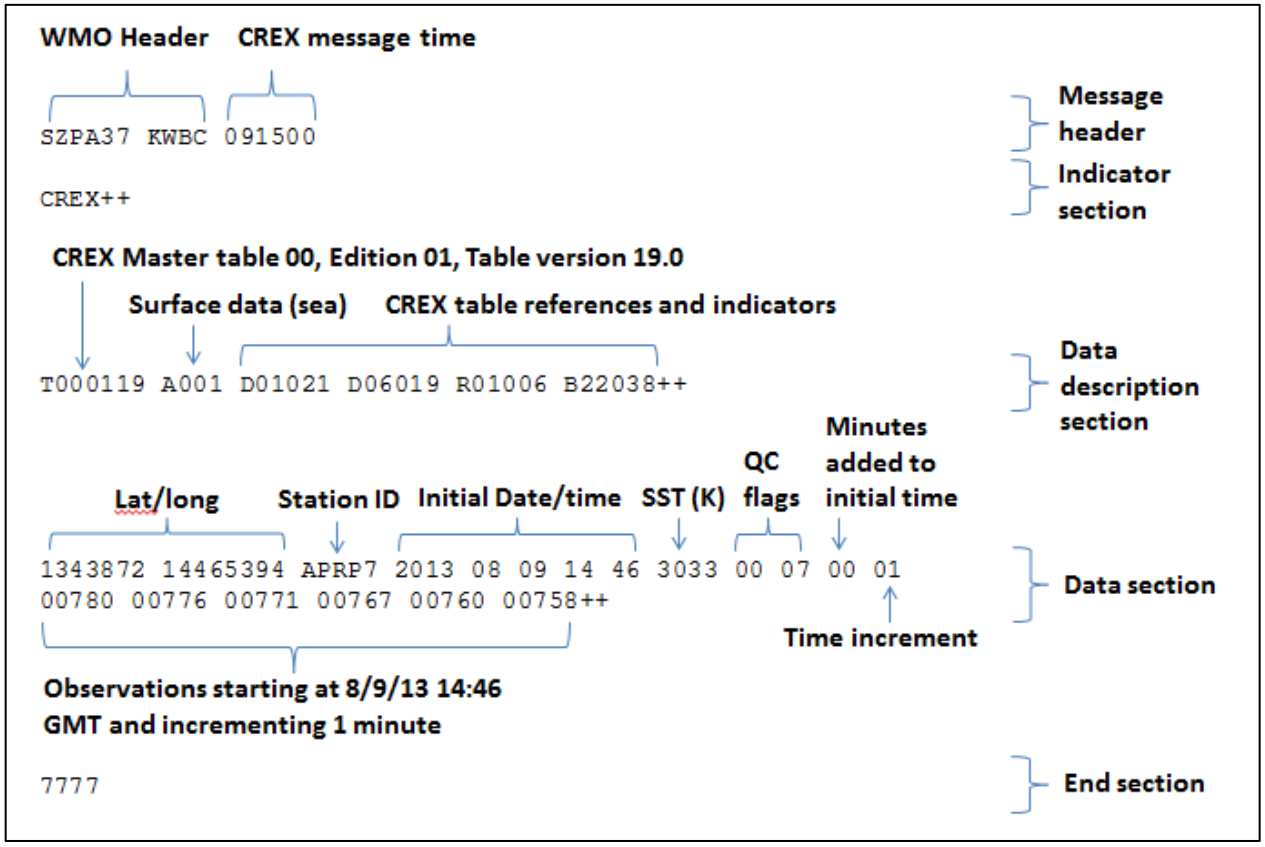


**Fig.3.** Identification of CREX message sections and elements.

Throughout the bulletin each subset (a station report) ends with the terminator (+) and two plus signs (++) indicate the end of a section. Numerous stations can be included in a single bulletin, which is organized by geographic region.

The **message header** contains the WMO header for that bulletin, which identifies the geographic WMO region in which the data were collected. See Appendix 4 (WMO and AWIPS Headers) for a list of all the region identifiers and a description of the WMO headers. The message time specifies, in GMT, the day, hour, and minute the bulletin was created.

The **Indicator section** marks the beginning of the **CREX** message.

The **Data Description section** provides message metadata and information on the form and content of the data included in the following data section. Each string of characters in the data description section begins with a letter that corresponds to a CREX lookup table. The CREX tables provide information on the data types and operators [REF 3]. The string of characters is a sequence, which can refer to a single data type, or in some cases a group of data types.

- **T000119** indicates that the message uses CREX Master Table number 00, Edition 1 CREX formats, and version **19** of the CREX tables. CREX Editions rarely change, but recently the WMO upgraded to Edition 2, which includes more message metadata in the data description section. Since CO-OPS will eventually retire CREX messages (based on WMO requirements) forcing existing users to upgrade their decoders to Edition 2 was not considered prudent at this time. Table version numbers, however, change frequently based on validation of newer proposed sequences.
- Table **A** provides the data category, and every CO-OPS message contains **A001**, indicating sea surface data.
- Table **B** classifies elements such as identifiers, station position, and data parameters.
- Table **D** provides a list of sequences common to types of observation reporting, or metadata information.
- The **R** indicator for replication specifies that the following x descriptors (in this case B22038) shall be repeated y number of times. This creates a time-series.

The **Data section** provides the station data values corresponding to the data descriptors in the previous section. Station header information is followed by the measurement values. One or more slashes (///) mean a value was not available. Each set of station data ends with +. The last station data set ends with ++ indicating the end of the data section.

The **End section** marks the end of the CREX message, and is always **7777**.

# APPENDIX 3: SHEF BULLETIN DESCRIPTIONS

A format used for the relay of NOS data to NWS is called SHEF (Standard Hydrometeorological Exchange Format). A formal description of SHEF code is available in the NWS SHEF Code Manual [REF 5].

The following is a SHEF message example, and Figure 4 describes each section.

SOUS41 KWBC 041830
TIDCB
:SHEF ENCODED 30 MINUTE WATER LEVEL MODEL GUIDANCE
:WATER LEVEL VALUES REFERENCED TO MLLW IN FEET (HMIFU)
:TIME ZONE IS UTC
:WATER LEVEL MODEL GUIDANCE IS FOR TOTAL WATER LEVELS
:PROVIDED BY DOC/NOAA/NOS/CO-OPS
:corms@noaa.gov 301-713-2540
.E SWPV2 20121204 Z DH1200/DC12041200/HMIFU/DIN30/ 0.406 / 0.834 / 1.148 / 1.429 / 1.724 / 1.975

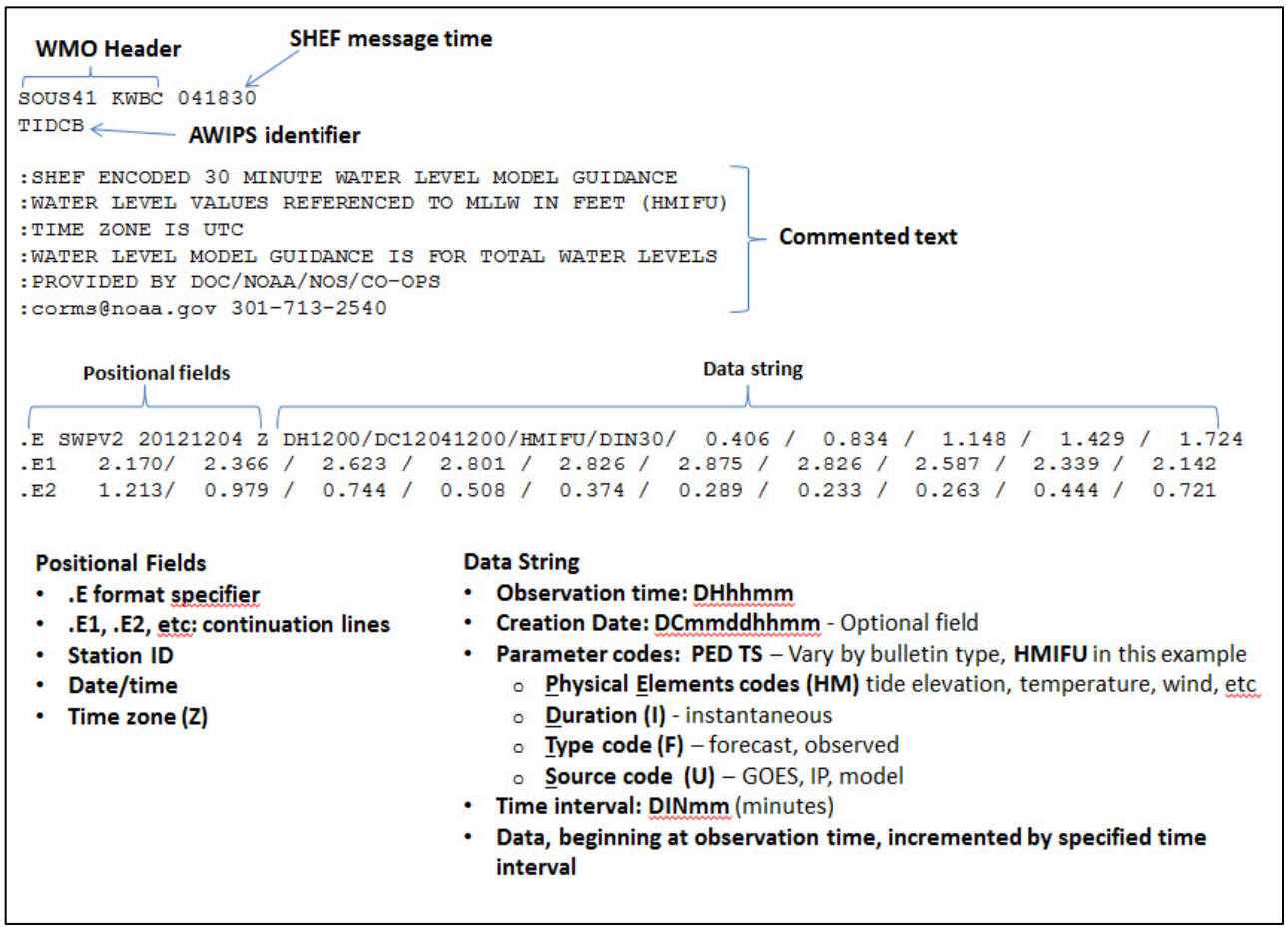


**Fig.4.** An explanation of SHEF message syntax and elements.

The message header contains the **WMO header**, which identifies the geographic WMO region in which the data were collected, and the **AWIPS header**, which also identifies the geographic

region but is read specifically by AWIPS systems. See Appendix 4 for a list of all the region headers. The message time specifies in GMT, the day, hour, and minute the bulletin was created. The lines that begin with a colon (:) are comment lines.

There are three possible SHEF formats available that can be used depending on the number of stations or data parameters provided in the message: .A, .B, and .E, but CO-OPS only uses .A and .E formats. The .A format is used to display data from multiple data types at a single station, and there will be only one data value associated with each data type. The .E format is used to display a time-series from a single data type at a single station. There can be both .A and .E records for a given station within a single bulletin. The .A and .E formats following the comment lines are specific to each station for which data are being reported. Both formats comprise positional fields and the data string. These components are illustrated in Figure 4, and described below.

**Positional Fields:**
The positional fields are used for all SHEF formats. These include the format specifier, NWSLI, date, and time zone. The .E1, .E2, .E3, etc. indicate continuation data lines for the .E formatted message. When the station data ends and the next station data sequence begins, the line will reset to .E. Continuation lines are also used in .A formatted messages.

**Data String:**
The major elements of this section are the observation time, a creation date, parameter codes, a time interval, and the parameter values. A slash (/) is used to separate information. The observation time applies to the first data value in the sequence. The creation date is an optional field mainly used in messages containing forecast data to indicate the time that the data elements were created. CO-OPS uses this field in the OFS Water Level Guidance and the Astronomical Tide bulletins.

The parameter codes describe the data types, and definitions can be found in the SHEF Code Manual [REF 5]. These codes are the Physical Elements (PE), Duration (D) and Type and Source codes (TS), Extremum (E) and Probability (P), or PEDTSEP. CO-OPS does not use E or P.

- Physical Elements: The first two characters designate the data type. The first character is the basic data type, and the second character provides more detail.
- Duration: CO-OPS always uses **I** because all data are instantaneous.
- Type and Source codes indicate whether the data are received directly from the station or have been computed. The type code specifies the type of data within the message, and the source code differentiates model data versus observed data.

The time interval is used only in the .E format, provides information on what interval to apply to the time-series. The data then follow. The observation time is applied to the first value, and the time interval is used to determine the time stamps of the subsequent values. An F after a water level value means that a parity error occurred during the transmission of that value and that the value should be considered suspect. A water level value of -9999 indicates either the value was never received or the received value was flagged during the quality control process and is not to be reported.

# APPENDIX 4: WMO AND AWIPS HEADERS

WMO headers are determined using WMO definitions [REF 6]. Both WMO and AWIPS headers contain characters pertaining to the data type and the geographical region. Each CO-OPS station falling within the WMO and AWIPS region is included in a bulletin, provided that public dissemination was not stopped by CORMS operators. The first two characters of the WMO header identify the data type, the next two characters identify the region, and the numbers differentiate between bulletins but do not hold a specific meaning. After the WMO header a 4-character Civil Aviation Organization identifier specifies the originating center. CO-OPS uses KWBC, which is the Washington Regional Telecommunication Hub, and indicates that the data are coming from the NWSTG.

AWIPS header syntax is different but provides similar information. The first three characters of the AWIPS header is the product category, and the next two characters specify the region or the Operational Forecast System (OFS).

CO-OPS requests new or revised WMO and AWIPS headers from the NWS Office of Operational Systems Operations Support & Performance Monitoring Branch (OPS31) by completing the Data Product Request for Change (RC) process [REF 8]. For CREX products, CO-OPS works with the Data Review Group (DRG) directly to obtain or revise WMO headers.

**CREX One-minute Water Level Headers**

| WMO Header | Geographic Area |
|---|---|
| SZNT31 KWBC | Atlantic Coast |
| SZGX32 KWBC | Gulf of Mexico Coast |
| SZCA33 KWBC | Caribbean Islands |
| SZPZ34 KWBC | Pacific Coast |
| SZAK35 KWBC | Alaskan Coast and Bays |
| SZHW36 KWBC | Hawaii |
| SZPA37 KWBC | Pacific Islands |

## CREX Six-minute Water Level and Meteorological Headers

| WMO Header | Geographic Area |
|---|---|
| KSAA30 KWBC | Atlantic Coast<br>(0 - 90 W Northern Hemisphere) |
| KSAA31 KWBC | Gulf of Mexico Coast<br>(0 - 90 W Northern Hemisphere) |
| KSAA32 KWBC | Great Lakes<br>(0 - 90 W Northern Hemisphere) |
| KSAB30 KWBC | Great Lakes<br>(90 W - 180 Northern Hemisphere) |
| KSAB31 KWBC | Gulf of Mexico Coast<br>(90 W - 180 Northern Hemisphere) |
| KSAB32 KWBC | Pacific Coast |
| KSAB33 KWBC | Alaska |
| KSAE30 KWBC | Caribbean Islands |
| KSAF30 KWBC | Hawaii |
| KSAG30 KWBC | Pacific Islands<br>(180 - 90 E Tropical) |
| KSAJ30 KWBC | Pacific Islands<br>(90 W - 180 Southern Hemisphere) |

## SHEF Observed Water Level Headers

| AWIPS Header | WMO Header | Geographic Area |
|---|---|---|
| TIDNT | SOUS41 KWBC | North Atlantic |
| TIDGX | SOUS42 KWBC | Gulf of Mexico |
| TIDGT | SOUS44 KWBC | Great Lakes |
| TIDPZ | SOUS43 KWBC | Pacific |
| TIDAK | SOUS45 KWBC | Alaska |
| TIDHW | SOPA46 KWBC | Hawaii |

## SHEF Meteorological Headers

| AWIPS Header | WMO Header | Geographic Area |
|---|---|---|
| OSONT | SXUS51 KWBC | North Atlantic |
| OSOGX | SXUS52 KWBC | Gulf of Mexico |
| OSOGT | SXUS54 KWBC | Great Lakes |
| OSOPZ | SXUS53 KWBC | Pacific |
| OSOAK | SXAK55 KWBC | Alaska |
| OSOHW | SXPA56 KWBC | Hawaii |

## SHEF Predicted Water Level Headers

| AWIPS Header | WMO Header | Geographic Area |
|---|---|---|
| TIDNT | SOUS61 KWBC | North Atlantic |
| TIDGX | SOUS62 KWBC | Gulf of Mexico |
| TIDPZ | SOUS63 KWBC | Pacific |
| TIDAK | SOUS64 KWBC | Alaska |
| TIDHI | SOUS65 KWBC | Hawaii |

## SHEF Operational Forecast System Water Level Model Guidance Headers

| AWIPS Header | WMO Header | OFS |
|---|---|---|
| TIDCB | SOUS41 KWBC | Chesapeake Bay |
| TIDDB | | Delaware Bay |
| TIDNY | | New York/New Jersey |
| TIDSJ | | St. Johns River |
| TIDTB | SOUS42 KWBC | Tampa Bay |
| TIDNG | | Northern Gulf of Mexico |
| TIDCR | SOUS43 KWBC | Columbia River Estuary |
| TIDSB* | | San Francisco Bay* |
| TIDLE | SOUS44 KWBC | Lake Erie |
| TIDLH | | Lake Huron |
| TIDLM | | Lake Michigan |
| TIDLO | | Lake Ontario |
| TIDLS | | Lake Superior |

*Coming soon

# APPENDIX 5: CREX AUTOMATED WATER LEVEL CHECKS

| NUMERIC CODE | MEANING |
|---|---|
| 00 | Good data |
| 01 | Maximum (high) water level limit exceeded |
| 02 | Minimum (low) water level limit exceeded |
| 03 | Rate-of-change limit for water level exceeded |
| 04 | Flat limit for water level exceeded |
| 05 | Observed water level minus predicted water level value limit |
| 06 | Observed primary water level value minus backup water level value limit exceeded |
| 07 | Value exceeded specified tolerance from expected value |
| 08 | Water level QA parameter (sigmas and/or outliers) limits |
| 09 | Sea temperature outside of expected range |
| 10 | Multiple QC checks listed above failed |