NEON SENSOR COMMAND, CONTROL AND CONFIGURATION (C3) DOCUMENT: BUOY METEOROLOGICAL STATION AND SUBMERGED SENSOR ASSEMBLY

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1 DESCRIPTION

Buoys will be deployed at 7 lake sites and 3 large river sites within NEON. These buoys are comprised of sensor sets which measure meteorological parameters over a water surface along with submerged sensors that measure physical and chemical parameters of the water body. Some of these sensors are unique to the buoy subsystem and others are shared with other NEON subsystems, such as the wadeable stream sensor sets. Due to power, space, and data storage constraints on the buoy, the configuration of sensors deployed on a buoy may be different than those in other parts of NEON.

Briefly, the buoy is comprised of meteorological station sensors, above and below water surface photosynthetically active radiation sensors, a profiling water quality multisonde, a static set of submerged temperature sensors that are deployed at site-specific depths, and a static submerged nitrate analyzer. The design of the data storage and transmission system on the buoys is also described here since they are unique to the buoy subsystem (Appendix B: DIGI RF Modem Configuration). The buoy schematic will be useful for reference while reading through this document (Appendix C: Buoy schematic drawing). Two software programs are used to control the buoy: YSI Profile wizard and MetStation_6.8.CR1, both were written by YSI/Xylem and configured prior to buoy delivery.

1.1 Purpose

This document specifies the command, control, and configuration details for operating a NEON sensor used for instrumental observations. It includes a detailed discussion of all necessary requirements for operational control parameters, conditions/constraints, set points, and any necessary error handling. All Level 0 Data Products generated by the sensor should be identified.

1.2 Scope

This document specifies the command, control, and configuration that are needed for operating these sensors. It does not provide implementation details, except for cases where these stem directly from the sensor conditions as described here.

A complete set of the Level 0 data products generated in this document can be found in Appendix A.

The buoy meteorological station and submerged sensor assembly will consist of following Data Generating Device (DGD) based on Data Generating Device DGD List and Hierarchies doc (AD [05]):

DGD Agile PN	DGD Agile Description
0348380000	Sensor, Buoy, 2D Wind, RM Young 05108
0354780000	Sensor, HMR3300 digital compass
0349250000	Sensor, Buoy, Net Radiation, NR01
0348420000	Sensor, Buoy, PAR, PQS-1
0348390000	Sensor, Buoy, Underwater PAR
0348410000	Sensor, Buoy, Humidity, HMP155
0348400000	Sensor, Buoy, Barometric Pressure
0351720501	Temperature Chain CRAM
0351721801	Temperature Chain TOOK
0351720301	Temperature Chain SUGG
0351720302	Temperature Chain BARC
HB07530100	Assembly, Multisonde with Sensors, FDOM, Lake
0329950100	Sensor, Buoy, SUNA Nitrate Analyzer with Integrated Wiper

Further detailed sensor info under each DGD is as following:

1. Under DGD 0348380000:
    a. 0348380000, Sensor, Buoy, 2D Wind, RM Young 05108, no firmware
2. Under DGD 0354780000:
    a. 0354780000, Sensor, HMR3300 digital compass, firmware shall be maintained to the current release during annual maintenance plans
3. Under 0349250000
    a. 0300070005, Sensor NR01 4-Component Up-Down Net Radiation 5m Cable, no firmware/software
4. Under 0348420000:
    a. 0300040000, Sensor PAR PQS1 Quantum, no firmware
5. Under 0348390000:
    a. 0320540000, Sensor, Li-1925A Li-Cor Underwater PAR, no firmware
6. Under 0348410000:
    a. 0322730000, Sensor Vaisala HMP155A Temperature/RH Probe, firmware SW 1.26
7. Under 0348400000:
    a. 0300380000, Sensor PTB330 Class A Digital Barometer with One Sensor, firmware 1.13 or 1.14

8. Under 0351720901:
    a. 0351720901, Temperature Chain PRPO, no firmware
9. Under 0351720902:
    a. 0351720902, Temperature Chain PRLA, no firmware
10. Under 0351720301:
    a. 0351720301, Temperature Chain SUGG, no firmware
11. Under 0351720502:
    a. 0351720502, Temperature Chain D05 SOFT, no firmware
12. Under 0351720501:
    a. 0351720501, Temperature Chain CRAM, no firmware
13. Under 0351721801:
    a. 0351721801, Temperature Chain TOOK, no firmware
14. Under 0351720302:
    a. 0351720302, Temperature Chain BARC, no firmware
15. Under HB07530100:
    a. NEON PN 0320170020, Sensor – YSI EXO2 Multisonde, firmware shall be maintained to the current release during annual maintenance plans.
    b. NEON PN 0320170001, Sensor – Conductivity/Temperture – YSI EXO sonde, firmware shall be maintained to the current release during annual maintenance plans.
    c. NEON PN 0320170003, Sensor – Dissolved Oxygen (Optical) – use with YSI EXO sonde, firmware shall be maintained to the current release during annual maintenance plans.
    d. NEON PN 0320170004, Sensor – Turbidity, use with YSI EXO sonde, firmware shall be maintained to the current release during annual maintenance plans.
    e. NEON PN 0320170005, Sensor – Total Aglae, use with YSI EXO sonde, firmware shall be maintained to the current release during annual maintenance plans.
    f. NEON PN 0320170006, Sensor – fDOM, use with YSI EXO sonde, firmware shall be maintained to the current release during annual maintenance plans.
    g. NEON PN 0320170007, Sensor – Central wiper for YSI EXO sonde only, firmware shall be maintained to the current release during annual maintenance plans.
    h. NEON PN 0320170015, Sensor – pH/ORP, unguarded, use with YSI EXO2 sonde, firmware shall be maintained to the current release during annual maintenance plans.
16. Under 0329950100:
    a. 0329950100, Sensor, SUNA Nutrient with Integrated Wiper, firmware shall be maintained to the current release during annual maintenance plans.
17. Other important parts with no assigned DGD:
    a. YSI 6980 Controller Assembly and YSI 6955 Winch Assembly (master CR1000 included in this assembly)
    b. Campbell Scientific CR1000 slave data logger is connected to the master for communication to the location controller

c. Campbell Scientific MD485 link connects the SUNA and master CR1000 to the radio link to the location controller
d. AM16/32 Multiplexer used to connect PQS1, Licor, net radiation, temperature and humidity sensors to slave CR1000
e. Depth sounder, 200115
f. Garmin GPS16X-HVS GPS Receiver reports positional information every 15 minutes

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

Applicable documents contain information that shall be applied in the current document. Examples are higher level requirements documents, standards, rules and regulations.

AD [01]	NEON.DOC.000001	NEON Observatory Design (NOD) Requirements
AD [02]	NEON.DOC.000291	NEON Configured Sensor List
AD [03]	NEON.DOC.005003	NEON Scientific Data Products Catalog
AD [04]	NEON.DOC.005005	NEON Level 0 Data Products Catalog
AD [05]	NEON.DOC.001104	Data Generating Device DGD List and Hierarchies

2.2 Reference Documents

Reference documents contain information complementing, explaining, detailing, or otherwise supporting the information included in the current document.

RD [01]	NEON.DOC.000008	NEON Acronym List
RD [02]	NEON.DOC.000243	NEON Glossary of Terms

2.3 Acronyms

Acronym	Explanation
ATBD	Algorithm Theoretical Basis Document
C^3	Command, Control, and Configuration Document
SOP	Standard Operating Procedures
QA/QC	Quality Assurance/Quality Control
AIS	Aquatic Instrument System
L0	Level 0
L1	Level 1
ENG	NEON Engineering group
CI	NEON Cyberinfrastructure group
DPS	NEON Data Products group
CVAL	NEON Calibration, Validation, and Audit Laboratory

3 SENSOR, BUOY, 2D WIND, RM YOUNG 05108 AND HMR3300 DIGITAL COMPASS INTRODUCTION (0348380000, 0354780000)

The sensor command, control, and configuration described here are related to the 2D wind speed and direction on buoy data product (NEON.DOM.SITE.DP0.20059.001) and L0 data streams (Appendix). This data product is derived from two separate DGD: 2D wind speed sensor and HMR3300 digital compass. Because of data storage and computational factors specific to the buoy meteorological station wind speed is measured at 1 Hz, but is stored as 60 second mean values in engineering units for ingest and publication. The wind direction reported by the sensor relies on compass heading readings from a HMR 3300 digital compass also installed on the buoy. This sensor is not used in any other locations within NEON.

3.1 Sensor, Buoy, 2D Wind, RM Young 05108 Overview of Sensor configuration (0348380000, 0354780000)

Table 1. RM Young 05108 configuration settings (0348380000).

Parameter	Default Setting
Wind speed: Acquisition rate	1 Hz average reported every 60 seconds
Wind direction: Acquisition rate	1 Hz average reported every 60 seconds
Measurement mode	Run

Table 2. HMR3300 Digital Compass configuration settings (0354780000).

Parameter	Default Setting
pitch: Acquisition rate	1 Hz average reported every 60 seconds
roll: Acquisition rate	1 Hz average reported every 60 seconds
yaw: Acquisition rate	1 Hz average reported every 60 seconds
Measurement mode	Output

3.2 Sensor, Buoy, 2D Wind, RM Young 05108 Error Handling (0348380000, 0354780000)

The RM Young 05108 Wind Monitor provides no error notification (0348380000).

The HMR3300 Digital Compass provides no error notification (0354780000) during operation, but will provide an error notification of “#W” for a low temperature warning or “#A” for alarm environment upon initialization.

3.3 Sensor, Buoy, 2D Wind, RM Young 05108 Sensor Controls Specification (0348380000, 0354780000)

There are no subunits that are actively controlled for either the RM Young wind sensor or HMR3300 digital compass.

4 SENSOR, BUOY, NET RADIATION, NR01 INTRODUCTION (0349250000)

The sensor command, control, and configuration described here are related to the net radiometer, buoy data product (NEON.DOM.SITE.DP0.20032.001) and L0 data streams (Appendix table). The AIS assembly to generate this data product consists of 1 component: net radiation sensor. This sensor is also used by TIS and AIS, but does not share data products with those configurations since the buoy is recording data above water and others are deployed above land.

4.1 Sensor, Buoy, Net Radiation, NR01 Overview of Sensor configuration (0349250000)

The radiation data from the sensor shall be unfiltered and uncorrected volt. Sensor body temperature will be unfiltered, and uncorrected ohm.

Table 3. NR01 net radiation sensor configuration settings (0349250000).

Parameter	Default Setting
Heater	Off
Temperature compensation	NA
Incoming radiation SW: Acquisition rate	1 per minute
Reflected radiation SW: Acquisition rate	1 per minute
Incoming radiation LW: Acquisition rate	1 per minute
Reflected radiation LW: Acquisition rate	1 per minute
Sensor body temperature	1 per minute
Heater diagnostic flag	1 per minute
Measurement mode	Run
Sensor error message	NA

4.2 Sensor, Buoy, Net Radiation, NR01 Error handling (0349250000)

This sensor provides no error notification.

4.3 Sensor, Buoy, Net Radiation, NR01 Sensor controls specification (0349250000)

Heater control is recommended to prevent condensation from forming in the sensor, resulting in inaccurate data. The Campbell Scientific CR1000 data logger is currently configured turn on the heater when the HMP 155 relative humidity is reading out ≥ 95% and turn off then the HMP 155 relative humidity is reading out ≤ 90% or when the data logger time is after 8 pm and before 6 am UTC. This is not an ideal configuration since UTC does not correspond to the day/night cycle at locations in different time zones. There is a plan to revise the programming of the Campbell Logger to match other NR01 sensor deployments in the NEON network where the heater control relies on the input of a HMP155 data stream. In those configurations, the heater turns on when the temperature of the NR01 body is within 2.5^{o} C of the dewpoint.

5 SENSOR, BUOY, HUMIDITY, HMP155 INTRODUCTION (0348410000)

The Vaisala Humidity and Temperature Probe HMP155A is selected to measure relative humidity and temperature on buoys deployed at lake and river sites data product (NEON.DOM.SITE.DP0.20032.001) and L0 data streams (Appendix table). The AIS assembly to generate this data product consists of 1 component: relative humidity sensor. A description and formulas that sensor used for calculating the dew point/frost point temperature are presented in (Vaisala, 2012). This sensor is also used by TIS and AIS, but does not share data products with those configurations since the buoy is recording data above water and others are deployed above land.

5.1 Sensor, Buoy, Humidity, HMP155 Overview of Sensor configuration (0348410000)

The relative humidity, temperature, and dew point/frost point temperature data from sensor shall be unfiltered and uncompensated. Sensor configuration settings are shown in Table 4.

Table 4. Sensor configuration settings for HMP155 humidity sensor (0348410000).

Parameter	Default Setting
Heater	Off
Pressure compensation	1.013 (No compensation)
Filtering	1.0 (no filter)
Chemical purge	Off
Measure mode	Run
Relative humidity: Acquisition rate	1 per minute
Temperature: Acquisition rate	1 per minute
Dew point/frost point temperature: Acquisition rate	1 per minute
Sensor status: Acquisition rate	1 per minute

5.2 Sensor, Buoy, Humidity, HMP155 Error handling (0348410000)

In an error state, the sensor outputs stars asterisks (***) instead of measured values. If the error occurs constantly, the sensor must be stopped and it is recommended to make a diagnosis by querying the error messages. The error messages of HMP155 shall be manually retrieved via the serial interface by using the ERRS command and the possible error messages are listed in Table 5.

Table 5. Truth table for sensor error handling for HMP155 humidity sensor (0348410000).

Control parameter(s)	Condition	Data acquisition system action	Output to CI
Sensor error status	Not failed	Do nothing	Sensor error flag
Sensor error status	Failed	Send trouble ticket	Sensor error flag

Table 6. Error messages and description for HMP155A humidity and temperature sensor.

Error Message	Description	Action
T MEAS error	Error in temperature measurement	Check the HUMICAP® sensor.
T REF error	Error in temperature measurement	Contact Vaisala Service Center, see page 55.
TA MEAS error	Error in T-probe measurement	Check the additional temperature probe.
TA REF error	Error in T-probe measurement	Contact Vaisala Service Center, see page 55.
F MEAS error	Error in humidity measurement	Check the HUMICAP® sensor.
F REF1 error	Error in humidity measurement	Contact Vaisala Service Center, see page 55.
F REF3 error	Error in humidity measurement	Contact Vaisala Service Center, see page 55.
Program flash checksum error	Internal error	Contact Vaisala Service Center, see page 55.
Parameter flash checksum error	Internal error	Contact Vaisala Service Center, see page 55.
INFOA checksum error	Internal error	Contact Vaisala Service Center, see page 55.
SCOEFS checksum error	Internal error	Contact Vaisala Service Center, see page 55.

5.3 Sensor, Buoy, Humidity, HMP155 Controls Specification (0348410000)

There are no subunits that are actively controlled.

6 SENSOR, BUOY, BAROMETRIC PRESSURE PTB330 INTRODUCTION (0348400000)

The sensor command, control, and configuration described here are related to the barometric pressure data product (NEON.DOM.SITE.DP0.20004.001) and L0 data streams (Appendix table). The AIS assembly to generate this data product consists of 1 component: barometric pressure. This sensor is also used by TIS and AIS, but does not share data products with those configurations since the buoy is recording data above water and others are deployed above land.

6.1 Sensor, Buoy, Barometric Pressure PTB330 configuration (0348400000)

The barometric pressure and temperature from sensor shall be unfiltered and uncompensated. Sensor configuration settings are shown in Table 7.

Table 7. Sensor configuration settings for PTB330 (0348400000).

Parameter	Default Setting
LCP1 (linear calibration correction)	Off
MPCP1 (multipoint calibration correction)	Off
Pressure units	kilopascal
Internal temperature e units	celsius
Atmospheric pressure: Acquisition rate	1 per minute
Internal temperature: Acquisition rate	1 per minute
Sensor Status: Acquisition rate	1 per minute

6.2 Sensor, Buoy, Barometric Pressure Error handling (0348400000)

All possible sensor error codes are shown in Table 9. When any of these errors occur the barometric pressure (NEON.DOM.SITE.DP0.20004.001) and internal temperature (NEON.DOM.SITE.DP0.20004.001) data streams will be set to zero, 0, and the sensor error flag (NEON.DOM.SITE.DP0.20004.001) will be set to one, 1. When an error occurs the specific sensor error code from Table 9 shall be made available to NEON's Problem Tracking and Resolution system to determine what action is necessary. If an error message occurs (i.e., error status = 1) a trouble ticket should be created (Table 8).

This document assumes that this sensor auto-resets its error status when the phenomenon causing the error ends. For example, if the temperature is outside the sensors' operating range the error flag will be set to 1 and the pressure data will be set to 0 until the temperature returns to a level within the operating range, at which point the error flag will be set to 0 and the pressure data stream will resume.

Table 8. Truth table for sensor error handling for PTB330 (0348400000).

Control parameter(s)	Condition	Data acquisition system action	Output to CI
Sensor error status	Not failed	Do nothing	Sensor error flag 0 (NEON.DOM.SITE.DP0.20004.001)
Sensor error status	Failed	Send trouble ticket	Sensor error flag 1 (NEON.DOM.SITE.DP0.20004.001)

Table 9. Codes and interpretations of sensor error messages for PTB330 (0348400000) (Vaisala, 2008).

Error Code	Error Message	Action
E10	Internal EEPROM read error.	Internal barometer failure. Return the barometer to the Vaisala Service Center.
E11	Internal EEPROM write error.	Internal barometer failure. Remove the barometer and return the faulty unit to Vaisala Service.
E12...E15	Add-on module 1/2/3/4 connection failure	Turn off the power and check the module connection. Turn on the power.
E8	Device internal temperature out of range	Ensure that the operating temperature is within the valid range
E6	Operating voltage out of range	Ensure that the operating voltage is within the valid range.
E7	Internal system voltage out of range	Internal barometer failure. Return the barometer to the Vaisala Service Center.
E20...E23	Configuration switches for analog output 1/2/3/4 set incorrectly	Check and re-set the switches of the analog output module, see section Changing Output Mode and Range on page 99.
E5	Communication module installed in incorrect add-on module slot	Disconnect the power and change the communication module to module slot 1.

E28...E31	Unknown/incompatible module installed in add-on module slot 1/2/3/4)	Ensure that the module is compatible with the PTB330.
E4	Pressure out of valid range	Check that the assumed pressure is within the measurement range for the barometer.
E3	Difference between pressure transducers too large	1) Check that the barometer modules are measuring the same pressure or 2) Check if one of the barometer modules is out of the valid range or 3) Check if the DPMAX value is set too low.
E16...E19	Pressure measurement failure on add-on module 1/2/3/4	Internal barometer failure. Return the barometer to the Vaisala Service Center.
E9	Checksum error in the internal configuration memory	Internal barometer failure. Return the barometer to the Vaisala Service Center.
E24...E27	EEPROM failure on add-on module 1/2/3/4	Internal barometer failure. Return the barometer to the Vaisala Service Center.

6.3 Sensor, Buoy, Barometric Pressure Controls Specification (0348400000)

There are no subunits that are actively controlled.

7 SENSOR, BUOY, PAR, PQS-1 INTRODUCTION (0348420000)

The sensor command, control, and configuration described here are related to the Photosynthetically active radiation at water surface data product (NEON.DOM.SITE.DP0.20042.001) and L0 data streams (Appendix table). The AIS assembly to generate this data product consists of 1 component: photosynthetically active radiation (PAR). This sensor is also used by TIS and AIS, and does share a data product with other AIS deployments. The data streams are the same for all deployments of this sensor, but the frequency at which data is returned will be different on the buoy compared to AIS deployments.

7.1 Sensor, Buoy, PAR, PQS-1 Overview of Sensor configuration (0348420000)

The PAR data from the sensor shall be unfiltered and uncorrected volt.

Table 10. Sensor configuration settings for PQS-1 (0348420000).

Parameter	Default Setting
inPAR measurement: Acquisition Rate	2 per minute
Data acquired from the sensor	PAR (volt)
Measurement mode	Run
Sensor error message	NA

7.2 Sensor, Buoy, PAR, PQS-1 Error handling (0348420000)

This sensor provides no error notification.

7.3 Sensor, Buoy, PAR, PQS-1 Controls Specification (0348420000)

There are no subunits that are actively controlled.

8 SENSOR, BUOY, UNDERWATER PAR LI-192SA INTRODUCTION (0348390000)

The sensor command, control, and configuration described here are related to the underwater photosynthetically active radiation (PAR) data product (NEON.DOM.SITE.DP0.20261.001) and L0 data streams (Appendix table). The AIS assembly to generate this data product consists of 1 component: underwater PAR sensor. This sensor is also shares a data product with other AIS deployments, specifically at the inlet and outlet location at lake sites. The data streams are the same for all deployments of this sensor, but the frequency at which data is returned will be different on the buoy compared to AIS deployments.

8.1 Sensor, Buoy, Underwater PAR Overview of Sensor configuration (0348390000)

The PAR data from the sensor shall be unfiltered and uncorrected volt.

Table 11. Sensor configuration settings for PAR LI-192SA (0348390000).

Parameter	Default Setting
inPAR measurement: Acquisition Rate	2 per minute
outPAR measurement: Acquisition Rate	2 per minute
Data acquired from the sensor	PAR (volt)
Measurement mode	Run
Sensor error message	NA

8.2 Sensor, Buoy, Underwater PAR Error handling (0348390000)

This sensor provides no error notification.

8.3 Sensor, Buoy, Underwater PAR Controls Specification (0348390000)

There are no subunits that are actively controlled.

9 SENSOR, BUOY, TEMPERATURE CHAINS INTRODUCTION (0351720301, 0351720302, 0351720501, 0351720502, 0351721801, 0351720901, 0351720902)

The sensor command, control, and configuration described here are related to the water temperature at specific depths data product (NEON.DOM.SITE.DP0.20264.001) and L0 data streams (Appendix table). The AIS assembly to generate this data product consists of 1 component: temperature chain, BARC. This sensor is not used in any other locations within NEON.

9.1 Sensor, Buoy, Temperature Chain Overview of Configurations that apply to all temperature chains (0351720301, 0351720302, 0351720501, 0351720502, 0351721801, 0351720901, 0351720902)

Table 12. Sensor configuration settings for temperature chains.

Parameter	Default Setting
Data acquired from the sensor	Temperature (celsius)
Measurement mode	Run
waterTemp	1 per minute

9.2 Error handling that applies to all temperature chains

The temperature chains provide no error notification.

9.3 Site specific temperature chain configurations

Table 13. L0 data streams from temperature at specific depths for the temperature chain deployed at SUGG (0351720301) at a frequency of 1 per minute.

fieldName	description	Units
depth0WaterTemp	Measurement of water temperature along a fixed chain from shallowest depth	celsius
depth1WaterTemp	Measurement of water temperature along a fixed chain from 2nd shallowest depth	celsius
depth2WaterTemp	Measurement of water temperature along a fixed chain from 3rd shallowest depth	celsius
depth3WaterTemp	Measurement of water temperature along a fixed chain from 4th shallowest depth	celsius
depth4WaterTemp	Measurement of water temperature along a fixed chain from 5th shallowest depth	celsius

Table 14. L0 data streams from temperature at specific depths for the temperature chain deployed at BARC (0351720302) at a frequency of 1 per minute.

fieldName	description	Units
depth0WaterTemp	Measurement of water temperature along a fixed chain from shallowest depth	celsius
depth1WaterTemp	Measurement of water temperature along a fixed chain from 2nd shallowest depth	celsius
depth2WaterTemp	Measurement of water temperature along a fixed chain from 3rd shallowest depth	celsius
depth3WaterTemp	Measurement of water temperature along a fixed chain from 4th shallowest depth	celsius
depth4WaterTemp	Measurement of water temperature along a fixed chain from 5th shallowest depth	celsius
depth5WaterTemp	Measurement of water temperature along a fixed chain from 6th shallowest depth	celsius
depth6WaterTemp	Measurement of water temperature along a fixed chain from 7th shallowest depth	celsius

Table 15. L0 data streams from temperature at specific depths for the temperature chain deployed at CRAM (0351720501) at a frequency of 1 per minute.

fieldName	description	Units
depth0WaterTemp	Measurement of water temperature along a fixed chain from shallowest depth	celsius
depth1WaterTemp	Measurement of water temperature along a fixed chain from 2nd shallowest depth	celsius
depth2WaterTemp	Measurement of water temperature along a fixed chain from 3rd shallowest depth	celsius
depth3WaterTemp	Measurement of water temperature along a fixed chain from 4th shallowest depth	celsius
depth4WaterTemp	Measurement of water temperature along a fixed chain from 5th shallowest depth	celsius
depth5WaterTemp	Measurement of water temperature along a fixed chain from 6th shallowest depth	celsius
depth6WaterTemp	Measurement of water temperature along a fixed chain from 7th shallowest depth	celsius

Table 16. L0 data streams from temperature at specific depths for the temperature chain deployed at TOOK (0351721801) at a frequency of 1 per minute.

fieldName	description	Units
depth0WaterTemp	Measurement of water temperature along a fixed chain from shallowest depth	celsius
depth1WaterTemp	Measurement of water temperature along a fixed chain from 2nd shallowest depth	celsius
depth2WaterTemp	Measurement of water temperature along a fixed chain from 3rd shallowest depth	celsius
depth3WaterTemp	Measurement of water temperature along a fixed chain from 4th shallowest depth	celsius
depth4WaterTemp	Measurement of water temperature along a fixed chain from 5th shallowest depth	celsius
depth5WaterTemp	Measurement of water temperature along a fixed chain from 6th shallowest depth	celsius
depth6WaterTemp	Measurement of water temperature along a fixed chain from 7th shallowest depth	celsius
Depth7WaterTemp	Measurement of water temperature along a fixed chain from 8th shallowest depth	celsius
Depth8WaterTemp	Measurement of water temperature along a fixed chain from 9th shallowest depth	celsius
Depth9WaterTemp	Measurement of water temperature along a fixed chain from 10th shallowest depth	celsius

Table 17. L0 data streams from temperature at specific depths for the temperature chain deployed at PRPO (0351720901) at a frequency of 1 per minute.

fieldName	description	Units
depth0WaterTemp	Measurement of water temperature along a fixed chain from shallowest depth	celsius
depth1WaterTemp	Measurement of water temperature along a fixed chain from 2nd shallowest depth	celsius
depth2WaterTemp	Measurement of water temperature along a fixed chain from 3rd shallowest depth	celsius
depth3WaterTemp	Measurement of water temperature along a fixed chain from 4th shallowest depth	celsius
depth4WaterTemp	Measurement of water temperature along a fixed chain from 5th shallowest depth	celsius

Table 18. L0 data streams from temperature at specific depths for the temperature chain deployed at PRLA (0351720902) at a frequency of 1 per minute.

fieldName	description	Units
depth0WaterTemp	Measurement of water temperature along a fixed chain from shallowest depth	celsius
depth1WaterTemp	Measurement of water temperature along a fixed chain from 2nd shallowest depth	celsius
depth2WaterTemp	Measurement of water temperature along a fixed chain from 3rd shallowest depth	celsius
depth3WaterTemp	Measurement of water temperature along a fixed chain from 4th shallowest depth	celsius
depth4WaterTemp	Measurement of water temperature along a fixed chain from 5th shallowest depth	celsius
depth5WaterTemp	Measurement of water temperature along a fixed chain from 6th shallowest depth	celsius
depth6WaterTemp	Measurement of water temperature along a fixed chain from 7th shallowest depth	celsius
Depth7WaterTemp	Measurement of water temperature along a fixed chain from 8th shallowest depth	celsius
Depth8WaterTemp	Measurement of water temperature along a fixed chain from 9th shallowest depth	celsius

9.4 Site specific temperature chain depths from water surface

SUGG: 0.05 m, 0.3 m, 0.55 m, 0.8 m, 1.05 m

BARC: 0.05 m, 0.55 m, 1.05 m, 1.55 m, 2.05 m, 2.55 m, 3.05 m

CRAM: 0.05 m, 1.75 m, 3.45 m, 5.15 m, 6.85 m, 8.55 m, 10.25 m

TOOK: 0.05 m, 1.75 m, 3.5 m, 5.25 m, 7.0 m, 8.75 m, 10.5 m, 12.25 m, 14.0 m, 15.75 m

PRPO: 0.05 m, 0.3 m, 0.55 m, 0.8 m, 1.05 m

PRLA: 0.05 m, 0.3 m, 0.55 m, 0.8 m, 1.05 m, 1.3 m, 1.55 m, 1.8 m, 2.05 m

D05: TBD

BLWA: 0.05m, 1.00m, 2.00m, 3.00m, 4.00m, 5.00m, 6.00m 7.00m, 8.00m, 9.00m

TOMB: 0.05m, 1.00m, 2.00m, 3.00m, 4.00m, 5.00m, 6.00m 7.00m, 8.00m, 9.00m

FLNT:0.05m, 1.1m, 2.25m, 4.5m

10 SENSOR, BUOY, MULTI SONDE INTRODUCTION (HB07530100)

The sensor configuration and sensor command and control described here are related to surface water Temperature, Actual Conductivity, pH, Dissolved Oxygen, Turbidity, Chlorophyll *a*, fDOM. The multisonde consists of a central sensor body that holds individual sensors for each measurement parameter listed below. The multisonde sensors hold their calibration constants within internal memory inside each sensor and perform the analog to digital data conversion internally before any data output occurs. Table 19 below details the data measurements streams and associated L0 data product ID's. This sensor is also used by AIS, and does share multiple data products with other AIS deployments. The data streams are the same for all deployments of this sensor, but the frequency at which data is returned will be different on the buoy compared to AIS deployments.

10.1 Sensor, Buoy, Multisonde Overview (HB07530100)

The sensor configuration and sensor command and control described here are related to the multisonde associated data products. A description of how sensor readings shall be converted to L1 DPs is presented in the associated ATBD (AD[06]). The AIS assembly used to generate these data products consists of multiple components, which vary according to the site type and location within a site. This document describes the assemblies that are deployed at lake and river sites. At these sites the components include the sonde body, pH, DO, turbidity, total algae (chlorophyll a), temperature, conductivity and fDOM sensors, a weighted guard and winch assembly for vertical profiling. Measurements are captured at a single station from a buoy platform at lake and river sites.

Configuration settings and the command and control structure are described below. The L0 data products resulting from this sensor are listed in the appendix. The multisonde assembly shall be configured to output the data streams defined in Table 17. The Multisonde assemblies contain a central wiper that is used to limit the accumulation of biological growth that will impact measurements. The wiper function shall be configured according to Table 18 for the Multisonde assemblies.

Table 19. L0 data streams from Multisonde, buoy collected once per 5 minutes (HB07530000)

fieldName	description	Units
conductance	Conductivity at ambient temperature	microsiemensPerCentimeter
specificConductance	Conductivity auto-corrected to 25 degrees C	microsiemensPerCentimeter
surfaceWaterTemperature	Temperature in surface water	celsius
sensorDepth	Water depth of measurement	meter

sondeSurfaceWaterPressure	Pressure of surface water measured by the multisonde in psi	poundsPerSquareInch
dissolvedOxygenSaturation	Dissolved Oxygen Percent Saturation	percent
dissolvedOxygen	Dissolved Oxygen Concentration	milligramsPerLiter
pH	Measurement of pH in water	pH
pHvoltage	pH meter voltage	millivolt
blueGreenAlgaeRaw	Raw signal of blue-green algae sensor as a percent of full scale detected in the sample	percent
blueGreenAlgaePhycocyanin	Blue-green algae phycocyanin concentration in water	microgramsPerLiter
chlorophyllRaw	Raw signal of chlorophyll a sensor as a percent of full scale detected in the sample	percent
chlorophyll	Chlorophyll a concentration in water	microgramsPerLiter
turbidityRaw	Raw signal of turbidity sensor as a percent of full scale detected in the sample	percent
turbidity	Turbidity of water as FNU	formazinNephelometricUnit
fDOMRaw	Raw signal of fluorescent dissolved organic matter sensor as a percent of full scale detected in the sample	percent
fDOM	Fluorescent dissolved organic matter concentration as quinine sulfate equilivents	quinineSulfateUnit
wiperPosition	Position of wiper	volt
batteryVoltage	Battery voltage	volt
sensorVoltage	Main voltage	volt

Table 20. Multisonde wiper configuration, Stream (HB07530000 and HB07530010)

Parameter	Setting
Samples per Wipe	1

10.2 Error handling

The multisonde sensor outputs a "fault code" field. YSI does not report the expected value or definitions for this field. If the fault code is anything other than "0", the number shall be reported to the NEON's Problem Tracking and Resolution system to determine what action is necessary.

There is no active or direct error monitoring. However, if the Multisonde output streams exhibit problems the sonde may be queried to determine if there are any internal faults. The sonde reports these internal faults via the SONDE_FULT YSIP command. The fault code be determined by performing the command Get Device Status and looking at bit 4 in the response. Table 21 shows the bit position descriptions.

Table 21. Truth table for sensor error handling Multisonde, buoy (HB07530000).

Device Status Bit Position	Condition	Data acquisition system action	Output to CI
0	Low Battery (<3.6V)	None	None
1	Low External Voltage (<7.5V)	Send trouble ticket	None
2	Low Real Time Clock Battery (<1.8V)	Send trouble ticket	None
3	microSD card Fault	None	None
4	Bluetooth Fault	None	None
5	Sensor Address Fault (address = 0)	Send trouble ticket	None
6	Power/Comms FPGA Fault	Send trouble ticket	None
7	Sensor #1 Over Power (>2000mW)	Send trouble ticket	None
8	Sensor #2 Over Power	Send trouble ticket	None
9	Sensor #3 Over Power	Send trouble ticket	None
10	Sensor #4 Over Power	Send trouble ticket	None
11	Sensor #5 Over Power	Send trouble ticket	None
12	Sensor #6 Over Power	Send trouble ticket	None
13	Sensor #7 Over Power	Send trouble ticket	None
14	Sensor #8 Over Power	Send trouble ticket	None
15	Sensor #9 Over Power	Send trouble ticket	None
16	Sensor #10 Over Power	Send trouble ticket	None
17	Sensor #11 Over Power	Send trouble ticket	None
18	Sensor #12 Over Power	Send trouble ticket	None
19	Sensor #13 Over Power	Send trouble ticket	None
20	Sensor #14 Over Power	Send trouble ticket	None
21	Sensor #15 Over Power	Send trouble ticket	None
22	Sensor #16 Over Power	Send trouble ticket	None
24-31	Reserved	NA	NA

10.3 Sensor controls specification Multisonde, buoy (HB07530000)

The sonde will be configured in the RS-232 menu to the above sensor configuration. The sonde will receive a query by the location controller. The sonde responds with the preconfigured data stream.

10.4 Rationale for wipers Multisonde, buoy (HB07530000)

Biofouling is anticipated to occur at all aquatic sites in the NEON Domains to varying degrees. Biofouling is the result of buildup of algae and other surface films that grow or are deposited on the optical lenses of the sensors.

The multisonde has a central wiper that will need to be programmed using the KOR software (Proprietary software written by YSI for use with the YSI EXO mulitsondes) to operate 12/hr. The central wiper is configured with a potentiometer that reports voltage (V) as a function of position of the wiper head as a sensor output from this unit.

10.5 Assembly integration Multisonde, buoy (HB07530000)

This occurs but is handled by the sensors internally in the multisonde body and data output from the multisonde has already been converted from analog to digital signal with calibration constants applied. This sensor reports raw data values for pH, Turbidity, Chlorophyll a, fDOM, and Wiper Position.

11 SENSOR, BUOY, SUNA NITRATE ANALYZER INTRODUCTION (0329950100)

The sensor command, control, and configuration described here are related to the surface water nitrate data product (NEON.DOM.SITE.DP0.20033.001) and L0 data streams (Appendix table). The AIS assembly to generate this data product consists of 1 component: submersible ultraviolet nitrate analyzer.

It is assumed that communication and control of the sensor will be executed via RS-232. The sensor may be queried to change settings or perform a "selftest" for error handling. Under the full ASCII output, the sensor generates 286 (0-285) data streams. NEON software has been developed to allow for these 286 data streams to be compressed to a single binary stream which may be parsed out during the ingest process. This scheme is described in Eq.1.

Stream#0= {0: <value>, 1: <value>,…285:<value>} **Equation 1**

The L0 data products resulting from this sensor are listed in the Appendix A, Table 33. The identification for each of the compressed data fields (e.g. the field numbers in Equation 1) are listed in Table 20 below.

Table 22. Data fields and position that are captured with the SUNA and compressed.

L0 Data Stream Field Position	Full ASCII Data Fields
0	Light Frame/Dark Frame
1	Date field (numeric)
2	Time field (numeric)
3	Nitrate concentration as micromoler
4	Nitrogen in nitrate as mg/L
5	Absorbance at 254 nm
6	Absorbance at 350 nm
7	Bromide trace
8	Spec Average or SW Average(Dark Correction Method)
9	Dark Signal Average (average dark intensity)
10	Integration Time Factor
11	spectrometer intensity at wavelength 189.29 nm
12	spectrometer intensity at wavelength 190.08 nm
13	spectrometer intensity at wavelength 190.87 nm
14	spectrometer intensity at wavelength 191.67 nm
15	spectrometer intensity at wavelength 192.46 nm
16	spectrometer intensity at wavelength 193.26 nm
17	spectrometer intensity at wavelength 194.05 nm
18	spectrometer intensity at wavelength 194.85 nm
19	spectrometer intensity at wavelength 195.64 nm

20	spectrometer intensity at wavelength 196.44 nm
21	spectrometer intensity at wavelength 197.23 nm
22	spectrometer intensity at wavelength 198.03 nm
23	spectrometer intensity at wavelength 198.83 nm
24	spectrometer intensity at wavelength 199.62 nm
25	spectrometer intensity at wavelength 200.42 nm
26	spectrometer intensity at wavelength 201.22 nm
27	spectrometer intensity at wavelength 202.02 nm
28	spectrometer intensity at wavelength 202.81 nm
29	spectrometer intensity at wavelength 203.61 nm
30	spectrometer intensity at wavelength 204.41 nm
31	spectrometer intensity at wavelength 205.21 nm
32	spectrometer intensity at wavelength 206.01 nm
33	spectrometer intensity at wavelength 206.81 nm
34	spectrometer intensity at wavelength 207.61 nm
35	spectrometer intensity at wavelength 208.41 nm
36	spectrometer intensity at wavelength 209.21 nm
37	spectrometer intensity at wavelength 210.01 nm
38	spectrometer intensity at wavelength 210.81 nm
39	spectrometer intensity at wavelength 211.61 nm
40	spectrometer intensity at wavelength 212.41 nm
41	spectrometer intensity at wavelength 213.21 nm
42	spectrometer intensity at wavelength 214.01 nm
43	spectrometer intensity at wavelength 214.82 nm
44	spectrometer intensity at wavelength 215.62 nm
45	spectrometer intensity at wavelength 216.42 nm
46	spectrometer intensity at wavelength 217.22 nm
47	spectrometer intensity at wavelength 218.03 nm
48	spectrometer intensity at wavelength 218.83 nm
49	spectrometer intensity at wavelength 219.63 nm
50	spectrometer intensity at wavelength 220.43 nm
51	spectrometer intensity at wavelength 221.24 nm
52	spectrometer intensity at wavelength 222.04 nm
53	spectrometer intensity at wavelength 222.85 nm
54	spectrometer intensity at wavelength 223.65 nm
55	spectrometer intensity at wavelength 224.46 nm
56	spectrometer intensity at wavelength 225.26 nm
57	spectrometer intensity at wavelength 226.06 nm

58	spectrometer intensity at wavelength 226.87 nm
59	spectrometer intensity at wavelength 227.68 nm
60	spectrometer intensity at wavelength 228.48 nm
61	spectrometer intensity at wavelength 229.29 nm
62	spectrometer intensity at wavelength 230.09 nm
63	spectrometer intensity at wavelength 230.9 nm
64	spectrometer intensity at wavelength 231.71 nm
65	spectrometer intensity at wavelength 232.51 nm
66	spectrometer intensity at wavelength 233.32 nm
67	spectrometer intensity at wavelength 234.13 nm
68	spectrometer intensity at wavelength 234.93 nm
69	spectrometer intensity at wavelength 235.74 nm
70	spectrometer intensity at wavelength 236.55 nm
71	spectrometer intensity at wavelength 237.36 nm
72	spectrometer intensity at wavelength 238.16 nm
73	spectrometer intensity at wavelength 238.97 nm
74	spectrometer intensity at wavelength 239.78 nm
75	spectrometer intensity at wavelength 240.59 nm
76	spectrometer intensity at wavelength 241.4 nm
77	spectrometer intensity at wavelength 242.21 nm
78	spectrometer intensity at wavelength 243.01 nm
79	spectrometer intensity at wavelength 243.82 nm
80	spectrometer intensity at wavelength 244.63 nm
81	spectrometer intensity at wavelength 245.44 nm
82	spectrometer intensity at wavelength 246.25 nm
83	spectrometer intensity at wavelength 247.06 nm
84	spectrometer intensity at wavelength 247.87 nm
85	spectrometer intensity at wavelength 248.68 nm
86	spectrometer intensity at wavelength 249.49 nm
87	spectrometer intensity at wavelength 250.3 nm
88	spectrometer intensity at wavelength 251.11 nm
89	spectrometer intensity at wavelength 251.92 nm
90	spectrometer intensity at wavelength 252.73 nm
91	spectrometer intensity at wavelength 253.55 nm
92	spectrometer intensity at wavelength 254.36 nm
93	spectrometer intensity at wavelength 255.17 nm
94	spectrometer intensity at wavelength 255.98 nm
95	spectrometer intensity at wavelength 256.79 nm

96	spectrometer intensity at wavelength 257.6 nm
97	spectrometer intensity at wavelength 258.41 nm
98	spectrometer intensity at wavelength 259.23 nm
99	spectrometer intensity at wavelength 260.04 nm
100	spectrometer intensity at wavelength 260.85 nm
101	spectrometer intensity at wavelength 261.66 nm
102	spectrometer intensity at wavelength 262.48 nm
103	spectrometer intensity at wavelength 263.29 nm
104	spectrometer intensity at wavelength 264.1 nm
105	spectrometer intensity at wavelength 264.91 nm
106	spectrometer intensity at wavelength 265.73 nm
107	spectrometer intensity at wavelength 266.54 nm
108	spectrometer intensity at wavelength 267.35 nm
109	spectrometer intensity at wavelength 268.17 nm
110	spectrometer intensity at wavelength 268.98 nm
111	spectrometer intensity at wavelength 269.79 nm
112	spectrometer intensity at wavelength 270.61 nm
113	spectrometer intensity at wavelength 271.42 nm
114	spectrometer intensity at wavelength 272.23 nm
115	spectrometer intensity at wavelength 273.05 nm
116	spectrometer intensity at wavelength 273.86 nm
117	spectrometer intensity at wavelength 274.68 nm
118	spectrometer intensity at wavelength 275.49 nm
119	spectrometer intensity at wavelength 276.31 nm
120	spectrometer intensity at wavelength 277.12 nm
121	spectrometer intensity at wavelength 277.93 nm
122	spectrometer intensity at wavelength 278.75 nm
123	spectrometer intensity at wavelength 279.56 nm
124	spectrometer intensity at wavelength 280.38 nm
125	spectrometer intensity at wavelength 281.19 nm
126	spectrometer intensity at wavelength 282.01 nm
127	spectrometer intensity at wavelength 282.82 nm
128	spectrometer intensity at wavelength 283.64 nm
129	spectrometer intensity at wavelength 284.45 nm
130	spectrometer intensity at wavelength 285.27 nm
131	spectrometer intensity at wavelength 286.08 nm
132	spectrometer intensity at wavelength 286.9 nm
133	spectrometer intensity at wavelength 287.71 nm

134	spectrometer intensity at wavelength 288.53 nm
135	spectrometer intensity at wavelength 289.35 nm
136	spectrometer intensity at wavelength 290.16 nm
137	spectrometer intensity at wavelength 290.98 nm
138	spectrometer intensity at wavelength 291.79 nm
139	spectrometer intensity at wavelength 292.61 nm
140	spectrometer intensity at wavelength 293.42 nm
141	spectrometer intensity at wavelength 294.24 nm
142	spectrometer intensity at wavelength 295.06 nm
143	spectrometer intensity at wavelength 295.87 nm
144	spectrometer intensity at wavelength 296.69 nm
145	spectrometer intensity at wavelength 297.51 nm
146	spectrometer intensity at wavelength 298.32 nm
147	spectrometer intensity at wavelength 299.14 nm
148	spectrometer intensity at wavelength 299.95 nm
149	spectrometer intensity at wavelength 300.77 nm
150	spectrometer intensity at wavelength 301.59 nm
151	spectrometer intensity at wavelength 302.4 nm
152	spectrometer intensity at wavelength 303.22 nm
153	spectrometer intensity at wavelength 304.04 nm
154	spectrometer intensity at wavelength 304.85 nm
155	spectrometer intensity at wavelength 305.67 nm
156	spectrometer intensity at wavelength 306.49 nm
157	spectrometer intensity at wavelength 307.3 nm
158	spectrometer intensity at wavelength 308.12 nm
159	spectrometer intensity at wavelength 308.93 nm
160	spectrometer intensity at wavelength 309.75 nm
161	spectrometer intensity at wavelength 310.57 nm
162	spectrometer intensity at wavelength 311.38 nm
163	spectrometer intensity at wavelength 312.2 nm
164	spectrometer intensity at wavelength 313.02 nm
165	spectrometer intensity at wavelength 313.83 nm
166	spectrometer intensity at wavelength 314.65 nm
167	spectrometer intensity at wavelength 315.47 nm
168	spectrometer intensity at wavelength 316.28 nm
169	spectrometer intensity at wavelength 317.1 nm
170	spectrometer intensity at wavelength 317.92 nm
171	spectrometer intensity at wavelength 318.73 nm

172	spectrometer intensity at wavelength 319.55 nm
173	spectrometer intensity at wavelength 320.37 nm
174	spectrometer intensity at wavelength 321.18 nm
175	spectrometer intensity at wavelength 322 nm
176	spectrometer intensity at wavelength 322.82 nm
177	spectrometer intensity at wavelength 323.63 nm
178	spectrometer intensity at wavelength 324.45 nm
179	spectrometer intensity at wavelength 325.27 nm
180	spectrometer intensity at wavelength 326.08 nm
181	spectrometer intensity at wavelength 326.9 nm
182	spectrometer intensity at wavelength 327.72 nm
183	spectrometer intensity at wavelength 328.53 nm
184	spectrometer intensity at wavelength 329.35 nm
185	spectrometer intensity at wavelength 330.17 nm
186	spectrometer intensity at wavelength 330.98 nm
187	spectrometer intensity at wavelength 331.8 nm
188	spectrometer intensity at wavelength 332.62 nm
189	spectrometer intensity at wavelength 333.43 nm
190	spectrometer intensity at wavelength 334.25 nm
191	spectrometer intensity at wavelength 335.06 nm
192	spectrometer intensity at wavelength 335.88 nm
193	spectrometer intensity at wavelength 336.7 nm
194	spectrometer intensity at wavelength 337.51 nm
195	spectrometer intensity at wavelength 338.33 nm
196	spectrometer intensity at wavelength 339.14 nm
197	spectrometer intensity at wavelength 339.96 nm
198	spectrometer intensity at wavelength 340.78 nm
199	spectrometer intensity at wavelength 341.59 nm
200	spectrometer intensity at wavelength 342.41 nm
201	spectrometer intensity at wavelength 343.22 nm
202	spectrometer intensity at wavelength 344.04 nm
203	spectrometer intensity at wavelength 344.85 nm
204	spectrometer intensity at wavelength 345.67 nm
205	spectrometer intensity at wavelength 346.48 nm
206	spectrometer intensity at wavelength 347.3 nm
207	spectrometer intensity at wavelength 348.12 nm
208	spectrometer intensity at wavelength 348.93 nm
209	spectrometer intensity at wavelength 349.75 nm

210	spectrometer intensity at wavelength 350.56 nm
211	spectrometer intensity at wavelength 351.38 nm
212	spectrometer intensity at wavelength 352.19 nm
213	spectrometer intensity at wavelength 353.01 nm
214	spectrometer intensity at wavelength 353.82 nm
215	spectrometer intensity at wavelength 354.63 nm
216	spectrometer intensity at wavelength 355.45 nm
217	spectrometer intensity at wavelength 356.26 nm
218	spectrometer intensity at wavelength 357.08 nm
219	spectrometer intensity at wavelength 357.89 nm
220	spectrometer intensity at wavelength 358.71 nm
221	spectrometer intensity at wavelength 359.52 nm
222	spectrometer intensity at wavelength 360.33 nm
223	spectrometer intensity at wavelength 361.15 nm
224	spectrometer intensity at wavelength 361.96 nm
225	spectrometer intensity at wavelength 362.78 nm
226	spectrometer intensity at wavelength 363.59 nm
227	spectrometer intensity at wavelength 364.4 nm
228	spectrometer intensity at wavelength 365.22 nm
229	spectrometer intensity at wavelength 366.03 nm
230	spectrometer intensity at wavelength 366.84 nm
231	spectrometer intensity at wavelength 367.65 nm
232	spectrometer intensity at wavelength 368.47 nm
233	spectrometer intensity at wavelength 369.28 nm
234	spectrometer intensity at wavelength 370.09 nm
235	spectrometer intensity at wavelength 370.91 nm
236	spectrometer intensity at wavelength 371.72 nm
237	spectrometer intensity at wavelength 372.53 nm
238	spectrometer intensity at wavelength 373.34 nm
239	spectrometer intensity at wavelength 374.15 nm
240	spectrometer intensity at wavelength 374.97 nm
241	spectrometer intensity at wavelength 375.78 nm
242	spectrometer intensity at wavelength 376.59 nm
243	spectrometer intensity at wavelength 377.4 nm
244	spectrometer intensity at wavelength 378.21 nm
245	spectrometer intensity at wavelength 379.02 nm
246	spectrometer intensity at wavelength 379.83 nm
247	spectrometer intensity at wavelength 380.64 nm

248	spectrometer intensity at wavelength 381.45 nm
249	spectrometer intensity at wavelength 382.27 nm
250	spectrometer intensity at wavelength 383.08 nm
251	spectrometer intensity at wavelength 383.89 nm
252	spectrometer intensity at wavelength 384.7 nm
253	spectrometer intensity at wavelength 385.51 nm
254	spectrometer intensity at wavelength 386.32 nm
255	spectrometer intensity at wavelength 387.13 nm
256	spectrometer intensity at wavelength 387.93 nm
257	spectrometer intensity at wavelength 388.74 nm
258	spectrometer intensity at wavelength 389.55 nm
259	spectrometer intensity at wavelength 390.36 nm
260	spectrometer intensity at wavelength 391.17 nm
261	spectrometer intensity at wavelength 391.98 nm
262	spectrometer intensity at wavelength 392.79 nm
263	spectrometer intensity at wavelength 393.6 nm
264	spectrometer intensity at wavelength 394.4 nm
265	spectrometer intensity at wavelength 395.21 nm
266	spectrometer intensity at wavelength 396.02 nm
267	Temperature of sensor
268	Spectrometer temperature
269	Lamp temperature
270	Cumulative lamp time
271	Relative humidity
272	Main voltage
273	Lamp voltage
274	Internal voltage
275	Main current
276	Fit aux 1
277	Fit aux 2
278	Fit base 1
279	Fit base 2
280	Fit RMSE
281	CTD Time
282	CTD Salinity
283	CTD Temperature
284	CTD Pressure
285	Check sum of data stream

On the buoys the SUNA does not store data on the Campbell Scientific data logger. Instead, the SUNA sends messages to the LC through a radio link and simultaneously stores daily data files as a backup in case of radio failure (Appendix B). This storage should be cleared during annual maintenance of the sensor in order to open space up for data storage the following year.

11.1 Sensor, Buoy, SUNA Nitrate Analyzer Overview of Sensor configuration (0329950100)

Sensor configuration settings are shown in Table 21. The sampling frequency shall be initially set to 15 min in order to capture the natural variability in the environment while minimizing the costs of maintenance and consumables. We will waive the requirements <Draft.N3> that nitrate be measured with a frequency of 1 min +/-until technology develops to allow for optimization of lamp life.

The wiper shall be configured on so that it clears the optics at the beginning of each measurement. This cycle takes approximately 30 seconds. The sensor takes approximately 15 seconds to warm up coming out of standby/sleep mode. Once a measurement is engaged, the sensor will take 10 measurements without the lamp engaged to provide the background current as a reference and correction factor. Then the sensor shall take samples at between 0.5 - .667 Hz before returning to standby/sleep mode.

The lamp used as the light source for the UV detector has a supported lifespan of 900 hours. The sampling strategy as stated will result in a usage according to Equation 1.

NOTE: the future sampling frequency may subject to change based on implemented usage and available resources.

Equation 1 (15 second warm up + 50(samples/measurement)* 1.4(seconds/sample)) * .00027778(hours/second) * 4(measurements/hour) * 24(hours/day)* 1 / 900(replacement/hours) = **397 days between recommended replacement**

Table 23. Sensor configuration settings buoy, SUNA nitrate (0329950100).

	Setting Parameter	Value
Input / Output	Message Level	Info
	Message File Save	2
	Output Frame	Full_ASCII
	Logging Frame	Full_ASCII
	Log File Type	Daily
Data	Operating Mode	Periodic

Acquisition	Operation Control	Samples
	External Device	Wiper
	External Pre-Run Time	30
	Ex. Dev. During Acq.	Off
	Lamp Stabil. Time [ds]	10
	Periodic Interval (min.)	15
	Dark Samples [no. of frames]	10
	Light Samples [no. of frames]	50
Process	Temperature Compensation	Off
	Salinity Fitting	Off
	Bromide Tracing	Off
	Concentrations to fit	1
	Dark Correction Method	SpecAverage
	Absorbance Cutoff	10
	Integration Time Adjustment	Off
	Fit Wavelength Low/High	217,240

11.2 Sensor, Buoy, SUNA Nitrate Analyzer Error Handling (0329950000)

This sensor does not report errors as part of the data output stream. Rather in the event of a failure or erroneous data outputs the status of the sensor may be queried. If values in the data stream do not pass automated quality control tests as described in AD[05], including assessing the internal humidity and power levels, those data may generate a flag which requires a self-test be performed by using the command <selftest>. The self-test will generate a $Ok for all components which pass; while all

components which fail will be terminated by (!). The sensor status will determine what action needs to be taken to address a reported error.

11.3 Sensor, Buoy, SUNA Nitrate Analyzer Controls specification (0329950000)

Biofouling is anticipated to occur at all aquatic sites in the NEON Domains to varying degrees. Biofouling may result in the accumulation of multiple species of aquatic organisms adhering to the surface of the sensor, having deleterious effects on measurements. Wipers are required to remove biofouling from optical lenses of the sensors. The wiper is integrated into the sensor and will perform a wipe prior to every measurement. The external device run time will be set to 30 seconds as described above. This will allow the wiper to complete a cleaning of the optics prior to data acquisition.

12 APPENDIX A: L0 DATA STREAM TABLES

Table 24. List of Level 0 data product associated with: Windspeed and Direction on buoy

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency (Hz)	dataType	units
0348380000	NEON.DOM.SITE.DP0.20059.001.00380.HOR.VER.000	windDirMean	Arithmetic mean of wind direction	1 Hz average reported every 60 seconds	real	degree
	NEON.DOM.SITE.DP0.20059.001.00340.HOR.VER.000	windSpeedMean	Arithmetic mean of wind speed	1 Hz average reported every 60 seconds	real	metersPerSecond
0354780000	NEON.DOM.SITE.DP0.20059.001.02898.HOR.VER.000	thetXaxsMean	Arithmetic mean of angle (thet) around the attitude and motion reference system along-axis (Xaxs), positive in clockwise direction, synonymous with roll angle	1 Hz average reported every 60 seconds	real	degree
	NEON.DOM.SITE.DP0.20059.001.02897.HOR.VER.000	thetYaxsMean	Arithmetic mean of angle (thet) around the attitude and motion reference system cross-axis (Yaxs), positive in clockwise direction, synonymous with pitch angle	1 Hz average reported every 60 seconds	real	degree
	NEON.DOM.SITE.DP0.20059.001.02899.HOR.VER.000	thetZaxsMean	Arithmetic mean of angle (thet) around the attitude and motion reference system vertical-axis (Zaxs), positive in clockwise direction, synonymous with yaw angle	1 Hz average reported every 60 seconds	real	degree

Table 25. List of Level 0 data product associated with: Net Radiometer on-buoy

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency (Hz)	dataType	units
0349250000	NEON.DOM.SITE.DP0.20032.001.01315.HOR.VER.000	inNetRadPyranometer	Net radiation from upward facing pyranometer	1 per minute	real	volt
	NEON.DOM.SITE.DP0.20032.001.01316.HOR.VER.000	outNetRadPyranometer	Net radiation from downward facing pyranometer	1 per minute	real	volt
	NEON.DOM.SITE.DP0.20032.001.01317.HOR.VER.000	inNetRadPyrgeometer	Net radiation from upward facing pyrgeometer	1 per minute	real	volt
	NEON.DOM.SITE.DP0.20032.001.01318.HOR.VER.000	outNetRadPyrgeometer	Net radiation from downward facing pyrgeometer	1 per minute	real	volt
	NEON.DOM.SITE.DP0.20032.001.01314.HOR.VER.000	sensorResistance	Sensor body resistance	1 per minute	real	ohm
	NEON.DOM.SITE.DP0.20032.001.01319.HOR.VER.000	heaterFlag	Heater flag indication whether the heater was operational for a measurement period, (1 = on, no value = off)	1 per minute	integer	NA

Table 26. List of Level 0 data product associated with: Humidity and Temperature on-buoy

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency (Hz)	dataType	units
0348410000	NEON.DOM.SITE.DP0.20271.001.01357.HOR.VER.000	RH	Relative humidity	1 per minute	real	percent
	NEON.DOM.SITE.DP0.20271.001.01309.HOR.VER.000	sensorTemp	Temperature of sensor	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20271.001.01358.HOR.VER.000	dewPoint	Dew point temperature	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20271.001.01359.HOR.VER.000	RHStatus	Status of the relative humidity sensor	1 per minute	real	NA

Table 27. List of Level 0 data product associated with: Barometric pressure on-buoy

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency (Hz)	dataType	units
0348400000	NEON.DOM.SITE.DP0.20004.001.01311.HOR.VER.000	rawBarometric Pressure	Uncalibrated barometric pressure	1 per minute	real	kilopascal
	NEON.DOM.SITE.DP0.20004.001.01309.HOR.VER.000	sensorTemp	Temperature of sensor	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20004.001.01312.HOR.VER.000	sensorStatus	Sensor status	1 per minute	integer	NA

Table 28. List of Level 0 data product associated with: Photosynthetically Active Radiation (PAR) at Water Surface

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency	dataType	units
0348420000	NEON.DOM.SITE.DP0.20042.001.01320.HOR.VER.000	inPAR	Incoming photosynthetically active radiation (PAR) (irradiance 400-700 nm)	2 per minute	real	volt

Table 29. List of Level 0 data product associated with DPName: Photosynthetically active radiation below water surface

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency	dataType	units
0348390000	NEON.DOM.SITE.DP0.20261.001.01320.HOR.VER.000	inPAR	Incoming photosynthetically active radiation (PAR) (irradiance 400-700 nm)	2 per minute	real	volt
	NEON.DOM.SITE.DP0.20261.001.01321.HOR.VER.000	outPAR	Outgoing photosynthetically active radiation (PAR) (radiance 400-700 nm)	2 per minute	real	volt

Table 30. List of Level 0 data product associated with: Temperature at specific depths for temperature chains deployed at SUGG.

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency	dataType	units
0351720301	NEON.DOM.SITE.DP0.20264.001.02887.HOR.VER.000	depth0WaterTemp	Measurement of water temperature along a fixed chain from shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02888.HOR.VER.000	depth1WaterTemp	Measurement of water temperature along a fixed chain from 2nd shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02889.HOR.VER.000	depth2WaterTemp	Measurement of water temperature along a fixed chain from 3rd shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02890.HOR.VER.000	depth3WaterTemp	Measurement of water temperature along a fixed chain from 4th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02891.HOR.VER.000	depth4WaterTemp	Measurement of water temperature along a fixed chain from 5th shallowest depth	1 per minute	real	celsius

Table 31. List of Level 0 data product associated with: Temperature at specific depths for temperature chains deployed at BARC.

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency	dataType	units
0351720302	NEON.DOM.SITE.DP0.20264.001.02887.HOR.VER.000	depth0WaterTemp	Measurement of water temperature along a fixed chain from shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02888.HOR.VER.000	depth1WaterTemp	Measurement of water temperature along a fixed chain from 2nd shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02889.HOR.VER.000	depth2WaterTemp	Measurement of water temperature along a fixed chain from 3rd shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02890.HOR.VER.000	depth3WaterTemp	Measurement of water temperature along a fixed chain from 4th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02891.HOR.VER.000	depth4WaterTemp	Measurement of water temperature along a fixed chain from 5th shallowest	1 per minute	real	celsius

			depth			
	NEON.DOM.SITE.DP0.20264.001.02892.HOR.VER.000	depth5WaterTemp	Measurement of water temperature along a fixed chain from 6th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02893.HOR.VER.000	depth6WaterTemp	Measurement of water temperature along a fixed chain from 7th shallowest depth	1 per minute	real	celsius

Table 32. List of Level 0 data product associated with: Temperature at specific depths for temperature chains deployed at CRAM.

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency	dataType	units
0351720501	NEON.DOM.SITE.DP0.20264.001.02887.HOR.VER.000	depth0WaterTemp	Measurement of water temperature along a fixed chain from shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02888.HOR.VER.000	depth1WaterTemp	Measurement of water temperature along a fixed chain from 2nd shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02889.HOR.VER.000	depth2WaterTemp	Measurement of water temperature along a fixed	1 per minute	real	celsius

			chain from 3rd shallowest depth			
	NEON.DOM.SITE.DP0.20264.001.02890.HOR.VER.000	depth3WaterTemp	Measurement of water temperature along a fixed chain from 4th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02891.HOR.VER.000	depth4WaterTemp	Measurement of water temperature along a fixed chain from 5th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02892.HOR.VER.000	depth5WaterTemp	Measurement of water temperature along a fixed chain from 6th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02893.HOR.VER.000	depth6WaterTemp	Measurement of water temperature along a fixed chain from 7th shallowest depth	1 per minute	real	celsius

Table 33. List of Level 0 data product associated with: Temperature at specific depths for temperature chains deployed at TOOK.

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency (Hz)	dataType	units

0351721801	NEON.DOM.SITE.DP0.20264.001.02887.HOR.VER.000	depth0WaterTemp	Measurement of water temperature along a fixed chain from shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02888.HOR.VER.000	depth1WaterTemp	Measurement of water temperature along a fixed chain from 2nd shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02889.HOR.VER.000	depth2WaterTemp	Measurement of water temperature along a fixed chain from 3rd shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02890.HOR.VER.000	depth3WaterTemp	Measurement of water temperature along a fixed chain from 4th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02891.HOR.VER.000	depth4WaterTemp	Measurement of water temperature along a fixed chain from 5th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02892.HOR.VER.000	depth5WaterTemp	Measurement of water temperature along a fixed chain from 6th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02893.HOR.VER.000	depth6WaterTemp	Measurement of water temperature along a fixed chain from 7th shallowest depth	1 per minute	real	celsius

	NEON.DOM.SITE.DP0.20264.001.02894.HOR.VER.000	Depth7WaterTemp	Measurement of water temperature along a fixed chain from 8th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02895.HOR.VER.000	Depth8WaterTemp	Measurement of water temperature along a fixed chain from 9th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02896.HOR.VER.000	Depth9WaterTemp	Measurement of water temperature along a fixed chain from 10th shallowest depth	1 per minute	real	celsius

Table 34. List of Level 0 data product associated with: Temperature at specific depths for temperature chains deployed at PRPO.

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency	dataType	units
0351720901	NEON.DOM.SITE.DP0.20264.001.02887.HOR.VER.000	depth0WaterTemp	Measurement of water temperature along a fixed chain from shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02888.HOR.VER.000	depth1WaterTemp	Measurement of water temperature along a fixed chain from 2nd shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02889.HOR.VER.000	depth2WaterTemp	Measurement of water temperature along a fixed chain from 3rd shallowest depth	1 per minute	real	celsius

	NEON.DOM.SITE.DP0.20264.001.02890.HOR.VER.000	depth3WaterTemp	Measurement of water temperature along a fixed chain from 4th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02891.HOR.VER.000	depth4WaterTemp	Measurement of water temperature along a fixed chain from 5th shallowest depth	1 per minute	real	celsius

Table 35. List of Level 0 data product associated with: Temperature at specific depths for temperature chains deployed at PRLA.

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency (Hz)	dataType	units
0351720902	NEON.DOM.SITE.DP0.20264.001.02887.HOR.VER.000	depth0WaterTemp	Measurement of water temperature along a fixed chain from shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02888.HOR.VER.000	depth1WaterTemp	Measurement of water temperature along a fixed chain from 2nd shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02889.HOR.VER.000	depth2WaterTemp	Measurement of water temperature along a fixed chain from 3rd shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02890.HOR.VER.000	depth3WaterTemp	Measurement of water temperature along a fixed chain from 4th shallowest depth	1 per minute	real	celsius

	NEON.DOM.SITE.DP0.20264.001.02891.HOR.VER.000	depth4WaterTemp	Measurement of water temperature along a fixed chain from 5th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02892.HOR.VER.000	depth5WaterTemp	Measurement of water temperature along a fixed chain from 6th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02893.HOR.VER.000	depth6WaterTemp	Measurement of water temperature along a fixed chain from 7th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02894.HOR.VER.000	Depth7WaterTemp	Measurement of water temperature along a fixed chain from 8th shallowest depth	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20264.001.02895.HOR.VER.000	Depth8WaterTemp	Measurement of water temperature along a fixed chain from 9th shallowest depth	1 per minute	real	celsius

Table 36. List of Level 0 data product associated with buoy profiling multi sonde: pH, chlorophyll, actual conductivity, fDOM, turbidity, and dissolved oxygen in surface water (HB07530100)

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency	dataType	units
HB07530100	NEON.DOM.SITE.DP0.20288.001.02926.HOR.VER.000	batteryVoltageBuoyParked	Battery voltage for multisonde while	1 per minute	real	volt

			parked			
	NEON.DOM.SITE.DP0.20288.001.02927.HOR.VER.000	batteryVoltageBuoyProfile	Battery voltage for multisonde while profiling	1 per minute	real	volt
	NEON.DOM.SITE.DP0.20288.001.02904.HOR.VER.000	blueGreenBuoyParked	Blue-green algae phycocyanin concentration in water from multisonde while parked	1 per minute	real	micrograms PerLiter
	NEON.DOM.SITE.DP0.20288.001.02905.HOR.VER.000	blueGreenBuoyProfile	Blue-green algae phycocyanin concentration in water from multisonde while profiling	1 per minute	real	micrograms PerLiter
	NEON.DOM.SITE.DP0.20288.001.02932.HOR.VER.000	blueGreenRawBuoyParked	Raw signal of blue-green algae sensor from multisonde while parked	1 per minute	real	percent
	NEON.DOM.SITE.DP0.20288.001.02933.HOR.VER.000	blueGreenRawBuoyProfile	Raw signal of blue-green algae sensor from multisonde while profiling	1 per minute	real	percent
	NEON.DOM.SITE.DP0.20288.001.02906.HOR.VER.000	chlaBuoyParked	Chlorophyll a concentration in water from multisonde while	1 per minute	real	micrograms PerLiter

			parked			
	NEON.DOM.SITE.DP0.20288.001.02907.HOR.VER.000	chlaBuoyProfile	Chlorophyll a concentration in water from multisonde while profiling	1 per minute	real	microgramsPerLiter
	NEON.DOM.SITE.DP0.20288.001.02930.HOR.VER.000	chlaRawBuoyParked	Raw signal of chlorophyll a sensor from multisonde while parked	1 per minute	real	percent
	NEON.DOM.SITE.DP0.20288.001.02931.HOR.VER.000	chlaRawBuoyProfile	Raw signal of chlorophyll a sensor from multisonde while profiling	1 per minute	real	percent
	NEON.DOM.SITE.DP0.20288.001.02908.HOR.VER.000	conductanceBuoyParked	Conductivity at ambient temperture from multisonde while parked	1 per minute	real	microsiemensPerCentimeter
	NEON.DOM.SITE.DP0.20288.001.02909.HOR.VER.000	conductanceBuoyProfile	Conductivity at ambient temperture from multisonde while profiling	1 per minute	real	microsiemensPerCentimeter
	NEON.DOM.SITE.DP0.20288.001.02912.HOR.VER.000	fDOMBuoyParked	Fluorescent dissolved organic matter concentration as quinine sulfate equilivents from	1 per minute	real	quinineSulfateUnit

			multisonde while parked			
	NEON.DOM.SITE.DP0.20288.001.02913.HOR.VER.000	fDOMBuoyProfile	Fluorescent dissolved organic matter concentration as quinine sulfate equilivents from multisonde while profiling	1 per minute	real	quinineSulfateUnit
	NEON.DOM.SITE.DP0.20288.001.02934.HOR.VER.000	fDOMRawBuoyParked	Raw signal of fluorescent dissolved organic matter sensor as a percent of full scale detected in the sample from multisonde while parked	1 per minute	real	percent
	NEON.DOM.SITE.DP0.20288.001.02935.HOR.VER.000	fDOMRawBuoyProfile	Raw signal of fluorescent dissolved organic matter sensor as a percent of full scale detected in the sample from multisonde while profiling	1 per minute	real	percent
	NEON.DOM.SITE.DP0.20288.001.02900.HOR.VER	pHBuoyParked	Measurement of pH in water from multisonde	1 per minute	real	pH

	.000		while parked			
	NEON.DOM.SITE.DP0.20288.001.02901.HOR.VER.000	pHBuoyProfile	Measurement of pH in water from multisonde while profiling	1 per minute	real	pH
	NEON.DOM.SITE.DP0.20288.001.02902.HOR.VER.000	pHVoltageBuoyParked	pH meter voltage from multisonde while parked	1 per minute	real	millivolt
	NEON.DOM.SITE.DP0.20288.001.02903.HOR.VER.000	pHVoltageBuoyProfile	pH voltage from multisonde while profiling	1 per minute	real	millivolt
	NEON.DOM.SITE.DP0.20288.001.02924.HOR.VER.000	sensorDepthBuoyParked	Water depth of measurement from multisonde while parked	1 per minute	real	meter
	NEON.DOM.SITE.DP0.20288.001.02925.HOR.VER.000	sensorDepthBuoyProfile	Water depth of measurement from multisonde while profiling	1 per minute	real	meter
	NEON.DOM.SITE.DP0.20288.001.02928.HOR.VER.000	sensorVoltageBuoyParked	Main voltage from multisonde while parked	1 per minute	real	volt
	NEON.DOM.SITE.DP0.20288.001.02929.HOR.VER.000	sensorVoltageBuoyProfile	Main voltage from multisonde while profiling	1 per minute	real	volt

	NEON.DOM.SITE.DP0.20288.001.02910.HOR.VER.000	specCondBuoyParked	Conductivity auto-corrected to 25 degrees C from multisonde while parked	1 per minute	real	microsiemensPerCentimeter
	NEON.DOM.SITE.DP0.20288.001.02911.HOR.VER.000	specCondBuoyProfile	Conductivity auto-corrected to 25 degrees C from multisonde while profiling	1 per minute	real	microsiemensPerCentimeter
	NEON.DOM.SITE.DP0.20288.001.02914.HOR.VER.000	turbidityBuoyParked	Turbidity of water as FNU from multisonde while parked	1 per minute	real	formazinNephelometricUnit
	NEON.DOM.SITE.DP0.20288.001.02915.HOR.VER.000	turbidityBuoyProfile	Turbidity of water as FNU from multisonde while profiling	1 per minute	real	formazinNephelometricUnit
	NEON.DOM.SITE.DP0.20288.001.02936.HOR.VER.000	turbidityRawBuoyParked	Raw signal of turbidity sensor from multisonde while parked	1 per minute	real	percent
	NEON.DOM.SITE.DP0.20288.001.02937.HOR.VER.000	turbidityRawBuoyProfile	Raw signal of turbidity sensor from multisonde while profiling	1 per minute	real	percent
	NEON.DOM.SITE.DP0.20288.001.02922.HOR.VER.000	waterPressure	Pressure of surface water measured by the	1 per minute	real	poundsPerSquareInch

		BuoyParked	multisonde while parked			
	NEON.DOM.SITE.DP0.20288.001.02923.HOR.VER.000	waterPressureBuoyProfile	Pressure of water measured by the multisonde while profiling	1 per minute	real	poundsPerSquareInch
	NEON.DOM.SITE.DP0.20288.001.02920.HOR.VER.000	waterTempBuoyParked	Water temperature from multisonde while parked	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20288.001.02921.HOR.VER.000	waterTempBuoyProfile	Water temperature from multisonde while profiling	1 per minute	real	celsius
	NEON.DOM.SITE.DP0.20288.001.02938.HOR.VER.000	wiperPositionBuoyParked	Position of wiper from multisonde while parked	1 per minute	real	volt
	NEON.DOM.SITE.DP0.20288.001.02939.HOR.VER.000	wiperPositionBuoyProfile	Position of wiper from multisonde while profiling	1 per minute	real	volt
	NEON.DOM.SITE.DP0.20288.001.02918.HOR.VER.000	DOBuoyParked	Dissolved Oxygen Concentration from multisonde while parked	1 per minute	real	milligramsPerLiter
	NEON.DOM.SITE.DP0.20288.001.02919.HOR.VER.000	DOBuoyProfile	Dissolved Oxygen Concentration from multisonde while	1 per minute	real	milligramsPerLiter

			profiling			
	NEON.DOM.SITE.DP0.20288.001.02916.HOR.VER.000	DOSaturationBuoyParked	Dissolved Oxygen Percent Saturation from multisonde while parked	1 per minute	real	percent
	NEON.DOM.SITE.DP0.20288.001.02917.HOR.VER.000	DOSaturationBuoyProfile	Dissolved Oxygen Percent Saturation from multisonde while profiling	1 per minute	real	percent

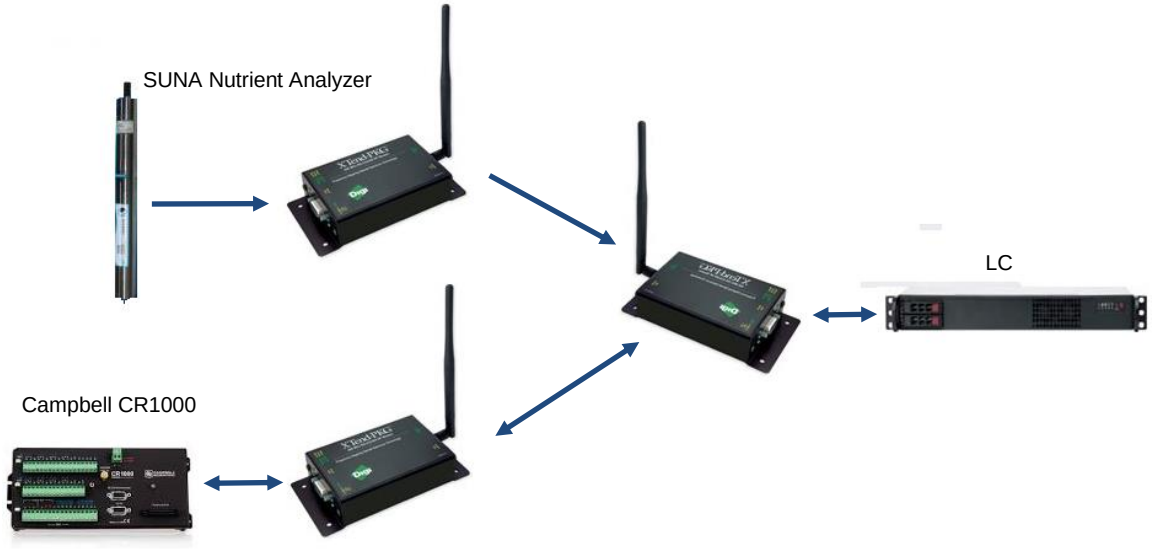
Table 37. List of Level 0 data product associated with DPName: SUNA Nutrient Analyzer

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency	dataType	units
0329950100	NEON.DOM.SITE.DP0.20033.001.02242.HOR.VER.000	rawNitrateSingleCompressedStream	Single compressed data stream from SUNA to be parsed at NEON headquarters	10 dark frames and 50 light frames per 15 minutes	binary	NA

13 APPENDIX B: DIGI 9XTEND RF MODEM CONFIGURATION

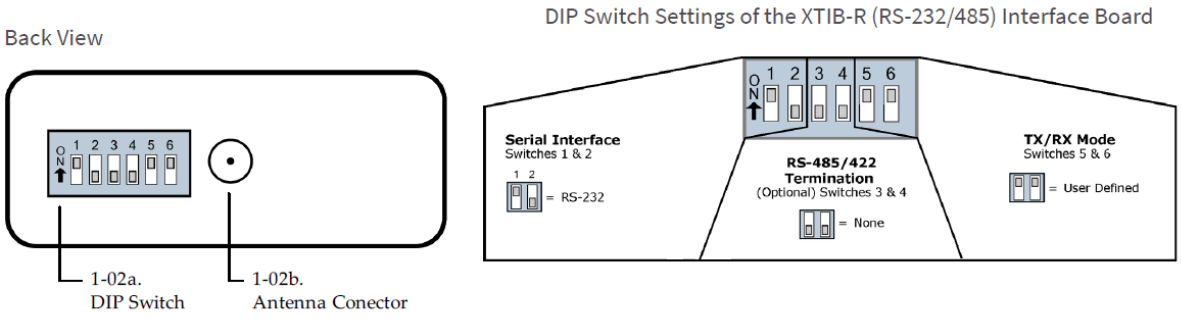
The buoy meteorological station uses 3 Digi 9XTend RS-232 RF modems for data transfer between the station and the Location Controller (LC) in the aquatic portal:

- SUNA Nitrate Analyzer data transmission modem (unidirectional)
- Campbell data loggers PKBUS protocol transmission and reception (bidirectional)
- LC base station (bidirectional)



To avoid data collisions in the LC base station, the modems need to be configured as follow:

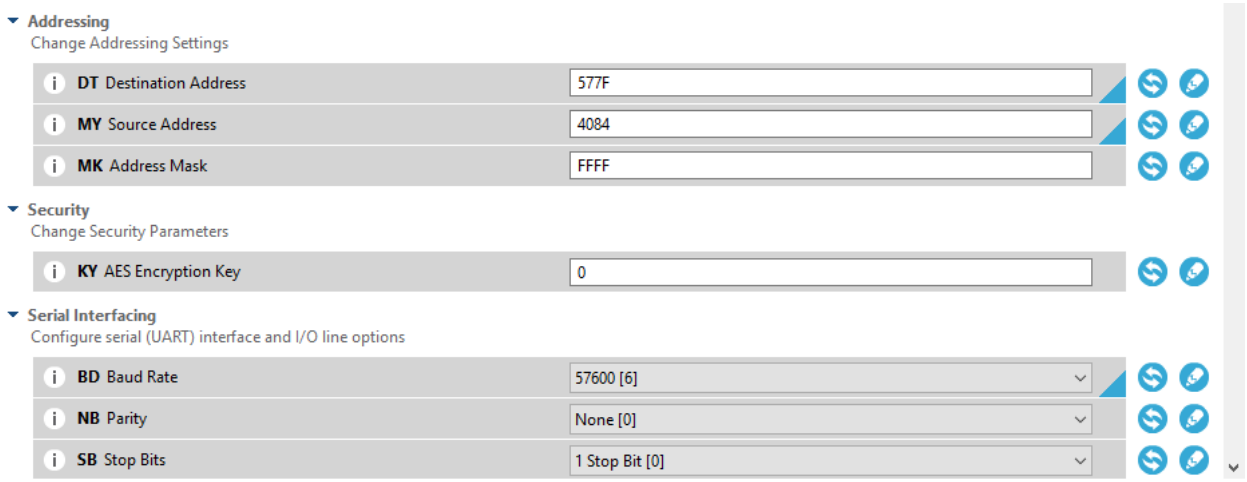
a) DIP Switch (all modems)



b) SUNA Modem

Using Digi- XCTU configuration/testing tool:

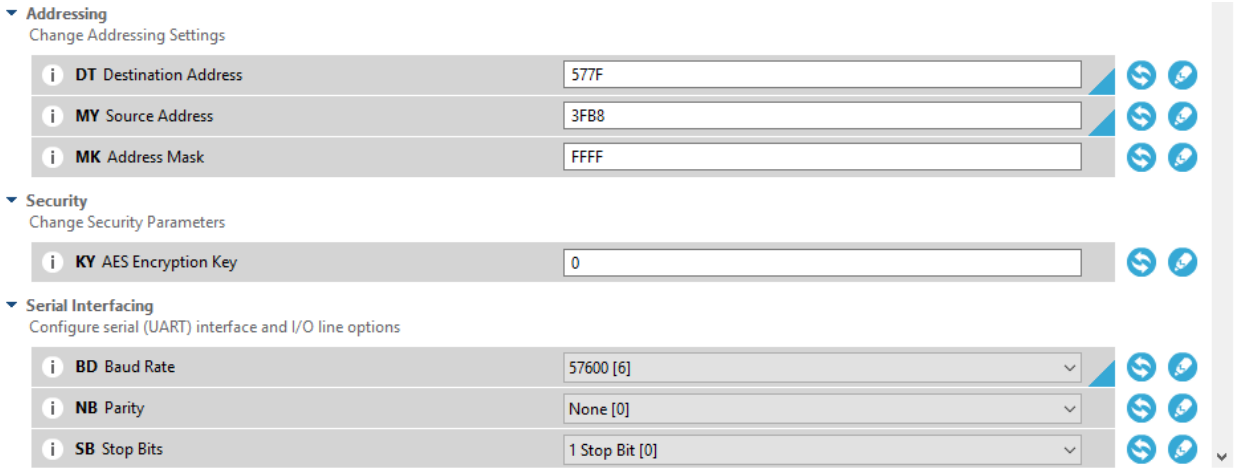
- Set the Destination Address (DT) to the LC Modem Source Address (MY)(e.g.577F)
- Set the Source Address (MY) to a unique value for the network (e.g. 4084)
- Set the Baud Rate (BD) to 57600, Parity (NB) to None and Stop Bits (SB) to 1



c) Campbell Modem

Using Digi- XCTU configuration/testing tool:

- Set the Destination Address (DT) to the LC Modem Source Address (MY)(e.g.577F)
- Set the Source Address (MY) to a unique value for the network (e.g. 3FB8)
- Set the Baud Rate (BD) to 57600, Parity (NB) to None and Stop Bits (SB) to 1

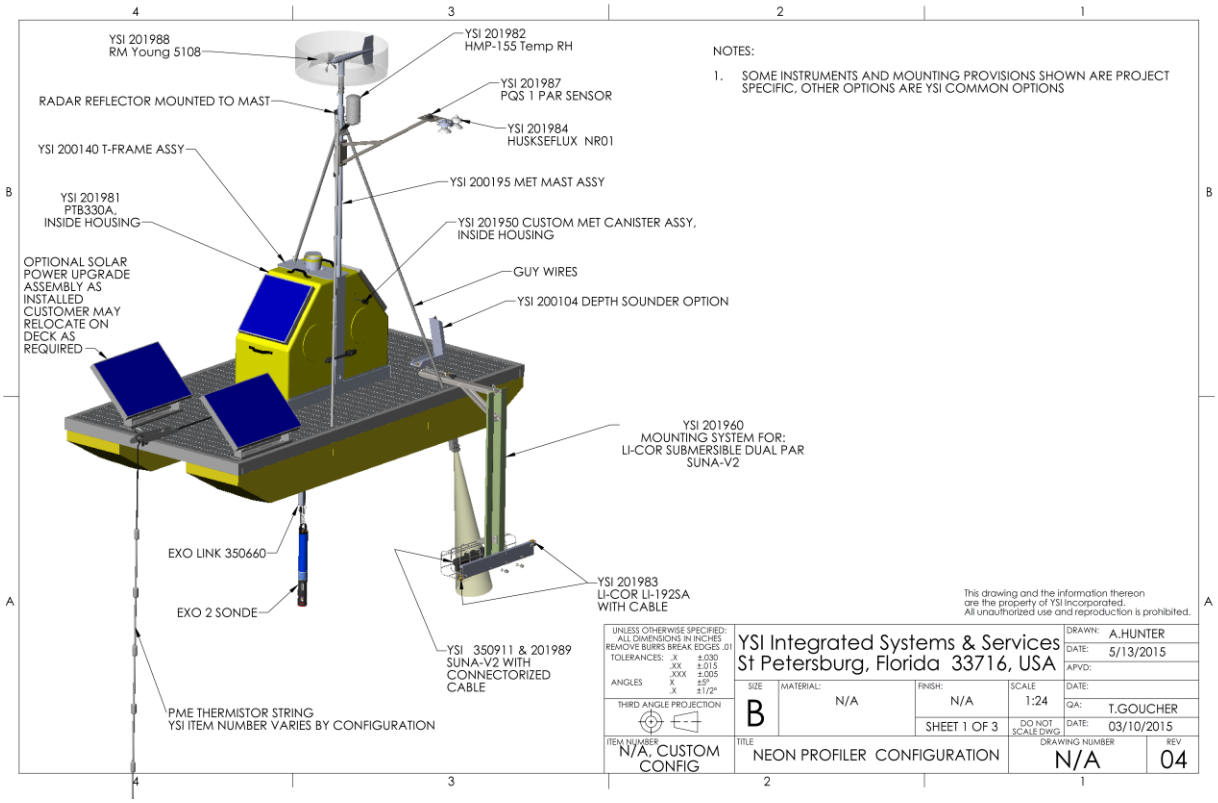


d) LC Modem

Using Digi- XCTU configuration/testing tool:

- Set the Destination Address (DT) to the Campbell Modem Source Address (MY)(e.g.3FB8)
- Set the Source Address (MY) to a unique value for the network (e.g. 577F)
- Set the Baud Rate (BD) to 57600, Parity (NB) to None and Stop Bits (SB) to 1

14 APPENDIX C: BUOY SCHEMATIC DRAWING



15 BIBLIOGRAPHY

Hukeseflux Thermal Sensors NR01 RA01 Namual Version 0715. Hukesflux Thermal Sensors Elektronicaweg 25, 2628 XG Delft. The Netherlands.

Kipp & Zonen (2010) Instruction Sheet for the PQS 1 PAR Quantum Sensor V1008. Kipp & Zonen B.V.P.O. Box 507, 2600 AM Delft. The Netherlands

Vaisala. 2008. User's Guide: Vaisala BAROCAP Digital Barometer PTB330. Vaisala Ojy, Helsinki.

Vaisala. 2012. User's Guide: Vaisala HUMICAP Humidity and Temperature Probe HMP155A.

YSI EXO Multisonde Manual Item# 603789REF Revision B

YSI Inc. (2014) EXO User Manual. YSI Incorporated, Yellow Springs, OH. pp. 156. Manual number 603789, Rev. D.