NEON USER GUIDE TO STREAM DISCHARGE FIELD COLLECTION (NEON.DP1.20048.001)

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CHANGE RECORD

REVISION	DATE	DESCRIPTION OF CHANGE
A	07/20/2017	Initial Release

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1 DESCRIPTION

1.1 Purpose

This document provides an overview of the data included in this NEON Level 1 data product, the quality controlled product generated from raw Level 0 data, and associated metadata. In the NEON data products framework, the raw data collected in the field, for example, a single stream discharge measurement, are considered the lowest level (Level 0). Raw data that have been quality checked via the steps detailed herein, as well as simple metrics that emerge from the raw data are considered Level 1 data products.

The text herein provides a discussion of measurement theory and implementation, data product provenance, quality assurance and control methods used, and approximations and/or assumptions made during L1 data creation.

1.2 Scope

This document describes the steps needed to generate the L1 data product Stream discharge field collection, the process of measuring the discharge of a stream at a unique point in time. This is achieved by multiplying velocity times depth of water times cross-sectional width, and associated metadata from input data. This document also provides details relevant to the publication of the data products via the NEON data portal, with additional detail available in the file, NEON Data Variables for Stream Discharge Field Collection (NEON.DP1.20048) (AD[05]), provided in the download package for this data product.

This document describes the process for ingesting and performing automated quality assurance and control procedures on the data collected in the field pertaining to AOS Protocol and Procedure: Stream Discharge (AD[07]). The raw data that are processed in this document are detailed in the file, NEON Raw Data Validation for Stream Discharge Field Collection (NEON.DP0.20048) (AD[04]), provided in the download package for this data product. Please note that raw data products (denoted by ‘DP0’) may not always have the same numbers as the corresponding L1 data product.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Associated Documents

AD[01]	NEON.DOC.000001	NEON Observatory Design (NOD) Requirements
AD[02]	NEON.DOC.000913	TOS Science Design for Spatial Sampling
AD[03]	NEON.DOC.002652	NEON Level 1, Level 2 and Level 3 Data Products Catalog
AD[04]	NEON.DP0.20048.001 _dataValidation.csv	NEON Raw Data Validation for Stream Discharge Field Collection (NEON.DP0.20048)
AD[05]	NEON.DP1.20048.001 _variables.csv	NEON Data Variables for Stream Discharge Field Collection (NEON.DP1.20048)
AD[06]	NEON.DOC.001152	Aquatic Sampling Strategy
AD[07]	NEON.DOC.001085	AOS Protocol and Procedure: Stream Discharge
AD[08]	NEON.DOC.000008	NEON Acronym List
AD[09]	NEON.DOC.000243	NEON Glossary of Terms
AD[10]	OS_Generic_Transitions .pdf	NEON Algorithm Theoretical Basis Document: OS Generic Transitions
AD[11]		NEON's Ingest Conversion Language (NICL) specifications

2.2 Acronyms

Acronym	Definition
AOS	Aquatic Observation System

3 DATA PRODUCT DESCRIPTION

The Stream Discharge Field Collection (NEON.DP1.20048) data product provides stage and discharge data for a site and date along with individual point water depth and velocity measurements collected using AOS Protocol and Procedure: Stream Discharge (AD[07]). Individual discharge measurements are conducted by means of "wading surveys" that occur in wadeable streams along permenantly benchmarked cross-sections at NEON aquatic sites. A meter tape is extended across the stream, the line of which defines the cross-section. The meter tape, or tag line, serves both to guide the line of measurement and to divide the stream into lateral sub-sections (of which there are typically 20-25 per cross-section). Within each subsection, an instantaneous velocity magnitude is obtained and transformed to a volumetric discharge magnitude by applying the velocity across the full subsection area. Total stream discharge is then calculated by the meter, which sums the discrete volumetric discharges for each subsection. Should site-specific conditions become unfavorable for wading surveys, such as insufficient water levels or velocities, a second method may need to be used and staff at NEON HQ will make this decision based on site conditions and site constraints. The method detailed in AOS Protocol and Procedure: Stream Discharge follows the United States Geological Society (USGS) protocols (Rantz et al. 1982, Turnipseed and Sauer, 2010).

Discharge is measured in rivers using an acoustic doppler current profiler (ADCP) sensor mounted to a boat.

The height of water relative to a staff gauge is recorded prior to and following the stream discharge measurement to enable the development of a stage-discharge rating curve and calculation of continuous discharge from pressure transducers, which are reported as other data products.

3.1 Spatial Sampling Design

Discharge is measured at all wadeable stream sites on a run or riffle near sensor set #1 or sensor set #2 and near the buoy at river sites. Point measurements of water depth and velocity are made along the transect from one bank to the other using a wading rod and attached velocity meter. For streams with a wetted width less than or equal to 2.00 m, point measurements are made at a **maximum** of 0.10 m increments. For streams with a wetted width greater than 2.00 m, 20 - 25 approximately evenly spaced points are measured. If the transect has a non-uniform flow with more concentrated areas of high flow, or 30% of depth < 0.06 meters, the number of sampling stations is increased so that a higher number of stations are concentrated along the part of the transect with greatest flow (Figure 2).

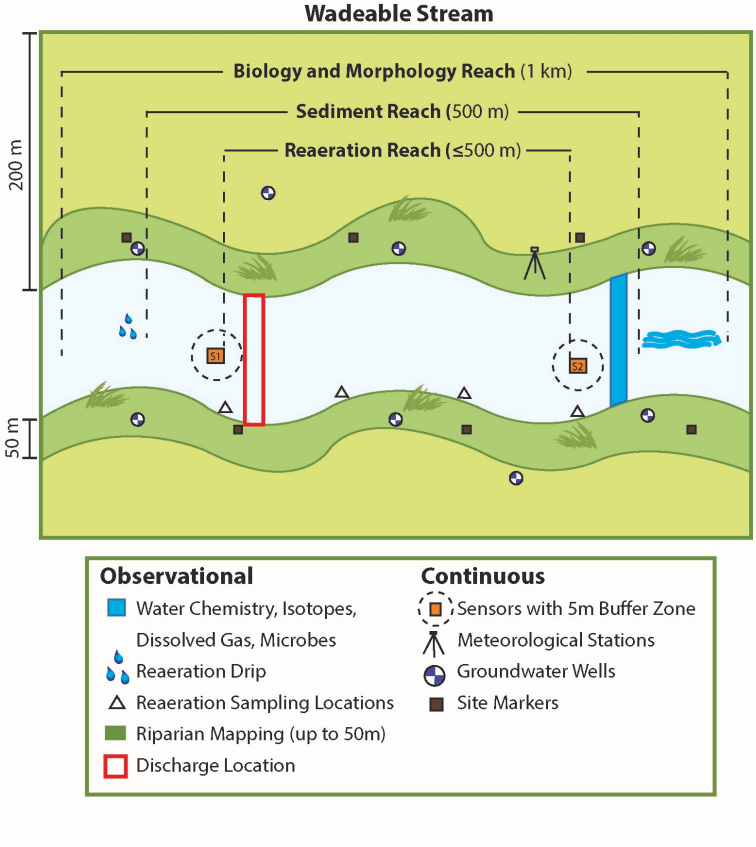

Figure 1: The discharge transect is located on a run or riffle associated with the pool near the staff gauge and a pressure transducer (usually by sensor set 1 or sensor set 2).

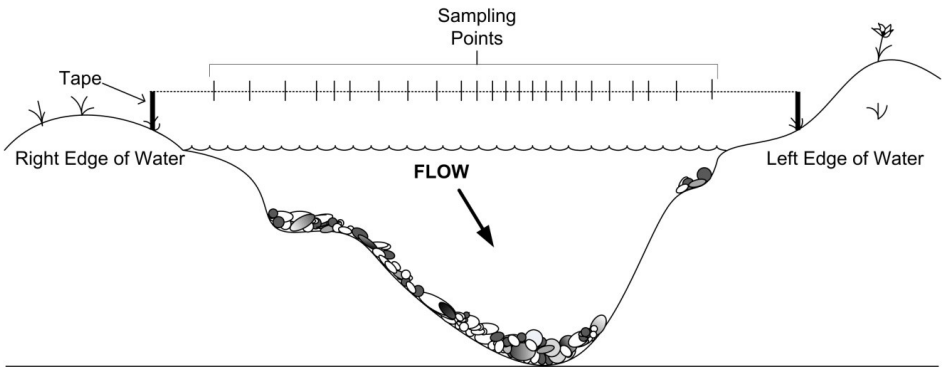

Figure 2: Uneven point measurement distribution across a sampling transect with concentrated areas of flow.

3.2 Temporal Sampling Design

Stream discharge field collection measurements are made 26 times per year until a valid stage-discharge relationship, i.e. rating curve, is developed. Once a relationship has been established, measurements will be made 12 times per year to verify the rating curve and identify when a new stage-discharge relationship may need to be developed. The stream discharge field collections will be planned to capture the range of discharge values for a particular stream. For some streams this may mean relatively evenlNEONy timed surveys, e.g. every two weeks during stage-discharge relationship development, while at other streams, the surveys may be concentrated during variable-flow times of year, e.g. spring snow-melt, with less frequenct surveys during baseflow times of year.

3.3 Variables Reported

All variables reported from the field or laboratory technician (L0 data) are listed in the file, NEON Raw Data Validation for Stream Discharge Field Collection (NEON.DP0.20048) (AD[04]). All variables reported in the published data (L1 data) are also provided separately in the file, NEON Data Variables for Stream Discharge Field Collection (NEON.DP1.20048) (AD[05]).

Field names have been standardized with Darwin Core terms (http://rs.tdwg.org/dwc/; accessed 16 February 2014), the Global Biodiversity Information Facility vocabularies (http://rs.gbif.org/vocabulary/gbif/; accessed 16 February 2014), the VegCore data dictionary (https://projects.nceas.ucsb.edu/nceas/projects/bien/wiki/VegCore; accessed 16 February 2014), where applicable. NEON TOS spatial data employs the World Geodetic System 1984 (WGS84) for its fundamental reference datum and Earth Gravitational Model 96 (EGM96) for its reference gravitational ellipsoid. Latitudes and longitudes are denoted in decimal notation to six decimal places, with longitudes indicated as negative west of the Greenwich meridian.

Some variables described in this document may be for NEON internal use only and will not appear in downloaded data.

3.4 Spatial Resolution and Extent

The finest resolution at which stream discharge field collection data are reported is a single set of point measurements made at a discharge transect. Overall, this results in a spatial hierarchy of:

namedLocation (ID of the discharge transect location) → **siteID** (ID of NEON site) → **domainID** (ID of a NEON domain).

The discharge transect is predominantly stationary over time. However, if a disturbance event occurs that changes the stream morphology, the discharge transect may need to be be moved and a new stage-discharge relationship may need to be developed.

Shapefiles of all NEON Aquatic Observation System sampling locations can be found in the Document Library: http://data.neonscience.org/documents. If users are interested in the geospatial locations of the data relative to a global coordinate system, those can be retrieved using the NEON data API using the **namedLocation** and the following:

1. The def.extr.geo.os.R function from the geoNEON package, available here: https://github.com/NEONScience/NEON-geolocation
2. The NEON API: http://data.neonscience.org/api

3.5 Temporal Resolution and Extent

The finest resolution at which stream discharge field collection data are reported is the **collectDate**, a single date on which point measurements of depth and velocity are made along a discharge transect. The total number of sampling events per year is expected to be 12 - 26 per wadeable stream or river site.

The NEON Data Portal currently provides data in monthly files for query and download efficiency. Queries including any part of a month will return data from the entire month. Code to stack files across months is available here: https://github.com/NEONScience/NEON-utilities

3.6 Associated Data Streams

The data from this L1 data product is used to develop two level 4 (L4) data products: Stream Discharge Rating Curve (NEON.DP4.00133) and Continuous Stream Discharge (NEON.DP4.00130). These data products can be linked by **siteID**.

3.7 Product Instances

The NEON Observatory contains 24 wadeable streams and 3 large rivers.

Stream discharge field collection yields approximately 702 stage and discharge records per year during stage-discharge relationship development and 324 stage and discharge records per year once a relationship has been developed. Assuming that 20 point measurements are collected per transect, there will be 14,040 point records per year during stage-discharge relationship development and 6,480 point records per year once a relationship has been developed.

3.8 Data Relationships

The protocol dictates that stream discharge field collection will take place at each siteID per event (one record expected per siteID and collectDate combination in dsc_fieldData). All of the point measurements across the transect are records in dsc_individualFieldData, which are child records of dsc_fieldData. The number of records in dsc_individualFieldData per siteID per collectDate vary depending on the width of the stream and usually range from 10 to 25 records.

dsc_fieldData has one record per site per date when stream discharge field collection is performed

dsc_individualFieldData has a variable number of child records (usually between 10 and 25 records) for each point measured along the transect record in dsc_fieldData

3.9 Special Considerations

4 DATA ENTRY CONSTRAINT AND VALIDATION

Many quality control measures are implemented at the point of data entry within a mobile data entry application or web user interface (UI). For example, data formats are constrained and data values controlled through the provision of dropdown options, which reduces the number of processing steps necessary to prepare the raw data for publication. An additional set of constraints are implemented during the process of ingest into the NEON database. The product-specific data constraint and validation requirements built into data entry applications and database ingest are described in the document NEON Raw Data Validation for Stream Discharge Field Collection (NEON.DP0.20048), provided with every download of this data product. Contained within this file is a field named 'entryValidationRulesForm', which describes syntactically the validation rules for each field built into the data entry application.

For stream discharge data, the following validation rules are checked via customized spreadsheet validation:

1. Velocity measurements contain valid location values. Horizontal distance measurements are to increase with each vertical along the transect.
2. Velocity measurements contain valid depth values. Beginning at the third vertical, measured depth is not to exceed 20 times that measured at the previous vertical.

Data entry constraints are described in Nicl syntax in the validation file provided with every data download, and the Nicl language is described in NEON's Ingest Conversion Language (NICL) specifications ([AD[11]).

5 DATA PROCESSING STEPS

Following data entry into a mobile application or web user interface, the steps used to process the data through to publication on the NEON Data Portal are detailed in the NEON Algorithm Theoretical Basis Document: OS Generic Transitions (AD[10]).

6 REFERENCES

Rantz, S. E., et al., 1982. Measurement and Computation of Streamflow, Vols. 1 and 2. U.S. Geological Survey Water-Supply Paper 2175.

Turnipseed, T.P., and Sauer, V.B.. 2010. Discharge Measurements at Gaging Stations: U.S. Geological Survey Techniques and Methods 3-A8. From http://pubs.usgs.gov/tm/tm3-a8/, accessed March 25, 2011.