D19 AQUATIC INSTRUMENT SYSTEM (AIS) SITE CHARACTERIZATION REPORT

PREPARED BY	ORGANIZATION	DATE
M. Fitzgerald	AQU	10/14/2015
C. Roehm	AQU	10/11/2013
R. Utz	AQU	9/18/2013
M. Fitzgerald	AQU	9/18/2013
S. Parker	AQU	9/14/2012
J. Coleman	FCC	9/26/2012
H. Powell	AQU	9/25/2012
K. Goodman	AQU	8/1/2010
B. McLaughlin	AQU	3/11/2015

APPROVALS (Name)	ORGANIZATION	APPROVAL DATE
Dave Tazik	SCI	12/03/2015
Vladimir Aleksiev	PSE	12/03/2015
Andrea Thorpe	PROJ SCI	12/04/2015

RELEASED BY (Name)	ORGANIZATION	RELEASE DATE
Anne Balsley	CM	12/09/2015

See Configuration Management System for approval history

Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A	02/03/2014	ECO-01433	Initial Release
B	12/09/2015	ECO-02794	REMOVED THE DOWNSTREAM STREON HUT/DRIP COORDINATE FROM TABLE 10, AND CHANGED FIGURE 19 TO REMOVE THE DOWNSTREAM HUT/DRIP Moved S1/S2 sensor coordinates to the UAF property. Previously S1 was on AK State Property.

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1 DESCRIPTION

1.1 Purpose

Information collected and described here is used to inform the site design activities for the NEON project Aquatic Instrument System (AIS). This report includes information gathered by the Aquatic (AQU)/STREON (STR) and Environmental, Health, & Safety (EHS) teams. The purpose of this report is for the science team to outline what is desired at each site within a domain in order to obtain the best scientific data possible to help answer NEON's Grand Challenge Questions; therefore, this is not a design document, but a report that is an input to the design process.

The Appendices include summary tables for the convenience of the multiple audiences of this report; some of the information in the tables is repeated from the body of this report while other information is exclusive to the summary tables.

1.2 Scope

AQU site characterization information presented in this document is for the D19 aquatic locations: Caribou Creek (core and STREON). Issues and concerns for each site that need further review are also addressed in this document according to our best knowledge. Unless otherwise noted, the information contained herein takes precedence over the same information repeated elsewhere; thereby, this document contains the official change-controlled information pertinent to these sites.

Disclaimer: All latitude and longitude coordinates are subject to the variation inherent in our GPS equipment and the conditions at the site. Some of the Aquatic sites are in narrow canyons with limited satellite coverage; resulting in coordinates that are not accurate to within 50 cm.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

AD[01]	
AD[02]	
AD[03]	
AD[04]	

2.2 Reference Documents

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

2.3 Verb Convention

"Shall" is used whenever a specification expresses a provision that is binding. The verbs "should" and "may" express non-mandatory provisions. "Will" is used to express a declaration of purpose on the part of the design activity.

3 D19 AIS SITE CHARACTERIZATION REPORT

3.1 Caribou Creek

Caribou Creek is a 2nd order wadeable stream that drains a predominantly forested taiga watershed. The flow regime of Caribou Creek is controlled by winter freezing and snowmelt-dominated: flow in the system ceases entirely from October or November through April or May due to freezing, and the hydrograph peaks during maximum snowmelt in the spring. The channel is relatively small (1-5 meters wide) and is shallow enough to facilitate field work in the NEON aquatics program during baseflow conditions.

3.1.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The initial estimated location for the Aquatic Auxiliary Portal is at the TIS Instrument Hut (Figure 1, Table 1). The primary power source will be the TIS Instrument Hut with 90% drawing that is due 10/10. The TIS designs will show a communications and power box standard to that of the soil array boxes as the Aquatic Auxiliary Portal and Aquatic Portal to tie into.

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Table 1 Aquatic Auxiliary Portal Location

Aquatic Auxiliary Portal	Latitude	Longitude
Location	65.154219	-147.502306

Table 2 Aquatic Portal Location

Aquatic Portal	Latitude	Longitude
Location	65.154219	-147.502306

3.1.2 Sensor Locations for Construction

The GPS coordinates for S1 and S2 presented in Table 3 were obtained by AQU with support from EHS. Many aquatic sites are in narrow canyons or covered by dense canopy, which reduces satellite availability. In these situations, AQU will provide a description of the location and an approximate GPS location (e.g. not accurate to within <1m). This description will suffice for the planning stages, but sites will likely need to be physically marked prior to construction.

These coordinates are to be used for the input to the AIS design:

Table 3 Sensors 1 and 2 locations.

Sensor	Latitude	Longitude
S1	65.152544°	-147.507854°
S2	65.153053°	-147.501944°

Pressure transducers and/or additional equipment installed to calculate discharge may be co-located at either the S1 or S2 sensor. The distance between S1 and S2 is approximately 320 m.

Table 4 Met sensor location.

Sensor	Latitude	Longitude
Met Station	65.152986	-147.503376

Figure 1 Kmz File of D19 Caribou Creek Denoting Locations of S1, S2, and Met Station. Projection is slightly off and shows the stream sensor coordinates off the channel. Coordinates are correct as collected in the field.

Figure 2 Photo of S1 location at D19 Caribou Creek. The entire channel is shown in this picture.

Figure 3 Photo of S2 location at D19 Caribou Creek. The channel width here is approximately the same as the S1 location.

Figure 4 Photo of met station location at D19 Caribou Creek. Although the vegetation adjacent to the channel is thick, the terrain is mostly level.

Figure 5 Typical conditions in the AQU reach.

3.1.3 AOS Area of Sampling Extent

During Operations, the AOS sampling extent for the Aquatic reach is expected to occur entirely within the existing Aquatic Permitted Area.

3.1.4 Groundwater Wells

The groundwater observation wells network at the site (Figure 6, Table 5) will consist of 8 – 2" diameter wells installed using a powered hand auger. Topography at the site is dominated by a flat vegetated floodplain which rises in elevation laterally from the stream center. The wells will be installed in the

floodplain region and due to variable permafrost depth the required drilling depth will vary with total depths between 0.5-2 meters below ground surface. Access to the site will be via the existing dirt road directly to the north of the stream. Since the wells will be installed using a powered hand auger, a defined path for drill rig access is not necessary, however an access path for walking around the site is desired and detailed in a later section. Wells should be within 3-6 feet of the GPS coordinates reported in Table 5.

AQU prefers the surface completion of the wells to include an above-grade stick-up protective cover and to be minimally invasive. The use of a concrete seal is desired but will be evaluated prior to the installation process as the concrete will not be minimally invasive at this site.

Figure 6 Initial Groundwater Well Locations Based on EMS kmz File at D19 Caribou Creek

Table 5 Groundwater Observation Well Locations

Well ID	Latitude	Longitude
D19-CARI-OW-01	65.152689	-147.507351
D19-CARI-OW-02	65.152671	-147.506058
D19-CARI-OW-03	65.152973	-147.505393
D19-CARI-OW-04	65.152752	-147.504883
D19-CARI-OW-05	65.152170	-147.506889

D19-CARI-OW-06	65.152067	-147.504900
D19-CARI-OW-07	65.152585	-147.503602
D19-CARI-OW-08	65.152779	-147.503119

3.1.5 Riparian Vegetation Cover

During the site visits, the following plant density and type were observed by the AQU team:

Riparian vegetation in the Caribou Creek watershed is characteristic of forested taiga. Thick stands of alder, willow, and dwarf birch line the area immediately adjacent to the channel. Such plants rarely grow more than 2-3 meters tall. The density of vegetation renders access to and mobility along the channel difficult. Further away (2-5 meters) from the channel the vegetation shifts to thick mats of moss and lichen with low-growing blueberry, willow and other shrub growth. Mature black spruce trees are also sparsely distributed in the flatlands adjacent to the channel.

Figure 7 Typical riparian vegetation at D19 Caribou Creek

3.1.6 Bank Morphology

The bank angle is estimated from the top of the bank, where one might stand to observe the stream, to the top of the water. The estimated angle is from the water to the bank, as illustrated in Figure 10 below.

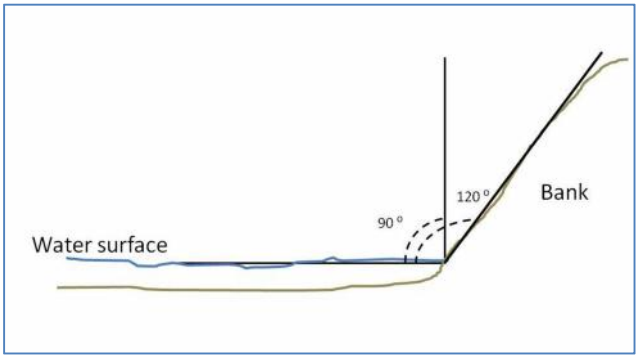

Figure 8 How Bank Angle is Measured

During 2011 site visits, AQU observed the following bank conditions at S1 and S2:

Table 6 Bank conditions at D19 Caribou Creek in 2011.

Morphology Type	S1	S2
RB* angle	100	135
LB* angle	120	90
Maximum water height (from channel bottom)	1.6 m	2.1 m
Bankfull width	2.9 m	3.3 m
Substrate composition	50% sand, 30% pebble, 20% cobble.	60% cobble, 30% sand, 10% boulder

* RB (right bank) and LB (left bank) are determined by facing downstream.

Bank height is typically low, and it is easy to access the channel from the bank (though vegetation is thick). Equipment required for calculating discharge may be co-located with either the S1 or S2 sensor.

3.1.7 Site Photos

The following photos of are representative of the site.

Figure 9 Substrate composition in Caribou Creek consists of heterogeneously spaced patches of sand, gravel, cobble and a few boulders.

Figure 10 Vegetation will need to be cleared to provide access to sensor locations.

Figure 11 Shallow subsurface geologic conditions in the Caribou Creek watershed, including the riparian area, consists of permafrost.

Figure 12 A gate maintained by the University of Alaska, Fairbanks by the Chatanika River bridge. The gate is locked with a combination padlock.

Figure 13 A dirt/wood chip road parallels Caribou Creek about 500 m away from the channel, but only all-terrain vehicles would be capable of traveling far.

3.1.8 Site Access Needs

The taiga forest floor is difficult to traverse and ecologically sensitive. A system of paths and/or boardwalk will be required to access and travel along the NEON/STREON reaches, which will likely require yearly maintenance due to damage caused by the annual freeze-thaw cycle. Additionally, the dirt/wood chip road paralleling Caribou Creek (red line in Figure 14) that provides the closest access will require the use of all-terrain vehicles (ATV's). At this point Science (AQU) has determined that unlined access paths are desired to be cut/enhanced (currently there is a deer/caribou trail traversing the north side of the creek) along the north side of the stream as shown in Figure 14 below. Should areas of this trail experience sufficient erosion or damage due to foot traffic from researchers on site, a series of short manually moveable foot bridges will be installed to protect those areas from additional impact. Very likely these moveable foot bridges can be installed by Field Operations (FOPS) staff and will not need to be installed by FCC or their contractors.

3.1.8.1 Science Perspective on Access Needs (Pathways, Stairs, Etc.) to Reduce Site Erosion/Impact

A system of paths and/or boardwalks will be required to access the AQU/STREON reaches. To minimize impact, the route may originate at the TIS instrument hut location, which will be accessed with the use of ATV's. Figure 14 shows the approximate route the system of paths to and along the AQU/STREON reaches will need to follow. At this time it is not anticipated to require boardwalks on the suggested stream access path (grey line Figure 14). However, should excessive erosion occur due to foot traffic in portions of the path, it may be necessary to add portions of a boardwalk to limit impacts to science.

Figure 14 Roads adjacent to Caribou Creek. The yellow line shows the path of a well-maintained gravel road, the red line shows the path of a narrower, less maintained wood chip road and the blue line shows the approximate extent of the NEON and STREON reaches. The gray line illustrates the approximate route of the system of trails and potential boardwalks to be developed to access the AQU/STREON reaches of Caribou Creek.

3.1.9 Power at the Site

The local power utility company is Golden Valley Electrical Coop Wayne Barbham 907-978-7493.

3.1.10 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D19 Caribou Creek are:

- The sensitivity of the taiga vegetation. Paths and/or boardwalks will be required to minimize impact to the riparian and upslope vegetation. Boardwalks are not currently being required. However, should excessive erosion occur due to foot traffic, portions of boardwalks may need to be added to the path. Boardwalk that is being installed elsewhere in AK is on grade (lying on the mosey surface) material and is not intended for ATV use to the site as shown in the red line. There is a portion of the red line where ATV's could be used. However, once the trail turns south ATVs cannot be used. This boardwalk and ATV has been discussed at length with EHS, FOPS, Engineering (ENG) and Systems Engineering (SE). We do not have a survey of the creek itself for the boardwalk layout, therefore we would either make a note in the TIS plans that approximately 1000' of additional boardwalk will be needed and field adjusted to accommodate the aquatic operations.
- The freeze/thaw cycle. Caribou Creek will be entirely frozen between fall and spring. Sensors and other monitoring equipment will need to be removed in the fall and replaced in the spring. However, during Construction and in the first few years of Operations, AQU will be assessing if the surface water is fully frozen in winter and if some sensors can remain in

place. Furthermore, annual freezing and thawing of the riparian area lands will need to be considered when developing the paths/boardwalks.

- Dense growth of riparian vegetation immediately adjacent to the channel. Thick stands of dwarf willow and alder will need to be cleared at sensor locations.

Driving and access constraints for D19 Caribou Creek are:

- The poor condition of the access road (red line in Figure 16) will require the use of ATV's to access the site during routine visits.
- NEON employees will require training in the use of the All-terrain vehicle and required personal protective equipment.
- Local and visiting NEON personnel will need to know the combination for the padlock at the gate shown in Figure 14.

3.1.11 Other Issues

No other science issues are identified at this time.

4 APPENDIX A. FCC SUMMARY TABLES FOR AIS SITE COMPONENTS AT D19

4.1 Caribou Creek FCC Summary Table

Site Component	Latitude	Longitude	Units
Stream, Lake, or Stream+STREON			Description
Aquatic Auxiliary Power Portal location	65.154219	-147.502306	Lat, Long in degrees
Aquatic Portal location			m away from bank, direction
Pathway needed? What is length?	Yes tundra mat out to the device posts		Yes/no, description w/ length
Pathway start location	Site1-PathStartLat	Site1-PathStartLong	Lat, Long in degrees
Pathway end location	Site1-PathEndLat	Site1-PathEndLong	Lat, Long in degrees
Stairs or ladder needed?			Yes/no, description
Stairs top location	Site1-StairsTopLat	Site1-StairsTopLong	Lat, Long in degrees
Stairs length	Site2-StairsLength		Meters
Ladder top location	Site1-LadderTopLat	Site1-LadderTopLong	Lat, Long in degrees
Ladder length	Site1-LadderLength		Meters
Boardwalk needed? What is length?			Yes/no, description w/ length
Boardwalk start location	Site1-BrdwlkStartLat	Site1-BrdwlkStartLong	Lat, Long in degrees
Boardwalk end location	Site1-BrdwlkEndLat	Site1-BrdwlkEndLong	Lat, Long in degrees
Shall stairs, boardwalk be installed during construction?			Yes/no, description
Fencing needs			Description
Site management			Description
Any additional site specific information			Description