D10 SITE CHARACTERIZATION REPORT

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See configuration management system for approval history.

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Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A	10/14/2014	ECO-01888	Initial release
B	02/04/2016	ECO-02916	Field-based meteorological station location and site design update

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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.

This report takes precedence over other documents and reports that may repeat the information contained herein.

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 D10 aquatic locations: Arikaree River (core). 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
RD[03]	[Reference to photos]
RD[04]	[Reference to map(s)]

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 D10 AIS SITE CHARACTERIZATION REPORT

3.1 Arikaree River

The Arikaree River is a small, wadeable stream flowing through a sand-alluvial basin. The stream is shallow and low gradient with a bed and banks composed of 90% sand. The stream is fed primarily via precipitation and is subject to occasional flooding when large, localized storms occur in the watershed. The site has 9 months of historical flow data, but the onsite rancher reports that last 1-in-100 year flood occurred in the 1960s. Water did not reach the existing ranch house.

The stream flows primarily in winter and dries into standing pools in summer.

The area is sensitive to disturbance and invasive plant species and is managed to ensure a diverse tall-grass prairie and bird community.

3.1.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The initial estimated location for the Aquatic Auxiliary Portal is in Table 1. The Aquatic Auxillary Portal is co-located with the Aquatic Portal (Figure 1).

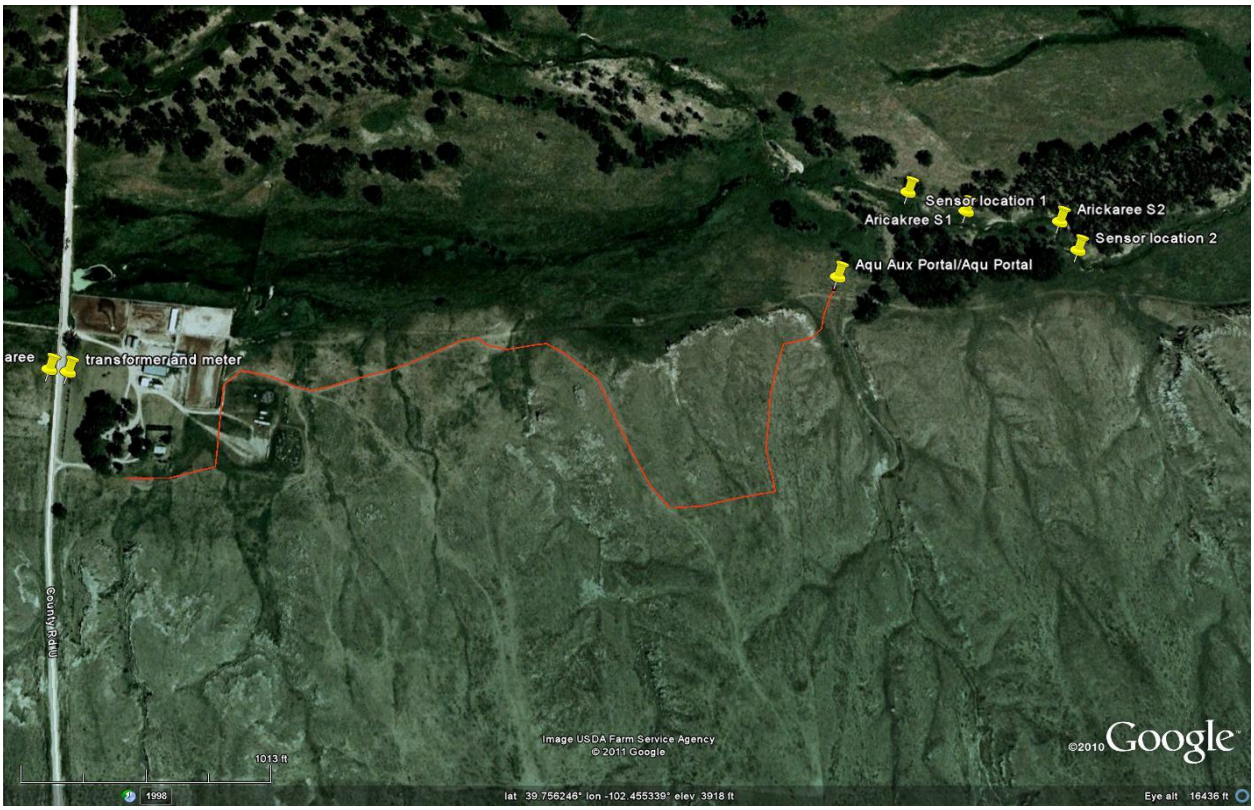

Figure 1 A Google-Earth-Derived Image of Aquatic Auxiliary Portal for D10 Arikaree River

Table 1 Aquatic Auxiliary Portal Location

Aquatic Auxiliary Portal	Latitude	Longitude
Location (same as Aquatic Portal)	339.75745	-102.45223

The initial estimated location for the Aquatic Portal is:

Table 2 Aquatic Portal Location

Aquatic Portal	Latitude	Longitude
Location	39.75745	--102.45223

3.1.2 Sensor Locations for Construction

AQU, with support from EHS, has defined GPS coordinates for S1, S2, and micromet station locations (Table 3 and 4, Figure 2). The micromet station is located in the same area as S1.

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.

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

Table 3 Sensor 1 & Sensor 2 Locations

Sensor	Latitude	Longitude
S1	39.75853	-102.45007
S2	39.75840	-102.44859

Table 4 Micromet & Precipitation Sensors and Associated Field Device Posts Locations

Sensor	Latitude	Longitude
Micromet	39.756552	-102.450975
Micromet FDP	39.756659	-102.450999
DIFR	39.756613	-102.450803
NADP	39.756666	-102.450942
DIFR/NADP FDP	39.756666	-102.450884

Figure 2 Kmz File of D10 Arikaree River Denoting Locations of S1, S2, Micromet Station, Primary Precipitation (DIFR) and Wet Deposition Collector (NADP).

S1 and S2 locations are confined by beaver dams on Arikaree River. The general location of S1 and S2 are shown in Figures 3 and 4. Once reaeration work is complete and actual distance between sensors is known, both sensor sets may move closer together and further away from ponds.

Figure 3 The General Location of S1 at D10 Arikaree River

Figure 4 Photo of S2 Location at D10 Arikaree River. Here, the 2011 AQU field contractors are measuring stream discharge.

Figure 5. Photo of the met station, DFIR, and wet deposition collector location from the view of the met station looking northwest.

The DFIR and wet deposition collector locations were chosen in accordance with NEON and NOAA requirements for primary precipitation measurements and the National Atmospheric Deposition Program (NADP) requirements for precipitation sampling. Field-based sensors will need to be fenced to protect sensors, infrastructure and grazing livestock. Figure 6 shows the meteorological and precipitation sensors, their associated field device posts and the cattle fence consistent with NEON requirements. Fencing materials will be specified by The Nature Conservancy in agreement with the land manager. A gate will be needed to access the sensors.

The meteorological station location was updated on April 16, 2015 following a request from the site host to move it from the originally proposed location that was in the field north of the portal. The site manager moves up to 400 head of cattle through that area and would pose potential safety concerns to both cattle and NEON property if left in that location. A standard barbed wire fence is to be used. The site manager indicated that corners (e.g. rectangular fence) will be acceptable but will be subject to rubbing by cattle and should be reinforced.

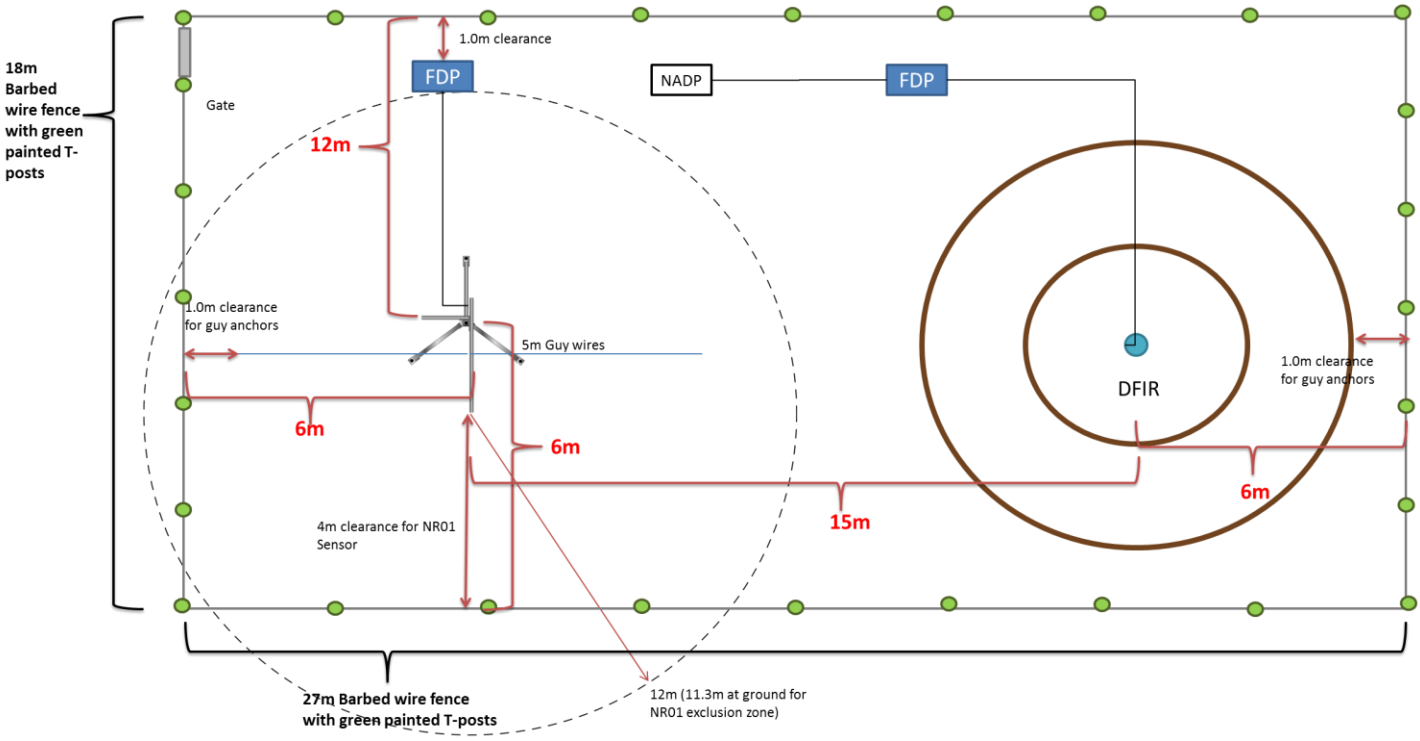

Figure 6. Schematic of met station, wet deposition collector and DFIR that includes cattle fence location relative to sensors and infrastructure.

3.1.3 Groundwater Wells

The site will be instrumented with 6 groundwater monitoring wells and it is desired to install an additional 2 piezometers near the stream. The selected location of groundwater wells and piezometers are shown in Figure 5 and associated GPS coordinates are in Table 5. Construction of the wells will utilize prefabricated sections of solid and factory slotted 2-inch-diameter schedule-80 PVC. The maximum anticipated drilling depth for the monitoring wells is 40 feet below ground surface. This assumes a depth to water of 15 feet, top of screen 10 feet below water, a 5-foot-long screen, and a 5-foot-long sump. Surface finishing of the wells will utilize square steel pipe that will surround and protect the above ground portion of the PVC casing. Setting the steel casing in a concrete pad approximately 2-feet by 2-feet in area is desired for longevity of the monitoring well. Drilling of the monitoring wells will be by one of two methods.

The desired method is by using a rotary auger rig mounted on a truck (International 4900 series with dimensions of ~ 10 feet wide by 25 feet in length). The second option is using a track mounted direct-push rig (Geoprobe) which is much smaller in size (~ 8 feet in width and 15 feet in length). The rotary auger is the preferred method since the actual drilling mechanism will generate a larger diameter hole (~8 inches) which will allow sufficient annular space for the sand pack and bentonite seal surrounding the well casing. In general, this is the industry standard technique for the installation of monitoring wells, and tends to yield higher quality wells. It should be noted that only the monitoring wells will be installed using either the rotary auger or direct-push equipment. If accepted, the piezometers will be installed by hand using minimally invasive techniques, such as a hand auger.

Figure 7 Map of groundwater well locations at D10 Arikaree River

Table 5 GPS coordinates of Monitoring Wells and Piezometers

Well ID	Latitude	Longitude
D10-ARIK-OW-01	39.758061252	-102.452208265
D10-ARIK-OW-02	39.757808748	-102.447659316
D10-ARIK-OW-03	39.759014093	-102.443433062
D10-ARIK-OW-04	39.760388689	-102.452073666
D10-ARIK-OW-05	39.759530426	-102.448144082
D10-ARIK-OW-06	39.761008305	-102.445797760
D10-ARIK-OW-07	39.758809798	-102.450364288
D10-ARIK-OW-08	39.758568555	-102.445713405

3.1.4 Riparian Vegetation Cover

During 2010-2011 site visits, the following plant density and type (Figure 6) were observed by the AQU team:

- Grass – 95% cover near the stream and in the surrounding area.
- Cottonwood trees – 30% cover in the surrounding area. There are a few trees at the stream edge, but they are mostly 5-10 feet back from the stream bank.
- Willow – 10% cover at the stream bank and surrounding areas; dense stand of willow upstream of S1.

Figure 8 The Riparian Canopy at D10 Arikaree River

3.1.5 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 7.

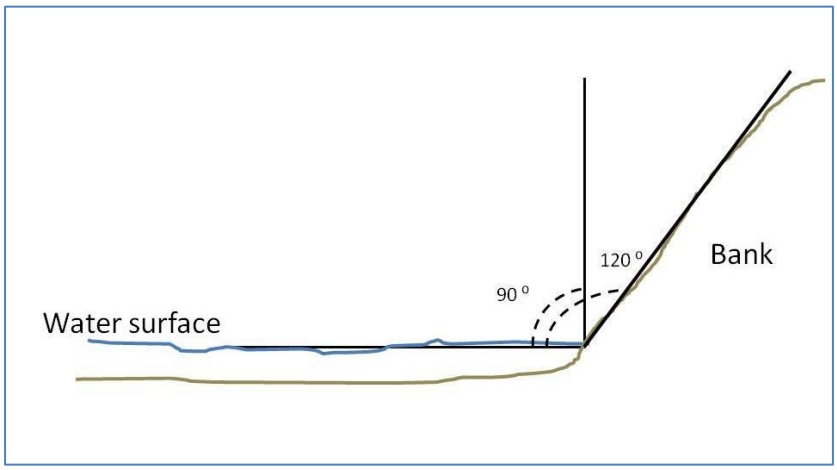

Figure 9 How Bank Angle is Measured

During 2011 site visits, AQU observed bank conditions at S1 and S2; these are summarized in Table 6 and illustrated in Figure 8.

Table 6 Bank Conditions At D10 Arikaree River In 2011

Morphology Type	S1	S2

RB* angle	150°	140°
LB* angle	150°	130°
Maximum water height	~0.4 m	0.5 m
Bankfull width	~2.9 m	2.1 m
Substrate composition	Sand	Sand

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

Figure 10 Bank view of S2 during high flows.

3.1.6 Site Photos

The following photos are representative of the site and illustrate site constraints during construction:

Figure 11 Typical Substrate in D10 Arikaree River are mostly sand with some cobble.

Figure 12 This is a beaver run off the main channel. These areas should be avoided as beaver are active in these areas (will chew on infrastructure) and this is an area of potential high erosion.

Figure 13 Cattle are often by the stream and looking for food.

Figure 14 Large bend in stream just above S2 creates a very shallow pool. There are lots of soft sediments in this pool and care should be taken (e.g. it is easy to sink in past your waste).

Figure 15 D10 Arikaree River is managed for diversity of tallgrass prairie species. Care should be taken to minimize fire hazards and removal of vegetation.

Figure 16 Nathan, the on-site ranch manager at Arikaree River with C. Seeger and E. Rissler.

3.1.7 Site Access Needs

A gate through an electrified fence may need to be installed to access the meteorological station. This will need to be coordinated with the site manager, Nathan. He currently has an electrified fence that put up for part of the year (winter) running primarily east-west along the south side of the permitted area.

Figure 17 Picture of electrified fence running east-west just north of met station.

The current permit will need to be expanded to include the area where the proposed meteorological station is located.

No pathways, boardwalks, stairs, or ladders are needed at D10 Arikaree River for Science purposes.

3.1.8 Communications at the Site

The local communications company is Plains Telephone Corporation 970-358-4211. The ranch house has communications and Plains Telephone plans to run fiber to the site in the next few years.

The Communication pedestal is at 39.755408°, -102.464015°

See table in Appendix C for additional IT info.

3.1.9 Power at the Site

The local power utility company is YW Electric Cooperative. The YW contact is Dave Allan at 970-345-2291.

3.1.10 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D10 Arikaree River are:

- Channel deformation due to heavy equipment (e.g. 5-7 ton total weight) on sand within 10 feet of the stream bank
- Erosion of the banks due to heavy equipment and personnel crossing the channel frequently; avoid beaver areas where erosion will be especially high
- Exposed ground due to travel across the native grass
- Loss of native grass species
- Introduction of exotic or nuisance species
- Fire via personnel action (e.g. smoking), vehicles parked on grass, equipment on grass,
- Disruption to normal cattle operation; scaring of cattle; personnel injury due to improper cattle interactions
- Destruction of wetland areas due to travel across wet zones to access the site

Driving and access constraints for D10 Arikaree River are:

- Vehicles and equipment will be transported to S1, S2 and well locations on an out-and-back track.
- Travel between points should be minimized.
- Vehicles and equipment should not be left idling or parked on tall grass due to fire hazard.
- Vehicles and equipment should not be transported

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 D10

4.1 Arikaree River FCC Summary Table

Site Component	Latitude	Longitude	Units
Stream, Lake, or Stream+STREON	Stream		Description
Aquatic Auxiliary Power Portal location	39.757712	-102.452116	Lat, Long in degrees
Aquatic Portal location	39.757712	-102.452116	m away from bank, direction
Pathway needed? What is length?	No		Yes/no, description w/ length
Pathway start location			Lat, Long in degrees
Pathway end location			Lat, Long in degrees
Stairs or ladder needed?	No		Yes/no, description
Stairs top location			Lat, Long in degrees
Stairs length			Meters
Ladder top location			Lat, Long in degrees
Ladder length			Meters
Boardwalk needed? What is length?	No		Yes/no, description w/ length
Boardwalk start location			Lat, Long in degrees
Boardwalk end location			Lat, Long in degrees
Shall stairs, boardwalk be installed during construction?	No		Yes/no, description
Fencing needs	Cattle Fence placed around all field-based sensors and infrastructure (i.e. not instream or GWW). No barbed wire, no corners; fencing must be 20m from NADP and 12m from met station; a single fence shall enclose the met station, DFIR, NADP and their associated FDPs (see Figure 6 above).		Description
Site management			Description
Any additional site specific information			Description

5 APPENDIX B. EHS SUMMARY TABLES FOR AIS SITE COMPONENTS AT D10

5.1 Arikaree River EHS Summary Table

Site Component	Latitude	Longitude	Units
Sensor 1 (S1) location	39.75853	-102.45007	Lat, Long in degrees
Sensor 2 (S2) location	39.75840	-102.44859	Lat, Long in degrees
Discharge Sensor location (if needed)			Lat, Long in degrees
Micromet Station location	39.756552	-102.450975	Lat, Long in degrees
Met Station FDP	39.756659	-102.450999	Lat, Long in degrees
Primary Precipitation (DFIR)	39.756613	-102.450803	Lat, Long in degrees
Wet Deposition (NADP)	39.756666	-102.450942	Lat, Long in degrees
DFIR/NADP FDP	39.756666	-102.450884	Lat, Long in degrees
Aquatic Auxiliary Power Portal location	39.757450	-102.452231	Lat, Long in degrees
Aquatic Portal location	39.757450	-102.452231	Lat, Long in degrees

6 APPENDIX C. IT SUMMARY TABLES FOR AIS SITE COMPONENTS AT D10

6.1 Arikaree River IT Summary Table

Site Component	Latitude	Longitude	Units
REQUIRED			
Aquatic Auxiliary Power Portal location	39.75745	-102.45223	Lat, Long in degrees
Aquatic Portal location	39.75745	-102.45223	Lat, Long in degrees
DESIRED			
Cell tower visible from site	Yes		Yes/no
Cell phone signal at site	Yes, Viaero		Yes/no, which carrier?
Strength of cell phone signal	Medium/High. Per account rep 4G upgrade is planned by summer '12		Description
Facility on property	Yes, at guest house		Yes/no
Internet connectivity at facility	Unknown		Yes/no, description
Phone number at facility location	Unknown		Area code & first 3 needed