D18 Aquatic Instrument System (AIS) Site Characterization Report

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See Configuration Management System for approval history

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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 D18 aquatic locations: Oksrukuyik Creek (core), Oksrukuyik Creek (STREON) (STREON), and Toolik Lake (relocatable). 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 D18 AIS SITE CHARACTERIZATION REPORT

3.1 Oksrukuyik Creek

The Oksrukuyik Creek (Oks) site is a wadeable stream on the North Slope of Alaska. The stream can be accessed from an abandoned Alaska DOT Material Site road off of the Dalton Highway near mile marker 297. The walk from the parking area at the end of the material site road to the center coordinate is 0.9 km.

The stream flows through open tundra, and has a series of lakes in its headwaters. Water sources to this stream are primarily snowmelt, rainfall, and lake inputs. Oks Creek flows approximately 4 months of the year, and is frozen from October to May.

3.1.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

This site is expected to be an alternate power (solar) site. The initial estimated location for the Aquatic Auxiliary Portal is:

Figure 1. A Google-Earth-Derived Image of Aquatic and Auxiliary Portal locations for D18 Oksrukuyik Creek

Table 1 Aquatic Auxiliary Portal Location

Aquatic Auxiliary Portal	Latitude	Longitude
Location	68.671123	-149.139757

The initial estimated location for the Aquatic Portal is:

Table 2 Aquatic Portal Location

Aquatic Portal	Latitude	Longitude
Location	68.669675	-149.147190

3.1.2 Sensor Locations for Construction

The GPS coordinates for S1, S2 the Met Station locations obtained by AQU, with input from EHS, are presented in Tables 3 and 4. 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 Sensor 1 & Sensor 2 Locations

Sensor	Latitude	Longitude
S1	68.669017	-149.149939
S2	68.669669	-149.143497

The discharge sensor should be located at S2.

Table 4 Met Station Location

Sensor	Latitude	Longitude
Met Station	68.669777	-149.142712

Figure 2. Kmz File of D18 Oksrukuyik Creek Denoting Locations of S1, S2, and Met Station.

Figure 3. Photo of S1 Location at D18 Oksrukuyik Creek

Figure 4. Photo of S2 Location at D18 Oksrukuyik Creek.

Figure 5. Photo of Met Station Location at D18 Oksrukuyik Creek

Figure 6. Sensors have been placed in shallow pools or deep runs, however riffles also occur throughout the reach.

3.1.3 Groundwater Wells

The groundwater observation wells network at the site (Figure 8, Table 05) will consist of 8 wells installed using a powered hand-auger. Topography at the site is fairly flat to the north of the stream and has a gentle hillslope to the south of the stream. The wells will be installed at varying positions around the stream focusing on water tracks that enter the stream. The maximum anticipated drilling depth will be 5 feet below ground surface. Wells will be drilled so that the base of the well interfaces with the permafrost layer. Wells will also be designed so that the depth of the well can be increased with minimal disturbance should arctic thawing continue to reduce permafrost.

AQU prefers the surface completion of the wells to include an above-grade stick-up protective cover and be minimally invasive. However, the State of Alaska has several requirements for construction of groundwater monitoring wells that NEON will either need to meet or apply for a waiver. Chief among the State requirements are 1) an acceptable grout to fill the annular space such as neat cement,

bentonite chips, or a bentonite / cement mixture; 2) surface seal of the well requires a poured concrete or cement slab poured around a steel outer casing with a locking cap; and 3) a licensed well driller is required to be onsite. No details are provided as to the thickness or size of the ground surface seal.

The AQU team prefers a steel casing with a non-cement pad and will apply for a waiver for each well. However, EHS should prepare the landowner for this State regulation and the real possibility that cement will need to be used.

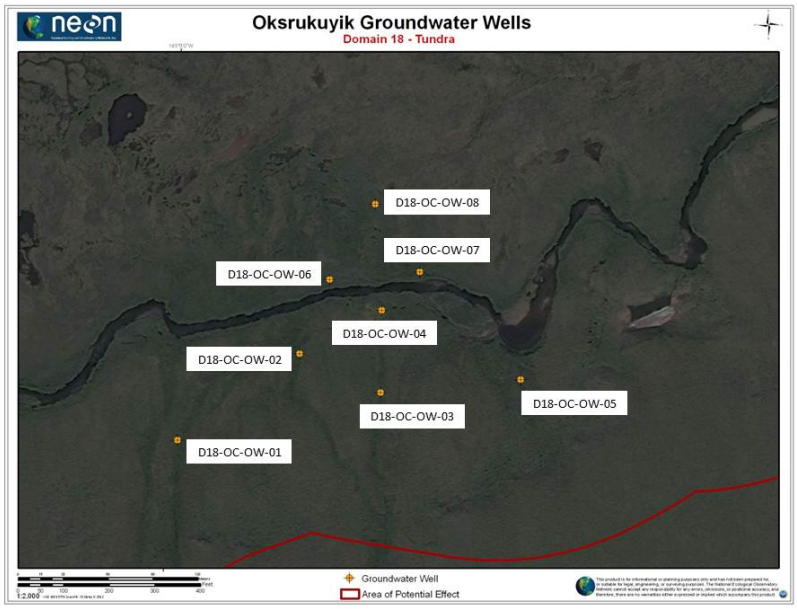

Figure 7. Initial Groundwater Well Locations Based on EMS kmz File at D18 Oksrukuyik Creek

Table 05 Groundwater Observation Well Locations

Well ID	Latitude	Longitude
D18-OC-OW-04	68.669126	-149.146473
D18-OC-OW-02	68.668847	-149.147794
D18-OC-OW-05	68.668739	-149.144146
D18-OC-OW-03	68.668632	-149.146439
D18-OC-OW-01	68.668307	-149.149752
D18-OC-OW-08	68.669758	-149.146637
D18-OC-OW-06	68.669298	-149.147347
D18-OC-OW-07	68.669363	-149.145868

3.1.4 Riparian Vegetation Cover

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

Oks Creek flows through a tundra ecosystem. Riparian vegetation consists of willows, dwarf birch, and some sedges. There is no overhanging vegetation along the AQU reach.

Figure 8. The riparian canopy at D18 Oksrukuyik Creek

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 the figure below.

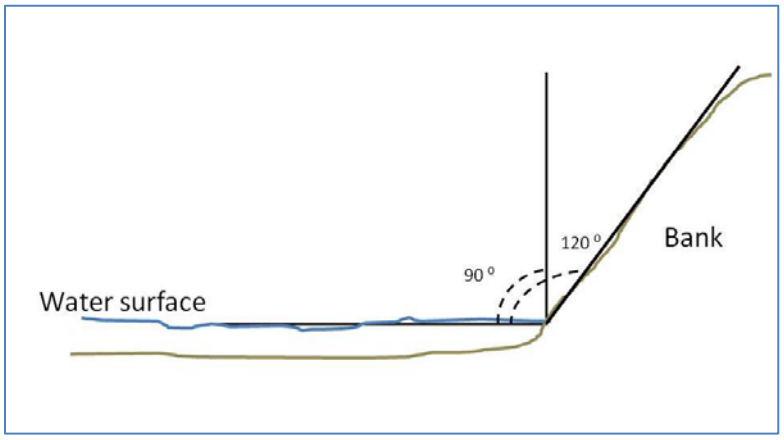

Figure 9. How Bank Angle is Measured

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

Table 6 Bank Conditions At D18 Oksrukuyik Creek in 2011

Morphology Type	S1	S2
RB* angle	160°	150°

LB* angle	160°	90°
Maximum water height	0.86 m	1.28 m
Bankfull width	5.8 m	5.9 m
Substrate composition	30% boulder, 70% cobble	15% boulder, 10% pebble, 75% cobble

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

Figure 10. The left bank at S1 is typical of bank morphology along the reach.

3.1.6 Site Photos

The following photos of are representative of the site.

Figure 11. Typical substrate in D18 Oksrukuyik Creek is mostly cobble mixed with boulder.

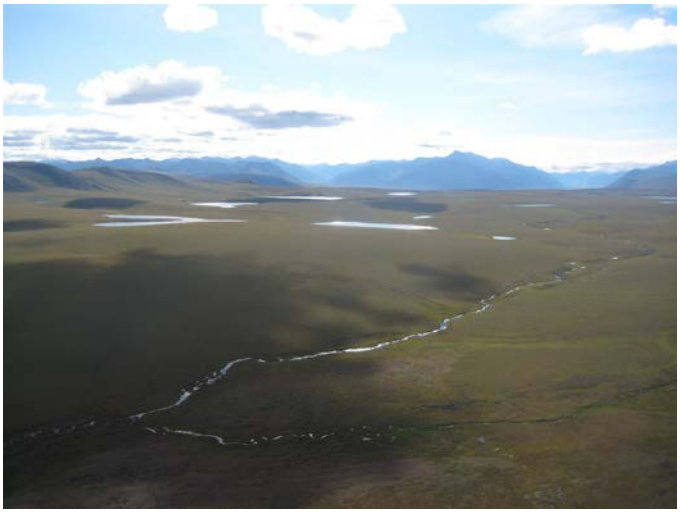

Figure 12. Oks Creek upstream of the AQU reach, looking southeast toward the Brooks Range. Note lakes in the headwaters.

3.1.7 Site Access Needs

Boardwalks are needed at D18 Oksrukuyik Creek for Science purposes from the parking area at the Material Site to the stream and along the stream bank from AQU S1 (most upstream point) to ST S2 (most downstream point).

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

The length of the boardwalk from the parking area to ST S2 and continuing to the upper AQU S1 is approximately 1.2 km and will be constructed over sloping tundra and some boggy ground near the stream bank.

Table 7 Boardwalk Location

Boardwalk	Latitude	Longitude
Start (parking)	68.676395682	-149.130607981
Midpoint (STREON S2)	68.671693386	-149.130607981
End (AQU S1)	68.669018610	-149.149940431

Figure 13. Google Earth image of boardwalk (yellow) starting at the parking area, extending along the northern streambank to S1.

3.1.8 Communications at the Site

ALL - See table in Appendix C for additional IT info

3.1.9 Power at the Site

Power at the site is anticipated to be derived from solar panels and batteries.

3.1.10 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D18 Oksrukuyik Creek are:

- The stream is frozen for a large portion of the year.
- Caribou hunting is common in the area from early to mid-August each year.
- Grizzy bears are in the area and have been known to chew on scientists' equipment.
- The Arctic LTER Streams Group is also conducting background chemical and biological monitoring and fish population research at this site.

Driving and access constraints for D18 Oksrukuyik Creek are:

- A 4-WD truck is needed to drive the Material Site Road during summer.
- The site can be accessed from a base camp at the Toolik Field Station (approximately 20 km south).
- The Material Site Road is closed by a locked chain near the Dalton Highway. The Marine Biological Laboratory (Woods Hole, MA) currently owns and maintains the lock.

- The Material Site Road is not accessible during winter months (late September-May). Trucks will have to park on the Dalton Highway and proceed to the site over snow.

3.1.11 Other Issues

No other science issues are identified at this time.

3.2 Oksrukuyik Creek (STREON)

The Oksrukuyik Creek (STREON) (STREON) is a wadeable stream on the North Slope of Alaska. The stream can be accessed from an abandoned Alaska DOT Material Site road off of the Dalton Highway near mile marker 297. The walk from the parking area at the end of the material site road to the center coordinate is 0.9 km.

The stream flows through open tundra, and has a series of lakes in its headwaters. Water sources to this stream are primarily snowmelt, rainfall, and lake inputs. Oks Creek flows approximately 4 months of the year, and is frozen from October to May.

3.2.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The initial estimated location for the Aquatic Auxiliary Portal is:

Figure 14. A Google-Earth-Derived Image of Aquatic and Auxiliary Portal locations for D18 Oksrukuyik Creek (STREON)

Table 8 Aquatic Auxiliary Portal Location

Aquatic Auxiliary Portal	Latitude	Longitude
Location	68.671123	-149.139757

The initial estimated location for the Aquatic Portal is:

Table 9 Aquatic Portal Location

Aquatic Portal	Latitude	Longitude

Location	68.669675	-149.147190

3.2.2 Sensor Locations for Construction

The GPS coordinates for ST S1, ST S2 the Met Station locations obtained by AQU, with input from EHS, are presented in Tables 10 and 11. 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 10 STREON Sensor 1 & Sensor 2 Locations

Sensor	Latitude	Longitude
ST S1	68.669934	-149.142071
ST S2	68.671693	-149.136259

Table 11 STREON Hut Location

Hut	Latitude	Longitude
Hut 1	68.669522	-149.142136
Hut 2	68.670856	-149.139456

Figure 15. Kmz File of D18 Oksrukuyik Creek (STREON) Denoting Locations of ST S1, ST S2, and TREON Hut

Figure 16. Photo of STREON S1 location at D18 Oksrukuyik Creek (STREON)

Figure 17. Photo of STREON S2 location at D18 Oksrukuyik Creek (STREON)

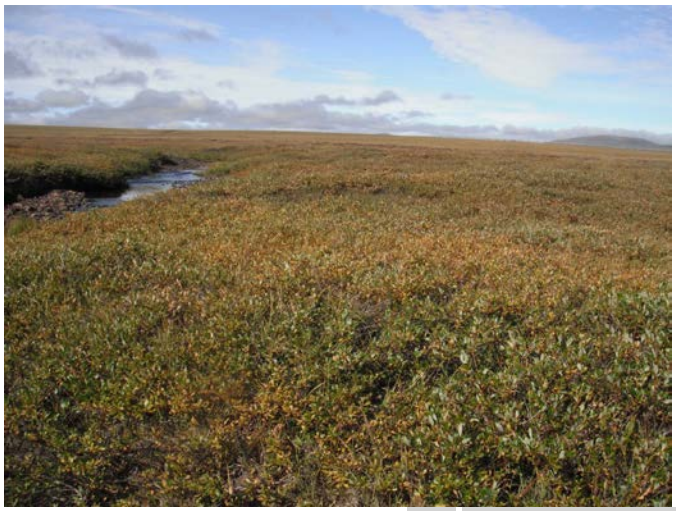

Figure 18. Photo of STREON Hut location at D18 Oksrukuyik Creek (STREON)

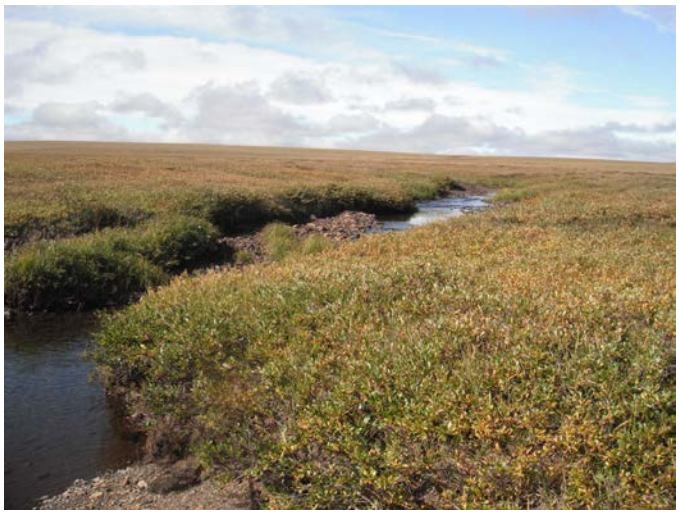

Figure 19. Photo of STREON dripper location at Oks Creek

3.2.3 Groundwater Wells

Groundwater wells are positioning at Oksrukuyik Creek is detailed in Section 3.1.3.

3.2.4 Riparian Vegetation Cover

During 2010-2011 site visits, the following plant density and type were observed by the AQU team:
Oks Creek flows through a tundra ecosystem. Riparian vegetation consists of willows, dwarf birch, and some sedges. There is no overhanging vegetation along the AQU reach.

Figure 20. The riparian canopy at D18 Oksrukuyik Creek (STREON) (STREON)

3.2.5 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 the figure below.

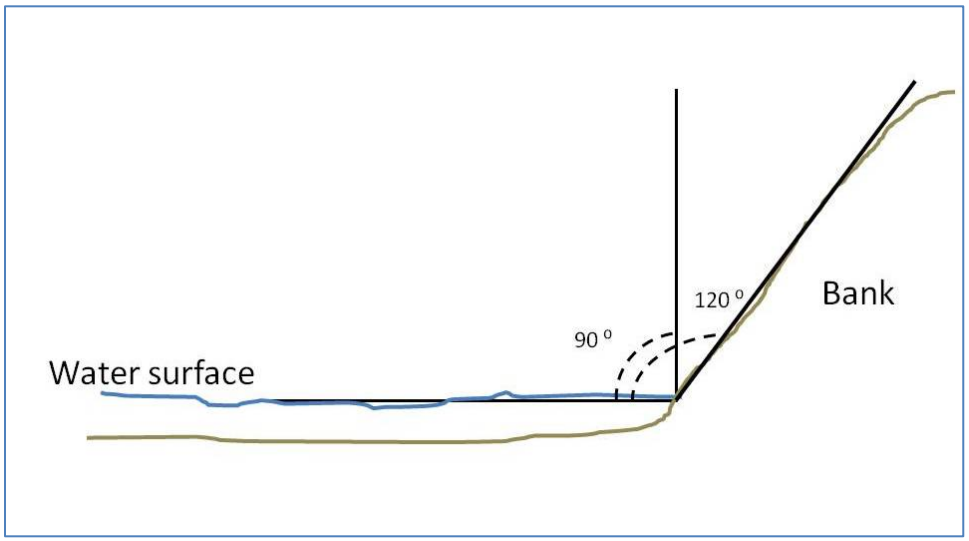

Figure 21. How Bank Angle is Measured

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

Table 12 Bank Conditions At D18 Oksrukuyik Creek (STREON) In 2011

Morphology Type	S1	S2
RB* angle	90°	160°

LB* angle	100°	170°
Maximum water height	1.7 m	1.63 m
Bankfull width	7.3 m	10.0 m
Substrate composition	70% cobble, 10% boulder, 20% pebble/gravel	15% boulder, 20% pebble, 65% cobble

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

Figure 22. Photo (looking upstream) of banks at STREON S2. Banks are similar at STREON S1.

3.2.6 Site Photos

The following photos of are representative of the site.

Figure 23. Typical substrate in D18 Oksrukuyik Creek (STREON) (STREON) is mostly composed of cobble and pebble.

Figure 24. Equipment installed my researchers on the Arctic LTER Streams project near the ST S1 location.

Figure 25. Arctic LTER research equipment, including auto-sampler tubing and a staff gauge in the stream near ST S1.

Figure 26. Arctic LTER research equipment containing the electronic fish tracker in the stream bottom at ST S1.

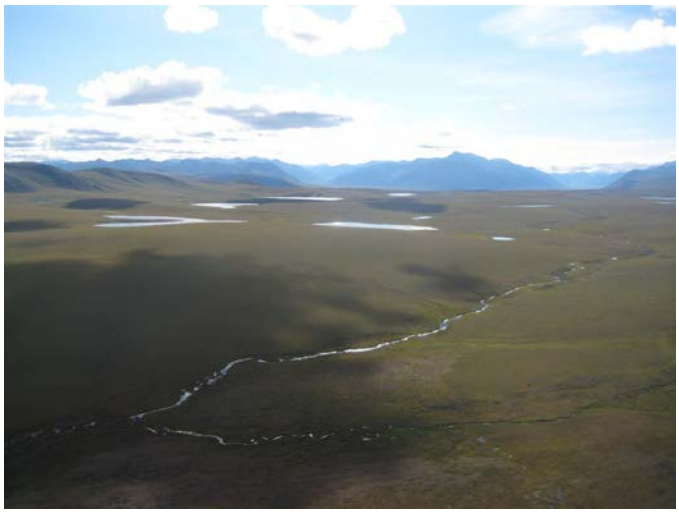

Figure 27. Looking southeast (upstream): Oks Creek upstream of the STREON study reach, showing lakes in the headwaters.

3.2.7 Site Access Needs

Boardwalks are needed at D18 Oksrukuyik Creek for Science purposes from the parking area at the Material Site to the stream and along the stream bank from AQU S1 (most upstream point) to STREON S2 (most downstream point).

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

The length of the boardwalk from the parking area to STREON S2 and continuing to the upper AQU S1 is approximately 1.2 km and will be constructed over sloping tundra and some boggy ground near the stream bank.

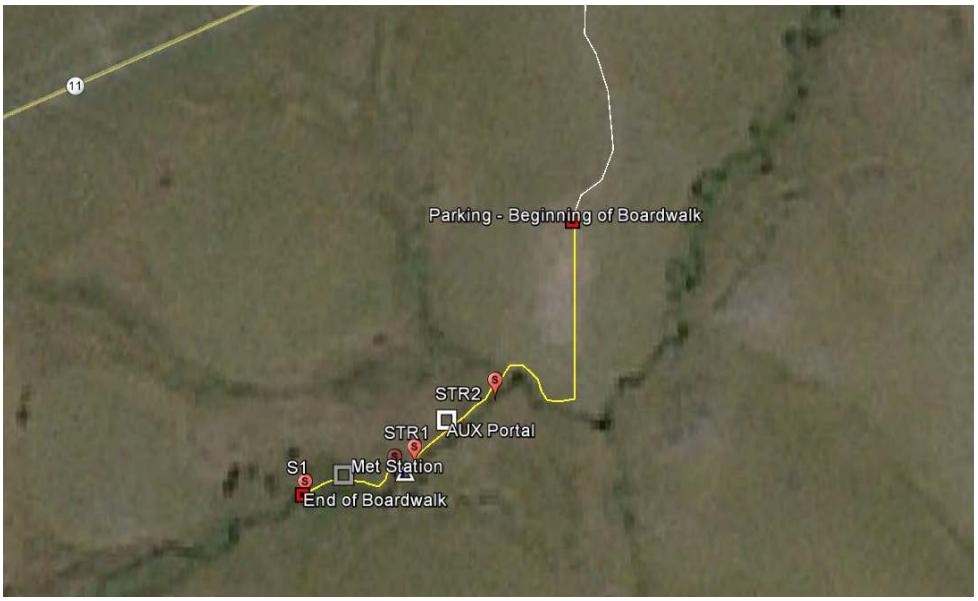

Figure 28. Image showing pathway for boardwalk (yellow line) needed for access at Oksurkuyik Creek.

Table 13 Boardwalk Location

Boardwalk	Latitude	Longitude
Start (parking)	68.676395682	-149.130607981
Midpoint (STREON S2)	68.671693386	-149.130607981
End (AQU S1)	68.6690182	-149.150057

3.2.8 Communications at the Site

ALL - See table in Appendix C for additional IT info

3.2.9 Power at the Site

Power at the site is anticipated to be derived from solar panels and batteries.

3.2.10 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D18 Oksrukuyik Creek (STREON) are:

- The stream is frozen for a large portion of the year.

- Caribou hunting is common in the area from early to mid-August each year.
- Grizzy bears are in the area and have been known to chew on scientists' equipment.
- The Arctic LTER Streams Group is also conducting background chemical and biological monitoring and fish population research at this site.

Driving and access constraints for D18 Oksrukuyik Creek (STREON) are:

- A 4-WD truck is needed to drive the Material Site Road during summer.
- The site can be accessed from a base camp at the Toolik Field Station (approximately 20 km south).
- The Material Site Road is closed by a locked chain near the Dalton Highway. The Marine Biological Laboratory (Woods Hole, MA) currently owns and maintains the lock.
- The Material Site Road is not accessible during winter months (late September-May). Trucks will have to park on the Dalton Highway and proceed to the site over snow.

3.2.11 Other Issues

No other science issues are identified at this time.

3.3 Toolik Lake

The Toolik Lake site is the relocatable Aquatic site in for D18. The lake is one of the largest in the area and is part of a lake district consisting of numerous kettle lakes formed by glaciers. These lakes and their outflows, along with runoff from snowmelt and rain, provide Toolik Lake with its water supply. Toolik Lake is situated on glacial deposits aged 120-150 kya (Itkillik 1, late Pleistocene) and 25-11.5 kya (Itkillik II, late Pleistocene). Glacial outwash extends into the lake, creating multiple shoals and bays.

The landscape is characterized by rolling hills in the foothills of the Brooks Range, and the vegetation cover is dominated by tundra shrubs, including willows (*Salix* spp.), blueberry (*Vaccinium uliginosum*) and dwarf birch (*Betula nana*).

3.3.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The initial estimated location for the Aquatic Auxiliary Portal (Table 14) and Aquatic Portal (Table 15) are co-located and illustrated in Figure 29. The portals are co-located. FCC is managing construction of a new research lab in which the portal will be located.

Table 14 Aquatic Auxiliary Portal Location

Aquatic Auxiliary Portal	Latitude	Longitude
Location	68.628064	-149.596756

Figure 29. A Google-Earth-Derived Image of Aquatic Portal for D18 Toolik Lake

Table 15 Aquatic Portal Location

Aquatic Portal	Latitude	Longitude
Location	68.628064	-149.596756

3.3.2 Sensor Locations for Construction

The GPS coordinates for S1 (Buoy), Inlet, Outlet, Staff Gauge and the Met Station locations obtained by AQU, with input from EHS, are presented in Tables 16 and 17. 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 landscape is relatively flat and the sensors should have direct line of site to the Portals regardless of any revision in their location.

Table 16 S1 Buoy Location

Sensor	Latitude	Longitude
S1 Buoy	68.630692	-149.610636

Table 17 Met Stations, Staff Gauge and Inlet and Outlet Locations

Sensor	Latitude	Longitude
Field-based Met Station	68.630437	-149.586765
Secondary Precipitation Gauge (Tipping Bucket)	68.630518	-149.586941
Met/Precip FDP	68.630526	-149.586830
Staff Gauge	68.628661	-149.594415
Camera	68.628579	-149.594414
Camera FDP	68.628443	-149.594415
Inlet	68.625739	-149.597241
Outlet	68.64069	-149.594909

Figure 30. Google earth image of D18 Toolik Lake denoting locations of S1, Met station and Secondary Precipitation Gauge. Locations of Inlet, Outlet, staff gauge and camera and field device posts are also noted.

Figure 31. Google Earth image of D18 Toolik Lake Met Station Location with Secondary Precipitation Gauge and Field Device Posts shown.

Figure 32. Google Earth image of D18 Toolik Lake Staff Gauge and Camera with associated Field Device Post.

3.3.3 Groundwater Wells

The groundwater observation wells network at the site (Figure 30, Table 18) will consist of 8 wells installed using a powered hand-auger. Topography at the site is dominated by rolling hills surrounding the lake. The wells will be installed at varying positions around the lake focusing on water tracks that enter the lake. The maximum anticipated drilling depth will be 5 feet below ground surface. Wells will be drilled so that the base of the well interfaces with the permafrost layer. Wells will also be designed so that the depth of the well can be increased with minimal disturbance should arctic thawing continue to reduce permafrost.

AQU prefers the surface completion of the wells to include an above-grade stick-up protective cover and be minimally invasive. However, the State of Alaska has several requirements for construction of groundwater monitoring wells that NEON will either need to meet or apply for a waiver. Chief among the State requirements are 1) an acceptable grout to fill the annular space such as neat cement, bentonite chips, or a bentonite / cement mixture; 2) surface seal of the well requires a poured concrete or cement slab poured around a steel outer casing with a locking cap; and 3) a licensed well driller is required to be onsite. No details are provided as to the thickness or size of the ground surface seal.

The AQU team prefers a steel casing with a non-cement pad and will apply for a waiver for each well. However, EHS should prepare the landowner for this State regulation and the real possibility that cement will need to be used.

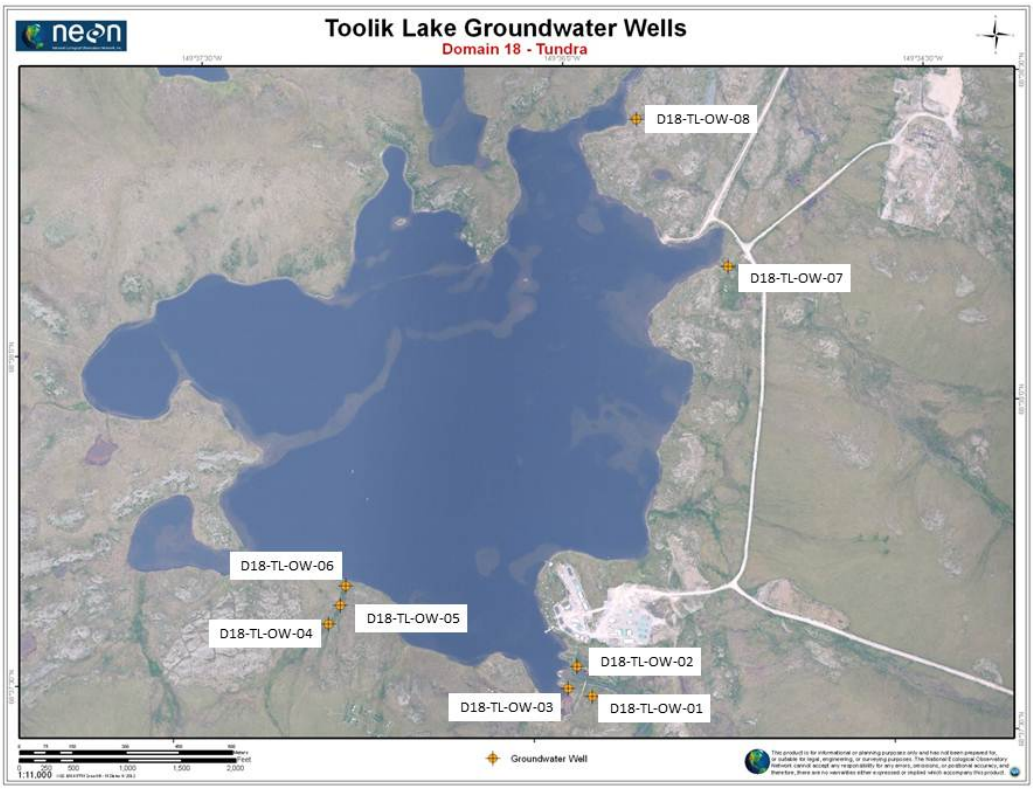

Figure 33. Initial Groundwater Well Locations Based on EMS kmz File at D18 Toolik Lake

Table 18 Groundwater Observation Well Locations

Well ID	Latitude	Longitude
D18-TL-OW-01	68.625371	-149.595773
D18-TL-OW-02	68.626277	-149.597488
D18-TL-OW-03	68.625570	-149.597307
D18-TL-OW-04	68.626793	-149.614545
D18-TL-OW-05	68.627249	-149.613816
D18-TL-OW-06	68.627664	-149.613609
D18-TL-OW-07	68.636382	-149.587824
D18-TL-OW-08	68.639912	-149.594257

3.3.4 Riparian Vegetation Cover

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

Toolik Lake is located within a tundra ecosystem. Riparian vegetation consists of willows, blueberry, dwarf birch, and some sedges. There is little to no overhanging vegetation around the lake as the shrubs are typically <1 m tall.

Figure 34. The Riparian Canopy at D18 Toolik Lake.

3.3.5 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 the figure below.

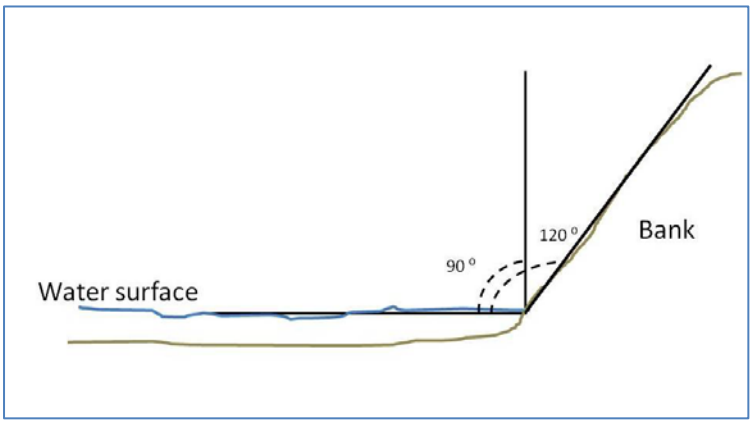

Figure 35. How Bank Angle is Measured

During 2012 site visits, AQU observed the following bank conditions at the lake:

Table 19 Bank Conditions At D18 Toolik Lake in 2011

Morphology Type	Average lake measurement
Average bank angle	105
Lake length	1,681 m
Lake width	1,850 m
Lake Area	1.5 km^2
Substrate composition	Cobble and silt

3.3.6 Site Photos

The following photos of are representative of the site.

Figure 36. Typical Substrate in D18 Toolik Lake is mostly cobble nearshore, and silt in the deeper areas of the lake. Boulder may be scattered throughout the lake. Bank material is peat and tundra.

Figure 37. This slump was observed in 2012 on the lake bank on the south side of Toolik Lake.

Figure 38. Docks maintained by Toolik Field Station are located on the southeast side of the lake next to the field station itself.

Figure 39. A boat launch is located on the north side of the lake off of a gravel access road. The field station is in the background of this photo.

3.3.7 Site Access Needs

A simple above grade boardwalk may need to be installed from the dirt road to the Outlet location at Toolik lake in order to minimize damage to local vegetation.

Figure 40. Image of boardwalk path (yellow line) required for access to Outlet; to include access to GWW 08.

Table 20 Boardwalk Location

Boardwalk	Latitude	Longitude
Start	68.638567	-149.587725
End	68.640519	-149.594365

3.3.8 Power at the Site

The local power utility company is:
Northern Plains Electric Cooperative
Rich Short
Office: 701.652.1844
Cell: 701.650.8581

3.3.9 Site Science Construction Constraints and Limitations

The following driving and access consideration apply to D18 Toolik Lake:

- Several vehicle and foot-access roads and paths are already in place at the site, existing roads should be used for access where possible.
- Access to the Outlet sensor location shall be by foot from the closest dirt road.

3.3.10 Other Issues

No other science issues are identified at this time.

4 APPENDIX A. FCC SUMMARY TABLES FOR AIS SITE COMPONENTS AT D18

4.1 Oksrukuyik Creek FCC Summary Table

Site Component	Latitude	Longitude	Units
Stream, Lake, or Stream+STREON	Stream+STREON		Description
Aquatic Auxiliary Power Portal location	68.669675	-149.147190	Lat, Long in degrees
Aquatic Portal location	68.671123	-149.139757	Lat, Long in degrees
Pathway needed? What is length?			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, 1548m		Yes/no, description w/ length
Boardwalk start location	68.676395	-149.130608	Lat, Long in degrees
Boardwalk midpoint	68.671693	-149.130608	Lat, Long in degrees
Boardwalk end location	68.669182	-149.150057	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

4.2 Oksrukuyik Creek (STREON) FCC Summary Table

Site Component	Latitude	Longitude	Units
Stream, Lake, or Stream+STREON	Stream+STREON		Description
Aquatic Auxiliary Power Portal location	68.671123	-149.139757	Lat, Long in degrees
Aquatic Portal location			m away from bank, direction
STREON Hut location			m away from bank, direction
Pathway needed? What is length?			Yes/no, description w/ length
Pathway start location	STR-PathStartLat	STR-PathStartLong	Lat, Long in degrees
Pathway end location	STR-PathEndLat	STR-PathEndLong	Lat, Long in degrees
Stairs or ladder needed?			Yes/no, description
Stairs top location	STR-StairsTopLat	STR-StairsTopLong	Lat, Long in degrees
Stairs length	STR-StairsLength		Meters
Ladder top location	STR-LadderTopLat	STR-LadderTopLong	Lat, Long in degrees
Ladder length	STR-LadderLength		Meters
Boardwalk needed? What is length?	Yes, 1548m		Yes/no, description w/ length
Boardwalk start location	68.676395	-149.130608	Lat, Long in degrees
Boardwalk midpoint	68.671693	-149.130608	Lat, Long in degrees
Boardwalk end location	68.669182	-149.150057	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

4.3 Toolik Lake FCC Summary Table

Site Component	Latitude	Longitude	Units
Stream, Lake, or Stream+STREON	Lake		Description
Aquatic Auxiliary Power Portal location	68.628064	-149.596756	Lat, Long in degrees
Aquatic Portal location			m away from bank, direction
Pathway needed? What is length?			Yes/no, description w/ length
Pathway start location	Site2-PathStartLat	Site2-PathStartLong	Lat, Long in degrees
Pathway end location	Site2-PathEndLat	Site2-PathEndLong	Lat, Long in degrees
Stairs or ladder needed?			Yes/no, description
Stairs top location	Site2-StairsTopLat	Site2-StairsTopLong	Lat, Long in degrees
Stairs length	Site2-StairsLength		Meters
Ladder top location	Site2-LadderTopLat	Site2-LadderTopLong	Lat, Long in degrees
Ladder length	Site2-LadderLength		Meters
Boardwalk needed? What is length?	Yes, 367m		Yes/no, description w/ length
Boardwalk start location	68.638567	-149.587725	Lat, Long in degrees
Boardwalk end location	68.640519	-149.594365	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