TECHNICAL MEMO

July 11, 2025

Attn: Martha Turner
Nulato Tribal Council
169 Kateel Ave
Nulato, AK 99765

Re: Geotechnical Services – Nulato River Road Drainage Crossing

Ms. Turner,

RECON LLC (RECON) has completed geotechnical services in support of the Nulato River Road Drainage Crossing, in Nulato, Alaska. This technical memo presents the findings from the site visits and geotechnical explorations.

PROJECT UNDERSTANDING

The Nulato Tribe is currently in the process of designing and constructing a bridge to cross a drainage feature located approximately half mile west of the upper Nulato Village. The drainage feature is crossed by an existing gravel road that provides access to the North Fork of the Nulato River and an existing rock quarry site. The drainage feature is currently spanned by a temporary culvert. RECON understands that the current culvert is undersized, and the drainage develops substantial aufeis during the winter months. Based on conversations with Nulato residents it is further understood that the aufeis commonly tops the road embankment, causing damage to the road and restricting access during late winter and spring. Design of the bridge requires an understanding of the surface and subsurface soil conditions and the impact on both bridge foundations and aufeis formation. The 2025 geotechnical investigations were intended to inform these design decisions.

RECON understands the design work for the project is planned to be completed in spring and summer of 2025 with construction scheduled for 2026 pending permits and funding.

FIELD EFFORT

RECON's engineering and surveying staff visited Nulato in May and June to observe aufeis, drainage conditions, and subsurface soil conditions. Surveying was completed as part of the overall project by RECON surveyors in June. Peppi Bolz, geological engineer with RECON, completed site visits on May 13 and June 3-5, 2025. RECON Principal Engineer Steve Rowland, PE additionally visited the site on June 3. This technical memo presents the geotechnical findings from the site visits.

During the May 13 site visit, the road was washed out at the drainage crossing and was being actively repaired. RECON staff documented the spring water flow, aufeis conditions, and made general site observations.

During the June site visit, RECON completed the following:

- Advanced four test pits near the drainage crossing,
- observed and documented the drainage conditions at the site and upstream to about 0.6 miles from the road, and
- attended the monthly Nulato Tribal Council Meeting and presented preliminary observations and design concepts.

Test Pits

The City of Nulato provided a Hitachi UHO82LC excavator and the Tribe provided an operator to advance the four test pits. Test pit locations were in the road shoulder near the east and west limits of the drainage and at two additional locations, about 330 feet away from the drainage crossing to the east and west along the road.

TP-1 though TP-3 were advanced to 15 feet below ground surface (bgs) and did not encounter frozen conditions. TP-4 was advanced to 11 feet bgs and encountered frozen conditions below about 8 feet bgs. Table 1 presents test pit locations and depths. Figure 1 shows the test pit location and equipment at TP-2. Figure 2 presents typical subsurface conditions encountered in TP-1. Test pits were backfilled with the excavated material. A site map with test pit locations is included in Attachment A. Attachment B presents test pit logs.

Table 1: Test Pit Locations

Test Pit	Latitude[1]	Longitude[1]	Depth (feet)
1	64.73493	-158.13328	15
2	64.73503	-158.13375	15
3	64.73525	-158.13545	15
4	64.73463	-158.13143	11

Notes:
[1] Datum = WGS84.

Figure 1: Test pit location and equipment at TP-2 (view east).

Figure 2: Typical subsurface conditions at the site (photo from TP-1).

Findings

Findings from the site visits are presented in the following sections.

DRAINAGE CROSSING

The site for the proposed drainage crossing is in a lower lying area of the Nulato River Road. A 36-inch diameter corrugated metal culvert currently provides drainage across the road. Large rocks sourced from the local quarry have been placed on the upstream and downstream side of the drainage crossing in an attempt to reduce road embankment erosion during water run-off during spring break-up. The drainage crossing reportedly washes out each spring as the culvert fills with aufeis through the winter which blocks the culvert for spring-time water run-off (see Figure 3). Several damaged and removed smaller sized (12-inch diameter, 18-inch diameter, and 24-inch diameter) culverts were noted next to the drainage crossing. The current culvert is reportedly the largest diameter culvert that has been installed at this crossing to date.

Figure 3: Drainage crossing during the May 2025 site visit (view north). Note icing in the culvert and local sourced boulders placed to reduce road embankment erosion.

Figure 4: Drainage crossing during the June 2025 site visit (view north).

The drainage channel is about 60-ft wide at the culvert location. Distance from the bottom of the channel to the top of the current road surface on the upstream side of the road is 6-ft.

Icing at the drainage reportedly reaches depths of up to 2-ft on top of the road surface during the winter months. The icing area extends east and west from the drainage crossing.

ICING AND STANDING WATER WEST OF THE DRAINAGE CROSSING

During the May site visit, RECON noted extensive aufeis (icing) between 350 and 600 feet west of the main drainage crossing (see Figures 5 and 6). The icing in this area originates in a separate drainage; however, part of this drainage is diverted along the north side of the road and joins the main drainage near the drainage crossing. During the June site visit, RECON noted standing water north of the road and on top of the road at this location. The road embankment was observed to be < 1-ft above the grade of the surrounding area.

Figure 5: Aufeis 350 to 800-ft west of the drainage crossing during the May site visit (view west).

Figure 6: Standing water north of road and on road about 400-ft west of the drainage crossing during the June site visit (view northeast).

DRAINAGE UPSTREAM FROM ROAD CROSSING

The channel on the upstream (north side) of the road has reportedly widened and deepened over the last few years since a wildfire burned through the area in 2015. Active degradation of permafrost and channel widening is evident in leaning trees and tension cracks along the sidewalls of the drainage in the lower part.

RECON engineers walked up the drainage during the June site visit and made the following observations:

- Burn severity and impact on tundra mat and tree cover varies throughout the area. Permafrost is likely present although the depth to the top of the permafrost table is likely to vary locally.
- Channel widening due to permafrost degradation along the sidewalls is most severe up to about 1,300 feet upstream from the road.
- Upstream of about 1,300 feet from the road, drainage sidewalls appear more stabilized, and the channel is narrower. Downward incising of the channel, likely due to degradation of permafrost, appears to be continuing.
- Two beaver dams and beaver activity were noted between about 500 and 900 feet north of the road. A beaver dam near 500 feet north of the road appears to have redirected the natural drainage to the west (see Figures 7 and 8).
- A small gravel road to the gun range has likely impacted the path of the new channel. The small road has been washed out by the drainage and is no longer usable. The drainage crosses the gravel road about 200 feet north of the road. A temporary log bridge for crossing the drainage using four wheelers has failed due to progressive widening of the channel.

Figure 7: Ponded water and sediment accumulation behind small beaver dam (view northeast).

Figure 8: Evidence of beaver activity.

SUMMARY OF SITE GEOLOGIC CONDITIONS

Bedrock near Nulato consists of Yukon-Koyukuk basin sedimentary deposits, including early and late Cretaceous nonmarine and marine sandstone, shale, and conglomerate deltaic deposits. Surficial deposits consist of high-terrace and slope deposits of light-gray and grayish orange silt with subordinate lenses of sand and peat (Patton and others, 2000). The area has not been glaciated.

SUBSURFACE CONDITIONS

TP-1 and TP-2 were advanced near the east and west side of the drainage crossing, respectively. TP-3 and TP-4 were advanced about 330 feet west and east of the drainage, respectively. TP-1 through TP-3 were located within the broad drainage area, whereas TP-4 is located just east of the drainage area.

Observed subsurface conditions consisted of (from top to bottom):

- Fill (variable, depending on location, up to 3-feet)
- Silt, ML (to depths explored, up to 15 feet below ground surface).

Gravel Fill (GP): Gravel fill consisted of brown, *Poorly Graded Gravel with Sand (GP).* The fill was moist to wet and included rounded to subangular, cobbles, gravel, and sand. Some of the coarse material was flat and/or elongated.

Silt (ML): Gray to brown, wet and relatively easy to excavate where unfrozen. Where frozen, bonded without excess ice (Nbn) with some layers of visible ice and occasional massive ice lenses (up to 6-inches thick) near organics. The unfrozen silt was soft to firm, mottled, and organic-rich. Organics included decomposed very fine organics, roots, sticks, and occasional small tree trunks. The thickness of the silt layer is unknown.

Remnants of original vegetation (tundra mat) were observed below the road fill and near the top of the silt in the test pits.

Water inflow was noted in TP-2 from the northwestern corner of the test pit, and generally within or below the fill and above the silt.

Frozen conditions were encountered in TP-4 near about 8 feet bgs. The frozen soil contained layers of visible ice and massive ice but generally did not appear to contain excess ice.

Road gravel fill thickness varies by location. Near the drainage crossing, gravel fill was about 2 to 3 feet thick in the test pits. A small test pit near TP-3 west of the drainage crossing indicated road fill thickness of 1.5 feet.

CONCLUSIONS

The drainage crossing on Nulato River Road is in a low-lying area which is affected by significant annual aufeis formation. An existing 36-inch culvert channels water from the drainage under the road from north to south. This culvert can accommodate typical water run-off; however, during the springtime, the culvert is fully blocked by aufeis and run-off during breakup washes out the road near the culvert. Icing height has been reported to about 2 feet above the road surface. Icing will likely be the driving factor for the drainage crossing design.

The subsurface conditions near the drainage crossing consist of wet, soft to firm, unfrozen silt with varying organics to the depths explored (15 feet bgs). Frozen conditions were encountered in one test pit about 330 feet east of the drainage crossing in a slightly elevated area. Permafrost conditions and depth along the road likely vary locally, due to wildfire disturbance, remaining vegetative cover, and resulting snow cover.

Subsurface conditions in this area are questionable for the long-term stability of traditional bridge, box culvert, or arch-culvert foundations. A drainage structure that provides sufficient opening for icing while spreading the load on the underlying soils will likely be a preferred design alternative for this location. The road surface in the low-lying, aufeis-prone area near the drainage crossing is near grade. Elevating the road through this area should reduce icing impacts on the road.

Beaver activity or other disturbance to the current drainage channel could affect the location where the drainage crosses the road in the future. RECON recommends intermittent monitoring of the drainage channel and mitigating potential channel changes that could affect the drainage crossing location.

We appreciate the opportunity to provide geotechnical engineering services to the Nulato Tribe. Please contact me with any questions.

Sincerely,

Peppi (Patrizia) Bolz, PE
RECON LLC

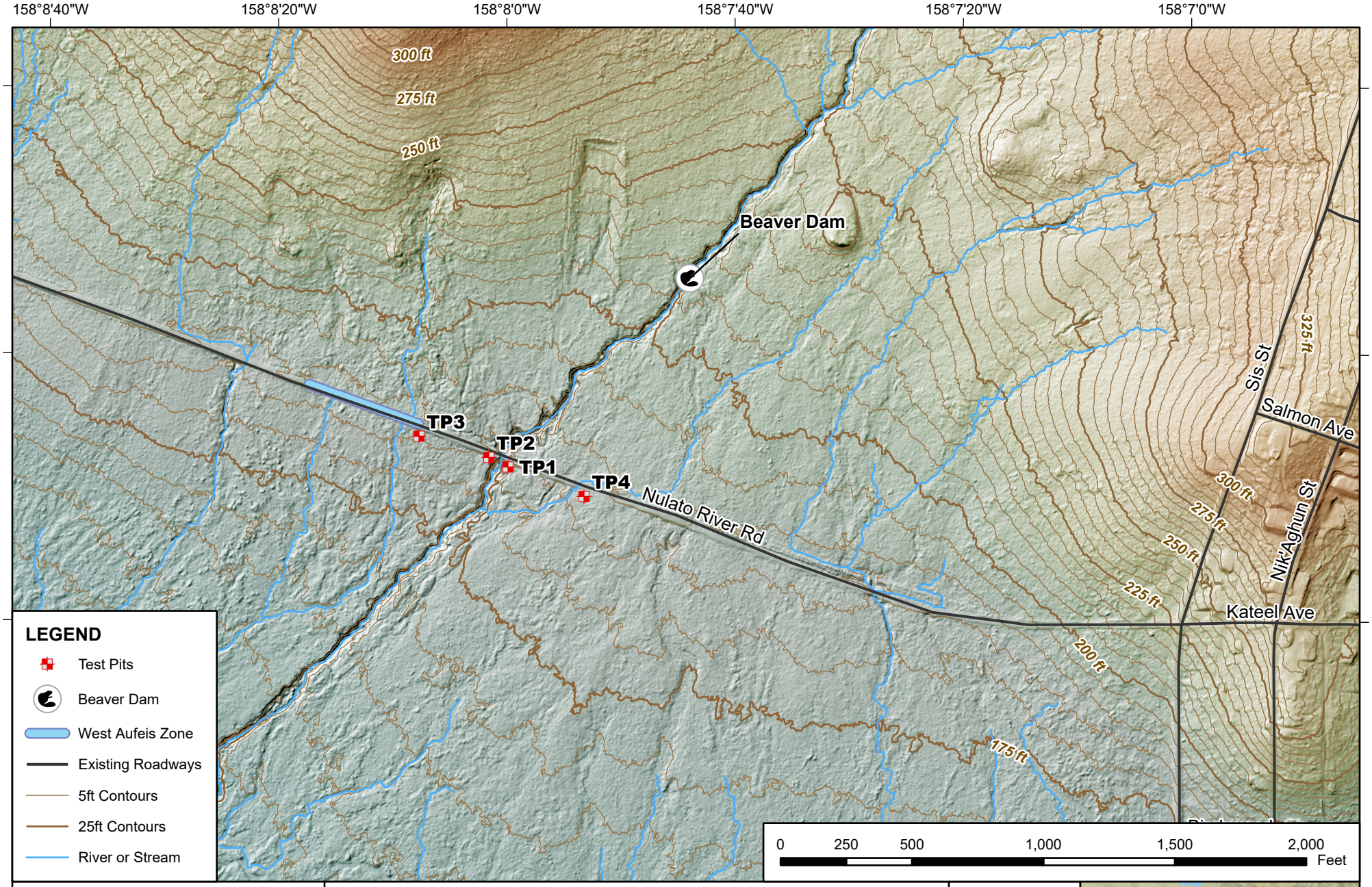
Attachments:
A – Site Map
B – Test Pit Logs (4)

References

Patton, W.W., Jr., and Moll-Stalcup, E.J., 2000, Geologic map of the Nulato Quadrangle, west-central Alaska: U.S. Geological Survey Geologic Investigations Series Map 2677, 41 p., 1 sheet.

Attachment A

Site Map


158°8'40"W
158°8'20"W
158°8'0"W
158°7'40"W
158°7'20"W
158°7'0"W
64°44'20"N
64°44'10"N
64°44'0"N
300 ft
275 ft
250 ft
225 ft
200 ft
175 ft
325 ft
Beaver Dam
TP1
TP2
TP3
TP4
Nulato River Rd
Sis St
Salmon Ave
Nik'Aghun St
Kateel Ave
LEGEND
Test Pits
Beaver Dam
West Aufeis Zone
Existing Roadways
5ft Contours
25ft Contours
River or Stream
0
250
500
1,000
1,500
2,000
Feet
Nulato Tribe
RECON
Map and Engineering by RECON LLC
565 W Recon Cir, Palmer, AK 99645
NAD 1983 Alaska State Plane Z6 (usft)
Basemap by RECON
Nulato River Road
Completed Test Pits
N
1" = 500'
1:6,000
6/24/2025
Map Area
Nome
Koyuk
Nulato
Kaltag
Unalakleet
Stebbins
Sources: Esri, USGS
1:10,000,000
Project: Nulato_Report_Map
Layout: MapLayout_8.5x11L_BlkB

Attachment B

Test Pit Logs (4)

TEST PIT: TP-1

Project: Nulato River Road
Method: Track-Mounted Excavator
Rig Type: Hitachi UHO82LC

Client: Nulato Tribe

Logged By: P. Bolz
Date Started: 06/03/2025
Date Completed: 06/03/2025

Lat / long: 64.73493, -158.13328
Datum: WGS84
Surface Elevation: 187'
Depth: 15.00'

Comments -

Depth (ft)	Frozen=	Graphic Log	Material Description
0			Brown, *Poorly Graded Gravel with Sand* (GP); moist; rounded to subangular cobbles, gravel, and sand; trace fines. [FILL]
3.0			Brown to gray, *Silt* (ML); wet; soft to firm; laminated to mottled; intermittent layers of black organics (roots and sticks).
15.0			Bottom of Test Pit near 15 feet below ground surface.

Photograph of completed TP-1.

TEST PIT: TP-2

Project: Nulato River Road
Method: Track-Mounted Excavator
Rig Type: Hitachi UHO82LC

Client: Nulato Tribe

Logged By: P. Bolz
Date Started: 06/03/2025
Date Completed: 06/03/2025

Lat / long: 64.73503, -158.1337
Datum: WGS84
Surface Elevation: 190'
Depth: 15.00'

Comments -

Depth (ft)	Frozen=	Graphic Log	Material Description
0			Brown to gray, *Poorly Graded Gravel with Sand* (GP); moist to wet; rounded to subangular cobbles, gravel, and sand; trace fines. [FILL]
2.0			Brown to gray, *Silt* (ML); wet; soft to firm; laminated to mottled; intermittent layers of black organics (roots and sticks).
15.0			Bottom of Test Pit near 15 feet below ground surface.

Photograph of completed TP-2.

TEST PIT: TP-3

Project: Nulato River Road
Method: Track-Mounted Excavator
Rig Type: Hitachi UHO82LC

Client: Nulato Tribe

Logged By: P. Bolz
Date Started: 06/03/2025
Date Completed: 06/03/2025

Lat / long: 64.73525, -158.13545
Datum: WGS84
Surface Elevation: 190'
Depth: 15.00'

Comments -

Depth (ft)	Frozen=	Graphic Log	Material Description
0			Black, *Peat* (PT); moist. [TUNDRA MAT] — 0.5
			Brown to gray, *Silt* (ML); wet; soft to firm; laminated to mottled; intermittent layers of black organics (roots and sticks).
5			
10			
15			15.0

Bottom of Test Pit near 15 feet below ground surface.

Photograph of completed TP-3.

TEST PIT: TP-4

Project: Nulato River Road
Method: Track-Mounted Excavator
Rig Type: Hitachi UHO82LC

Client: Nulato Tribe

Logged By: P. Bolz
Date Started: 06/03/2025
Date Completed: 06/03/2025

Lat / long: 64.73463, -158.13143
Datum: WGS84
Surface Elevation: 194'
Depth: 11.00'

Comments -

Depth (ft)	Frozen=	Graphic Log	Material Description	
			Black, *Peat* (PT); moist. [TUNDRA MAT]	0.5
5			Brown to gray, *Silt* (ML); wet; soft to firm; laminated to mottled; intermittent layers of black to brown organics (roots, sticks, and small tree trunks).	8.0
10			Brown to gray, *Silt* (ML); frozen (Nbn, Vs, Vx); laminated to mottled; intermittent layers of black organics (roots, sticks, and small tree trunks); some lenses of massive ice (up to 6 inches thick)..	11.0

Bottom of Test Pit near 11 feet below ground surface.

Photograph of completed TP-4