KNIFE RIVER ELBEE BEND BANK STABILIZATION
KNRI 257081

APPENDIX A

Geological Investigation Field Report for Knife River - Elbee Bend Bank Stabilization Project, Knife River Indian Villages National Historic Site, Stanton, ND, January 6, 2022, prepared by U.S. Army Corps of Engineers Omaha District

Knife River – Elbee Bend Bank Stabilization Project
GEOLOGICAL INVESTIGATION
Knife River Indian Villages, ND

FIELD REPORT

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06 Jan 2022

1. PROJECT SCOPE

A soil investigation was completed on the right bank (cutbank) and left bank (pointbar) of Elbee Bend - Knife River in support of a bank stabilization project near Stanton, ND.

Cutbank erosion rates of 1.0 to 3.5 feet per year (Sexton, 2012) within the past several decades threaten an archaeological site, a highway, and above-ground power lines within the Knife River Indian Villages Historical Sites (**Figure 1**). The National Park Service has requested that USACE design and construct a revetment to stabilize the cutbank of Elbee Bend. A subsurface geotechnical investigation was undertaken to collect relevant information on soil characteristics and potential borrow material from the left bank.

2. GEOTECHNICAL FIELD INVESTIGATION

Fieldwork for the soil investigation (**Figure 2**) was conducted from 01 December 2021 through 09 December 2021. Work consisted of pushing twelve (12) cone penetration tests (CPTs) and drilling six (6) auger borings.

CPT boring locations were selected by the Geotechnical Engineer to gain insight on specific areas within the project boundary and designated KN-FY21-CPT01 to KN-FY21-CPT12. Auger borings were then acquired that target specific intervals within certain CPTs and designated as KN-FY21-BHxx based on which CPT boring the auger twinned. CPT and auger boring locations are plotted on a map, **Figure 2**.

Fifteen (15) samples of disturbed soil were collected utilizing either a shelbe tube or a 2-foot split spoon sampler advanced within a hollow stem auger. Borings ranged from 4.5 to 78.6 feet below ground surface.

Table 1.

Boring Designation	Latitude[1]	Longitude[1]	Elevation (top of soil surface)[2]	Total Depth (feet below grade[3] surface)
KN-FY21-CPT01	47.3459	-101.3864	1668	30.4
KN-FY21-CPT02	47.3453	-101.3862	1674	36.9
KN-FY21-CPT03	47.3455	-101.3861	1674	30.8
KN-FY21-CPT04	47.3450	-101.3856	1663	31.1
KN-FY21-CPT05	47.3461	-101.3858	1664	30.6
KN-FY21-CPT06	47.3459	-101.3856	1677	40.1
KN-FY21-CPT07	47.3453	-101.3856	1678	30.2
KN-FY21-CPT08	47.3442	-101.3858	1684	78.6
KN-FY21-CPT09	47.3448	-101.3865	1693	40.1

KN-FY21-CPT10	47.3455	-101.3871	1688	50.0
KN-FY21-CPT11	47.3465	-101.3868	1688	40.1
KN-FY21-CPT12	47.3470	-101.3863	1684	40.2
KN-FY21-BH04	47.3450	-101.3856	1663	7.5
KN-FY21-BH05	47.3461	-101.3858	1664	5.5
KN-FY21-BH03	47.3455	-101.3861	1674	7.5
KN-FY21-BH01	47.3459	-101.3864	1668	4.5
KN-FY21-BH11	47.3465	-101.3868	1688	46.5
KN-FY21-BH10	47.3455	-101.3871	1688	39.5

[1]Latitude and longitude are as-drilled locations from a hand-held Garmin 62s GPS, accuracy +/-9 feet.
[2]Elevations extracted from USACE topography survey
[3]distance is measured from below grade. For surface samples it is the depth from the surface.

2.1 Utility Clearances/Soil Boring Locations

All of the soil boring locations were staked on a USACE Site Visit at locations provided by the USACE Soils Engineer. The utility clearances were obtained through the 811 - North Dakota.

2.2 Geotechnical Borings

Eighteen (18) geotechnical soil borings were pushed/drilled to obtain lithologic and groundwater information. Disturbed and undisturbed samples were described in the field, collected in sampling jars or buckets, or Shelby tubes and sent to a laboratory for potential analysis.

Borings were advanced to a depth of 4.5 to 78.6 feet below grade surface.

The location of the borings are presented in **Table 1**.

2.1.1 Drilling Methodology

Drilling was performed with a Geoprobe Model 3230DT track rig equipped with dual CPTu and HSA capability. The CPTu tool consists of a conical point having a 60° apex angle and 10 cm^2 base area. The CPT consisted of a 10-ton cone with a filter in the U2 location. The geoprobe drilling instructions specified that the 10-ton cone should be advanced to a depth of 3 feet below ground surface (bgs) to start the measurement.. CPT data was collected as the penetrometer tip was advanced through the soil at a constant rate of 20 mm/s. The force on the conical point (cone) required to penetrate the soil was measured by electrical methods at a minimum of 50 mm of penetration. Stress was calculated by dividing the measured force (total cone force) by the cone base area to obtain cone resistance (qc). Pore-water pressure induced during the advancement of the penetrometer tip using an electronic pressure transducer was measured by a piezocone that is advanced at a rate of 20 mm/s and readings taken at a minimum of every 50 mm of penetration. The CPT was conducted in accordance with ASTM 5778 -07, "Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils." CPT logs are included in **Attachment B**

The CPT data was reviewed by the getotechnical engineer who communicated which borings and intervals were twinned with HSA. The HSA tool consists of 4.25-inch-inside-diameter (ID) hollow-stem augers. A two-foot long split spoon was advanced to collect samples at designated depths. The borings had a diameter of approximately 8.5 inches. No drilling fluids, water, or other additives were used.

Standard penetration tests were performed in accordance with ASTM D 1586, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils." Representative samples of the subsurface material were taken from the selected split-spoon (2-in outer diameter/1.375 in inner diameter with plastic sample retainer without liners) intervals, placed in a pint jar, and sealed with at least three wraps of electrical tape. During SPT drives, average rod stickup, above ground to the hammer, is 7 feet. Year 2021 calibration for the automatic hammer mounted on the Geoprobe Model 3230DT track rig used to complete the borings averaged 91.3% @ 55 blows per minute energy transfer ratio.

2.1.2 Soil Sampling Methodology

Representative disturbed samples were collected from each boring. Samples were collected at all changes in material. Representative samples of the subsurface material were logged and then taken from the split spoon sampler. Samples were placed in a pint jar and sealed with three wraps of electrical tape. Shelby tube samples were collected. Sample information is recorded on the drilling logs included in **Attachment B.**

2.1.3 Lab Testing

Samples were visually identified and classified in the field. For each change in lithography, a representative sample was jarred, labeled, and sealed. Collected samples were sent to Terracon in Omaha, NE for testing. Lab testing results are included in the appendices if available.

2.1.5 Boring Abandonment

At the completion of drilling, the borings were abandoned by backfilling with drill cuttings and bentonite chips as needed.

2.1.6 CPT Data Analysis

The CPT data was processed using CPT-Pro software (Geosoft). Input parameters included: 1) surface density of 17 kN/m^3; 109 lb/ft^3, 0.25 foot (ft) minimum layer thickness, and soil classification of Robertson, 1990.

Of the available soil classifications, the Robertson, 1990 soil classification provided the best fit as correlated with the data collected with the HSA method. A comparison is provided in **Table 2**.

Table 2

BH / CPT	Auger BH Depth Interval (ft bgs)	Auger BH Soil Class. (USCS)	CPT Soil Class. (Robertson, 90)	CPT Soil Class. Lithology (Robertson, 90)	CPT Depth Interval (ft bgs)	CPT Soil Class/Lith. (Robertson, 90)
01	3 to 4.5	SP	6	Clean sands to silty sands		
03*	6 to 6.5	CL	6	Clean sands to silty sands		
03	6.5 to 7.5	SP	6	Clean sands to silty sands		
04	6.0 to 6.6	SM	6	Clean sands to silty sands		
04	6.6 to 7.5	CL-ML	4	Clayey silt to silty clay		
05**	4.0 to 4.6	SP	6	Clean sands to silty sands	5.8 to 6.2	5/ Silty sand to and silt
05**	4.6 to 5.0	CL	6	Clean sands to silty sands	6.2 to 7.0	4/ Clayey silt ot silty clay
10	8.0 to 10.0	CL	3	Clays, clay to silty clay		
10	19.0 to 21.0	CL	3/2	Clays, clay to silty clay/ Organic soils-peats		
10	34.0 to 36.0	CL-ML	3	Clays, clay to silty clay		
10	39.0 to 39.5	CH	3	Clay, clay to silty clay		
11	7.0 to 9.0	CL	3	Clay, clay to silty clay		
11	14.0 to 16.0	CL	3	Clay, clay to silty clay		
11	18.0 to 19.0	SP	6	Clean sands to silty sands		
11***	45.0 to 46.5	CH				

* The CPT didn't seem to pickup the clay seam (but neither did the other soil classification options).
**If the auger samples are shifted 1.5' deeper, the lithologies are a closer match
*** CPT bottom at 40.1 ft

3. SITE GEOLOGY

3.1 General geology

The Knife River is a tributary of the Missouri River with the Elbee Bend site on the Knife River located approximately 2 miles from the junction of the two rivers. In 1983, Reiten published a Quaternary geology report which included subsurface materials (lithologic) information from 35 drill holes and 8 cores with aerial imaging and radiocarbon dating. The report established the basic geologic framework including terrace interpretation and designation which has been digitized and explained in Graham (2015). Recent (past few decades) increases in erosion rates of Archeology sites, situated on river bluffs, are linked to Knife River erosion and channel migration patterns (Sturdevant, 2009; Sexton, 2011). Many of the sites include charcoal and organic material radiocarbon dated to a few thousand years old (Reiten, 1983). The recent changes in channel migration rates and patterns are postulated to be related to river base-level modifications caused by dam/reservoir development on the Missouri River and associated fluvial-backwater development (Ellis, 2006; USACE 2018).

The geologic history of this area includes repeated advances and retreats of the Pleistocene North American Ice Sheet and Missouri River valley development. Prior to Pleistocene North American continental-scale glacial advances, the Missouri River course transported water/sediment to the northeast and Hudson Bay. The North American glacial advances (ice sheet centered over eastern Canada) changed continental-scale river drainage basins and guided the Missouri River course to the south and Gulf of Mexico. The Missouri River currently skirts the edge of the landscape molded by the the glacial advance and retreats. The Knife River, as a tributary to the Missouri River, currently joins the Missouri River on the eastern side of the Missouri River valley which means that the Knife River flows through and over underlying Missouri River alluvium. It likely occupies the abandoned channel of a recent Missori River course.

Geologic maps (Graham, 2015 – Hybels Map) show several units at the surface that are designated as Oahe and Coleharbor Formations. The Oahe Formation includes Holocene-age fluvial (river)- Qo7 <shown on the map>, eolian (wind) – Qo6 <not shown on the map>, and loess (wind) – Q05 <not differentiated on the map, but commonly forms a mantle on glacial sediment> deposits. The Coleharbor Formation includes Pleistocene to Holocene-age glacial deposits that include till (moraine) – Qc2, outwash-Oc3 <not differentiated on the map>, and lacustrine - Qc4 sediment. These units and interpretations are illustrated on lidar DEM data (**Figure 2**).

The Knife River Valley and Missouri River Valley are significant features in the area of interest. The sediment/soils that fill the Knife and Missouri valleys are composed of gravel, sand, silt and clay in channel belts, channel-fills, and overbank floodplains and are undifferentiated as Unit Qo7 on the most current geological map (Graham, 2015). The river valleys have cut-into and eroded the pre-existing glacial sediment which is now located on the flanks of the valleys. The glacial sediment is interpreted to have originated as till (basal glacial sediment that is typified as unsorted material with gravel, sand, silt, and clay mixtures), glacio-lacustrine (short-lived lakes at the margins of glacial ablation/melt zones that fill with fine-grained material), glacial-outwash (alluvial deposits), and eolian/loess (wind-deposits of silt and fine sand downwind of glacial sediment sources). Note: Missouri River Alluvium refers to very recent channel-belts/sediment deposited by migration of the Missouri River whereas MoRiv Chan Belt refers to an older Missouri River channel-belt which the Knife River has eroded into. The sediment/soils of these units would be very similar. Also, the Knife River Chan Belt Terrace marks a Knife River channel belt that is higher in elevation (approximately 10 feet) but sedimentologically very similar to the

modern Knife River deposits. It preserves a time when the Knife River base level was at a different level either because the Knife River base level was at a higher elevation or the entire area was at a lower elevation due to glacial-loading, i.e., subsequent crustal rebound due to glacial isostatic rebound after ice sheet retreat.

3.2 Site Geology

The area of interest is the Elbee Bend, of the Knife River. Aerial image and lidar DEM data analysis shows the Knife River to be a single-thread, meandering channel. The river channel transports water and sediment to the junction with the Missouri River through Quaternary sediment including fluvial (river), glacial, and lacustrine/glacial-lacustrine sediment. Several of the Knife meander bends have increased channel migration (meander) rates in the past few decades with the Elbee bend being the focus of this study.

A previous quaternary geology study (cira 1983) sampled the subsurface material (Reiten, 1983). In the Elbee bend cutbank, the river is actively eroding fine-grained material including clay, silt, and fine sand (Drill core DH-07 and Core C-7, C-6; Reiten, 1983). DH-07 sampled sediment described as a pebble loam which is a mixture of gravel, sand, silt, and clay. The unsorted nature as well as the range of particle sizes suggests a glacial till or glacial lacustrine origin as possible.. The base of the Knife River bankfull erosion appears to occur at a depth of 37 feet below ground surface along the Elbee Bend cutbank (bgs; DH-07) at the interpreted interface between glacio-lacustrine and glacial moraine/till sediment. The surface sediment silt is interpreted to be loess (wind-blown silt common in formerly glaciated landscapes) with the underlying sediment interpreted to be glacial-lacustrine (interbedded silt, fine sand, and clay deposited as suspension sediment in a standing body of water) or terrace alluvial/fluvial deposits of the Knife River.

This study provides substantially more subsurface information. Key findings include: 1) subsurface material/lithologic lateral continuity (or lack of), 2) correlation of geologic units, 3) subsurface material engineering characteristics. The CPT borings CPT-01 to CPT-07 were acquired on the Knife River left bank which is the modern Knife River point bar/ depositional bend. The CPT borings CPT-08 to CPT-12 were acquired on the Knife River right bank which is the modern Knife River cutbank.

Two (2) cross-sections were constructed to display the CPT and drilling data (**Figure 3 and Figure 4**). Two (2) geological cross-sections were constructed to illustrate the west to east, cross-valley (**Figure 5**) and south to north, valley-edge (**Figure 6**) subsurface materials and correlations. The valley-edge cross-section was oriented with south to the left as envisioned as if standing across the Knife River on the point bar (south/ left bank) perspective. The cross-valley cross section (**Figure 5**) illustrates the juxtaposition and continuity of sediment/soil of the west/ right bank of the Knife River to the sediment/soil of the relatively coarse-grained/sandy deposits of the Knife River alluvium overlying the Missouri River (MoRiv) deposits. The MoRiv deposits can be further separated into a lower, coarser-grained alluvium and an upper, finer-grained/heterolithic alluvium. The upper MoRiv alluvium is interpreted to represent the abandoned channel of the Missour River which the Knife River is currently occupying and filling. CPT-02 was advanced to refusal at 36.9 feet bgs which is shown as a candidate for the boundary between the unconsolidated alluvium and the underlying bedrock. Outcrop observations indicate relative age of different units (**Figure 7**). If a unit of material can be observed to thin onto or lap onto another unit, it is technically on top of the other unit and therefore must be younger (law of superposition – the layer on the bottom is the oldest). The oldest unit, observable in the cutbank outcrop (sampled by CPT 09) which is onlapped by other units at the surface contains the archaeological artifacts and might be interpreted as glacial lacustrine with the laminated (thin interbeds) of clay, silt, and fine sand to a depth of approximately 30 feet. To the north, outcrop observations show two (2) successively onlapping younger units marked by yellow arrows on **Figure 7**. At the surface the older of the two onlapping units is

interpreted as Knife River terrace alluvium (samped by CPT-10 and CPT-11) and the younger of the two onlapping units (sampled by CPT-12) is interpreted as Missouri River alluvium (additional geomorphic evidence from surface aerial image and lidar DEM data). The Knife River terrace alluvium is interpreted to extend to a depth of just approximately 10 feet. At depths greater than about 10 feet, this unit interpreted to be a continuation of the glacial lacustrine meaning that the onlapping unit is not very deep. The youngest observed (in the cutbank outcrop – **Figure 7**) onlapping unit is interpreted to be Missouri River alluvium which is composed of approximately 20 foot-thick fining upward sequences with sand at the base and interbedded silt, clay, and fine sand at the top. To the south of the oldest unit (sampled by CPT-09), another onlapping unit (sampled by CPT-08) as observed in cutbank outcrop and aerial image/lidar DEM is interpreted to be Missiour River alluvium.

See **Attachment B** for drill and CPT logs.

3.3 Groundwater

Groundwater was encountered, and all of the samples were described as moist to wet. No collapse of boreholes was noted. Groundwater levels were calculated based on an equation: water table depth (d_{water}; NCHRP Synthesis 368: Cone Penetration Testing, 2007, p 25: Geostratigraphy Profiling). Groundwater levels shown in **Table 3**.

$\mathbf{d_{water} = d_{cone} - h_w}$ where

d_{cone} = depth of piezocone

h_w = water head (heigh of water above the cone)

$\mathbf{h_w = \mu_0/\sigma_w}$ where:

μ_0 = equilibrium pore pressure

σ_w = unit weight of water (64.2 lb/ft^3)

Table 3.

Boring	Final Dissipation (psf) <μ_0>	Depth of Test (ft)	Water Level above test (ft) <h_w>	Water Level bgs (ft)
KN-FY21-CPT01	1758	26.7	28.2	? (didn't dissipate)
KN-FY21-CPT02	2501	36.9	40.1	? (didn't dissipate)
KN-FY21-CPT03	1558	30.8	25.0	5.9
KN-FY21-CPT04	1712	31.1	27.4	3.7
KN-FY21-CPT05	1658	30.6	26.6	4.0
KN-FY21-CPT06	1677	40.1	26.9	13.3
KN-FY21-CPT07	1501	30.3	24.1	6.2
KN-FY21-CPT08	3516	78.6	56.3	22.2

KN-FY21-CPT09	4911	40.2	78.7	? didn't dissipate
KN-FY21-CPT10	1725	50.0	27.6	22.3
KN-FY21-CPT11	1606	40.2	25.7	14.5
KN-FY21-CPT12	1361	40.2	21.8	18.4

4. WORK PLAN DEVIATIONS/PROBLEMS ENCOUNTERED

The CPT borings were advanced as planned, but computer/software license complications precluded soil classification in the field. Basic tip resistance, sleeve friction, and pore pressure plots were digitally sent to the project geologist and engineer. All CPT borings (both right and left bank) were acquired. Cold (December) weather and snow delayed Auger boring sampling by two (2) days, but allowed the data to be processed and the project engineer to choose CPT borings and sample depths for twin auger borings.

Sampling: Jar samples were taken and noted on the drilling logs.

5. SEISMICITY

In reference to the American Society of Civil Engineers "Minimum Design Loads for Buildings and other Structures (ASCE 7-16)," the Department of Defense (DoD) "Unified Facilities Criteria (UFC) Seismic Design for Buildings (UFC 3-310-04) dated 1 May 2012, and the International Building Code (IBC) 2012, United States Air Force Academy has a 0.2-second spectral response acceleration (Ss) of 0.051 g and a 1.0-second spectral response acceleration (S1) of 0.022 g.

These accelerations are interpolated from 1:5,000,000 scale maps prepared by the U.S. Geological Survey (USGS), the Building Seismic Safety Council (BSSC), and the ASCE 7 Seismic Subcommittee for 0.2-second spectral response acceleration (5% critical damping), Site Class E, and 1.0-second spectral response acceleration (5% critical damping), Site Class E, respectively. These accelerations were confirmed by using the USGS Seismic Design Maps web-based tool available at https://hazards.atcouncil.org/ (ASCE7-16). The USGS web tool provides a link to the Applied Technology Council (ATC) website. A printout of the data is included as Attachment E.

ASCE 7 officially defines risk category as "A categorization of buildings and other structures for determination of flood, wind, snow, ice, and earthquake loads based on the risk associated with unacceptable performance". A risk category of II was used in this analysis and is defined as buildings and other structures except those listed in Risk Categories I, III, and IV (Table 1604.5: Risk Category of Buildings and Other Structures, ASCE7-16).

For all structures located within regions of the maps having Ss values greater than 0.051 g, or values of S1 greater than 0.022 g, the spectral response accelerations taken from these maps must be adjusted for site class effects using coefficients provided in the aforementioned guidance. Chapter 20 of ASCE 7-10, Site Classification, provides six site classes, Class A through Class F, which are defined on various geotechnical parameters (shear wave velocity, standard penetration resistance, or undrained shear strength). For this investigation, shear wave velocity and undrained shear strength were not determined. Therefore, the site classification is based on standard penetration resistance (i.e., SPT blow counts). For design purposes, the

reference site condition for this project is taken as site class D (Stiff Soil). This is based on the limited standard penetration resistance (ASTM D 1586) data (12 soil borings collected during this investigation).

Chapter 20 of ASCE 7-10 defines a site class E site as having an average standard penetration resistance ($\bar{N}$) of < 15 for the top 100 feet of the site profile. The ($\bar{N}$) value for the twelve (12) borings for the site is 8.5. The PGA was taken from calculations using the 2016 ASCE 7 with March 2013 errata. The adjusted maximum considered earthquake spectral response acceleration parameters (USGS values) using the site class E response coefficients (for $S_s \leq 0.051$ and $S_1 \leq 0.022$) are:

The short-period spectral acceleration ($S_{MS} = F_a S_S$) is (2.4 x 0.051) = 0.121

The 1-second period spectral acceleration ($S_{M1} = F_v S_1$) is (4.2 x 0.022) = 0.091

Table 3: Summary of Seismic Design Parameters

Site Location	N (blows/ft)	Site Class	PGA (g)	S_s (g)	S_1 (g)	F_a	F_v	S_{MS}	S_{M1}
Stanton, ND	8.5	E	0.023	0.051	0.022	2.4	4.2	0.121	0.091

Note: the ($\bar{N}$) value was obtained using an CPT-SPT correlation equation: $(q_t/p_a)/N_{60} = 8.5(1-I_c/4.6)$ (Robertson and Cabal, 2014). Where q_t = corrected cone resistance; p_a = atmospheric pressure; N_{60} = SPT N-value; I_c = Soil Behavior Type index.

References

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ATTACHMENT A: Figures

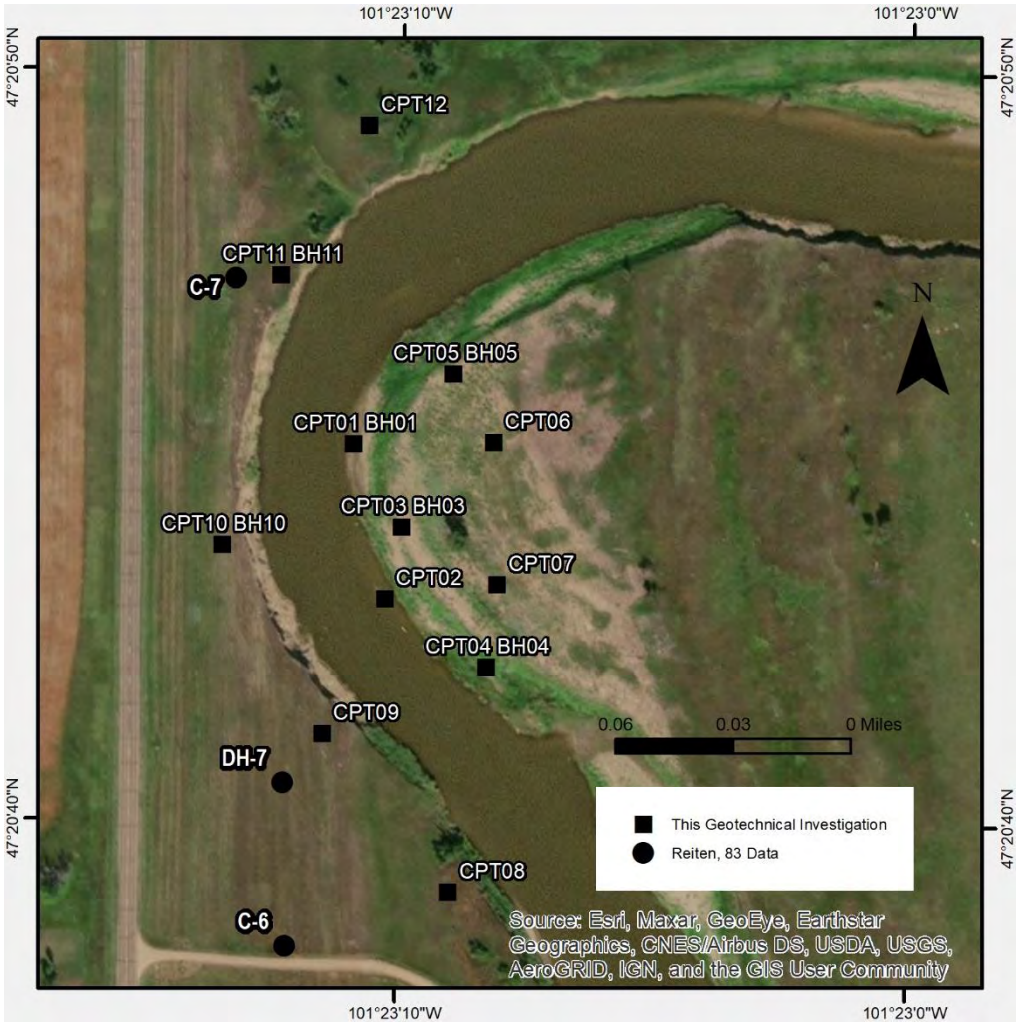


Figure 1. CPT and Borehole Location Map. Knife River flow is generally from north to south (top of image to bottom of image) and right bank (RB) is to the west whereas left bank (LB) is the the east.

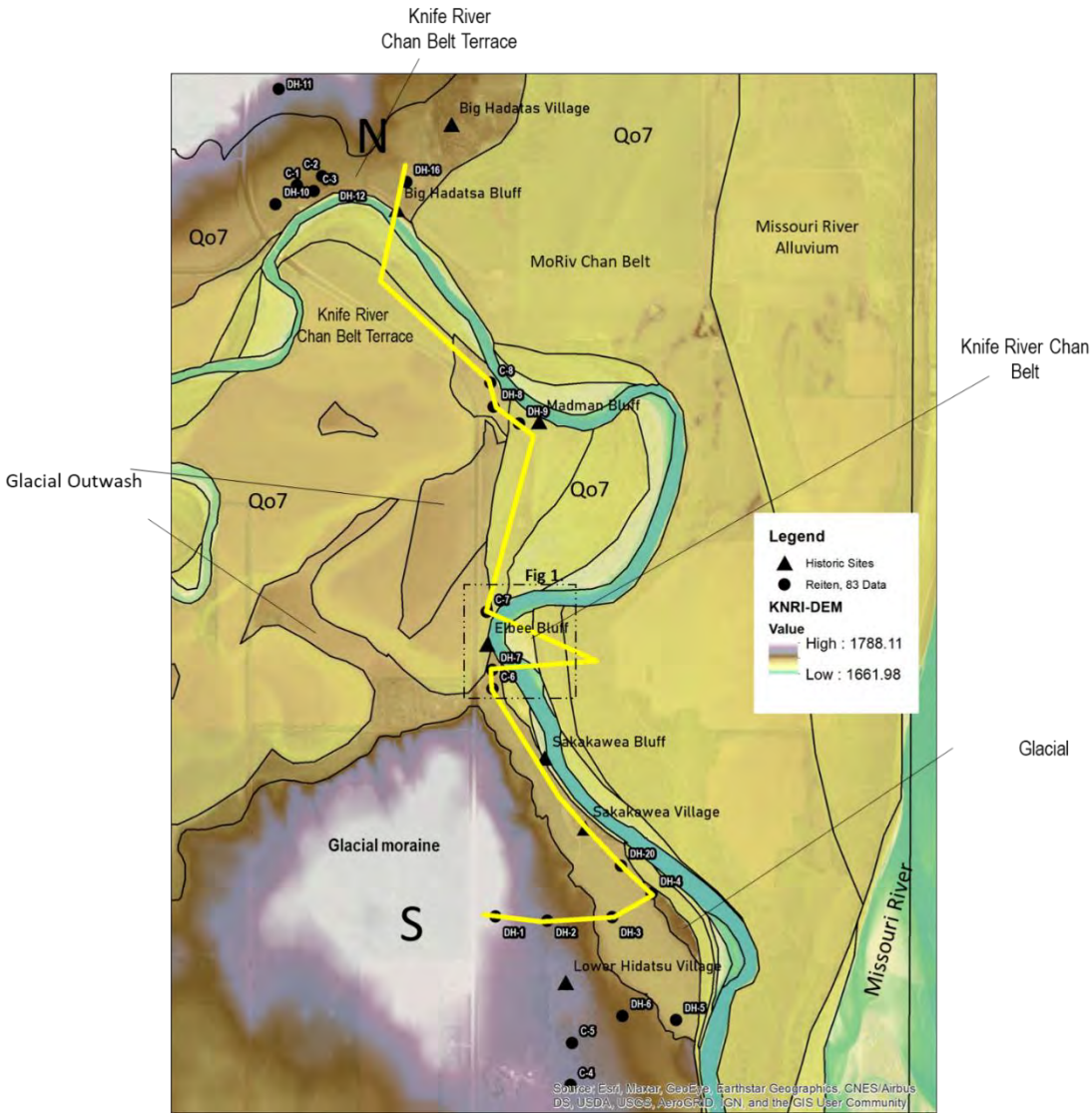


Figure 2. Lidar DEM data (from 2019 National Park Service/NPS survey) with geomorphic and lithologic units indicated. The Knife River Valley and Missouri River Valley are significant features in the area of interest. The sediment/soils that fill the Knife and Missouri valleys are composed of gravel, sand, silt and clay in channel belts, channel-fills, and overbank floodplains and are undifferentiated as Unit Qo7 on the most current Geological map (Graham, 2015). The river valleys have cut-into and eroded the pre-existing glacial sediment which is now located on the flanks of the valleys. The glacial sediment is interpreted to have originated as till (basal glacial sediment that is typified as unsorted material with gravel, sand, silt, and clay mixtures), glacio-lacustrine (short-lived lakes at the margins of glacial ablation/melt zones that fill with fine-grained material), and eolian/loess (wind-deposits of silt and fine sand downwind of glacial sediment sources). Note: Missouri River Alluvium refers to very recent channel-belts/sediment deposited by migration of the Missouri River whereas MoRiv Chan Belt refers to an older Missouri River channel-belt which the Knife River has eroded into. The sediment/soils of these units would be very similar. Also, the Knife River Chan Belt Terrace marks a Knife River channel belt that is higher in elevation (approximately 10 feet) but sedimentologically very similar to the modern Knife River deposits. It preserves a time when the Knife River base level was at a different level either because the Knife River base level was at a higher elevation or the entire area was at a lower elevation due to glacial-loading, i.e., subsequent crustal rebound due to glacial isostatic rebound after ice sheet retreat. Location of Figure 1 map shown with dashed box symbol.

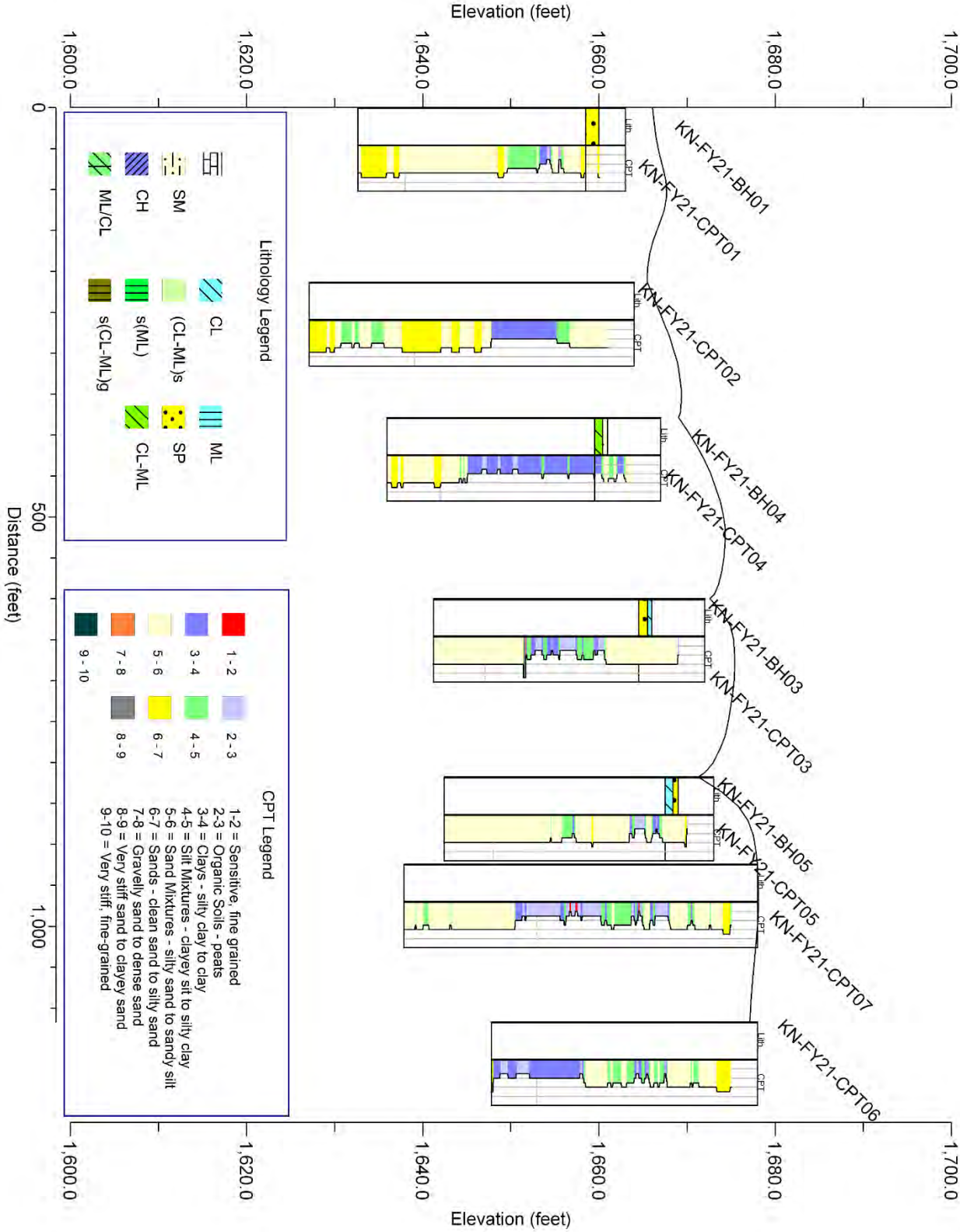


Figure 3. Knife River left bank CPT and BH cross section. Locations shown on Figure 1.

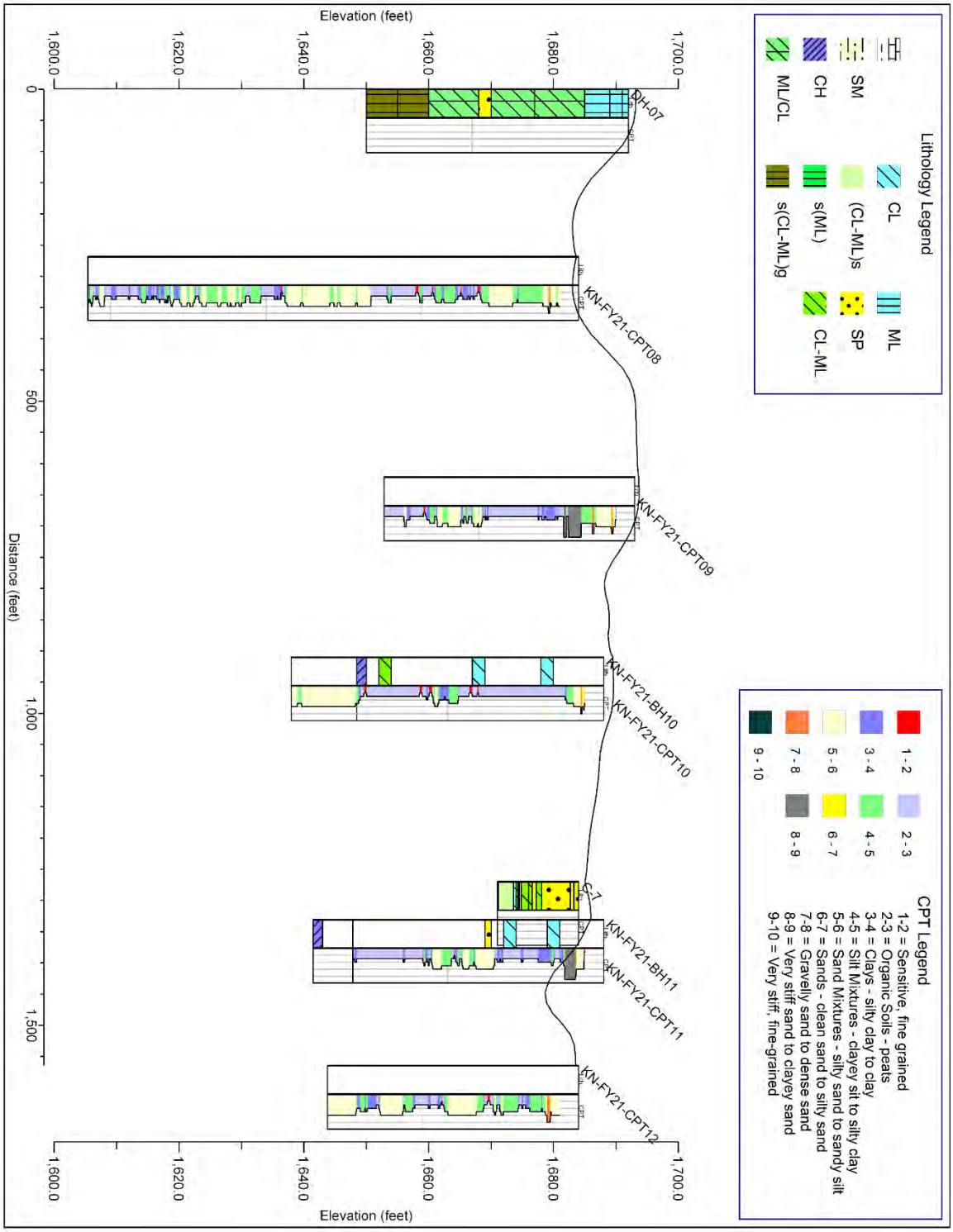


Figure 4. Knife River right bank CPT and BH cross section. Locations shown on Figure 1.

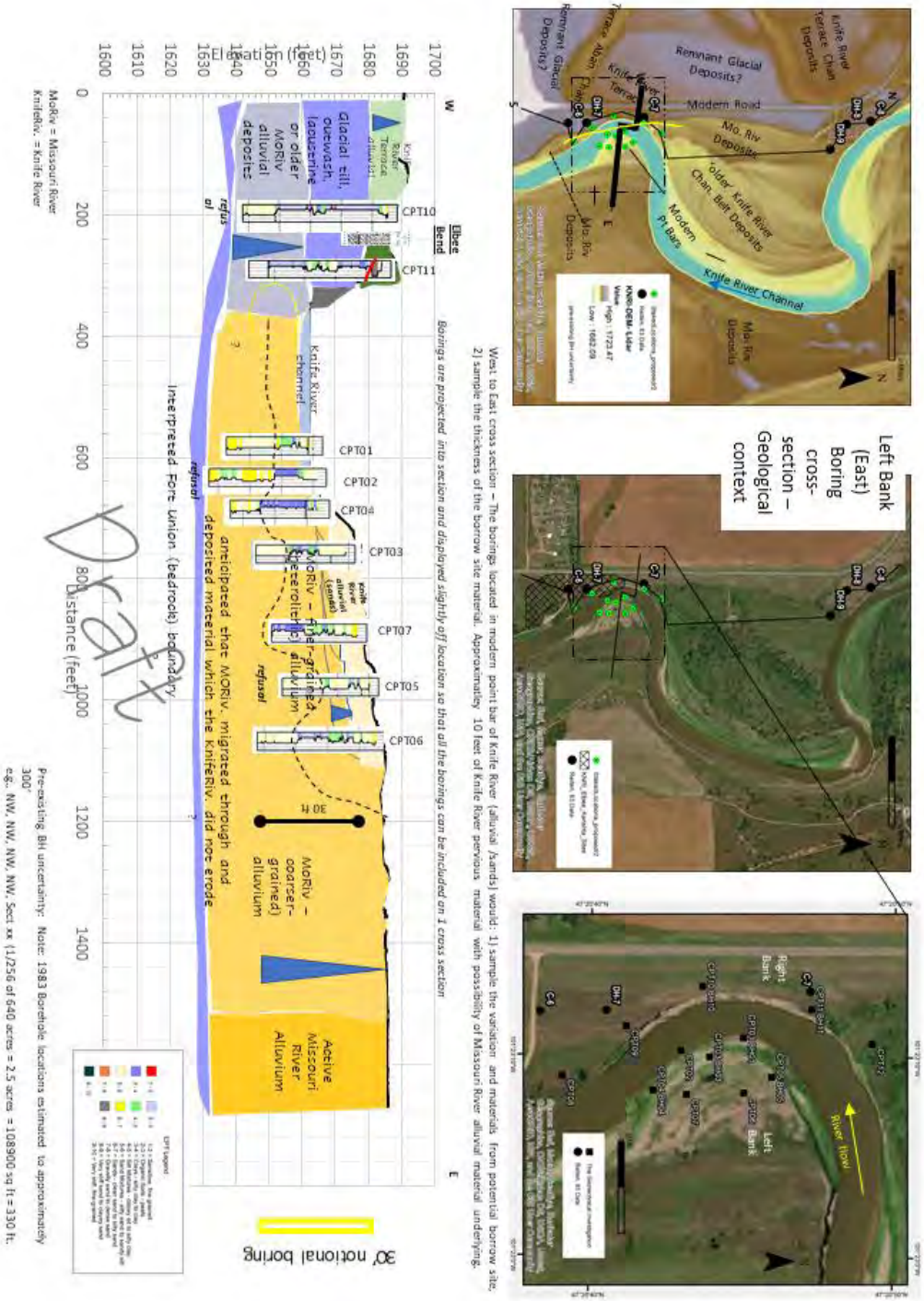


Figure 5. West to East Geological Cross Section with correlations and interpretation. The soil investigation goal was to collect representative material that the revetment will tie into and rest upon.The collected CPT data provides a range of potential soil material. In general, the material appears to be Missouri River-dominated alluvium.

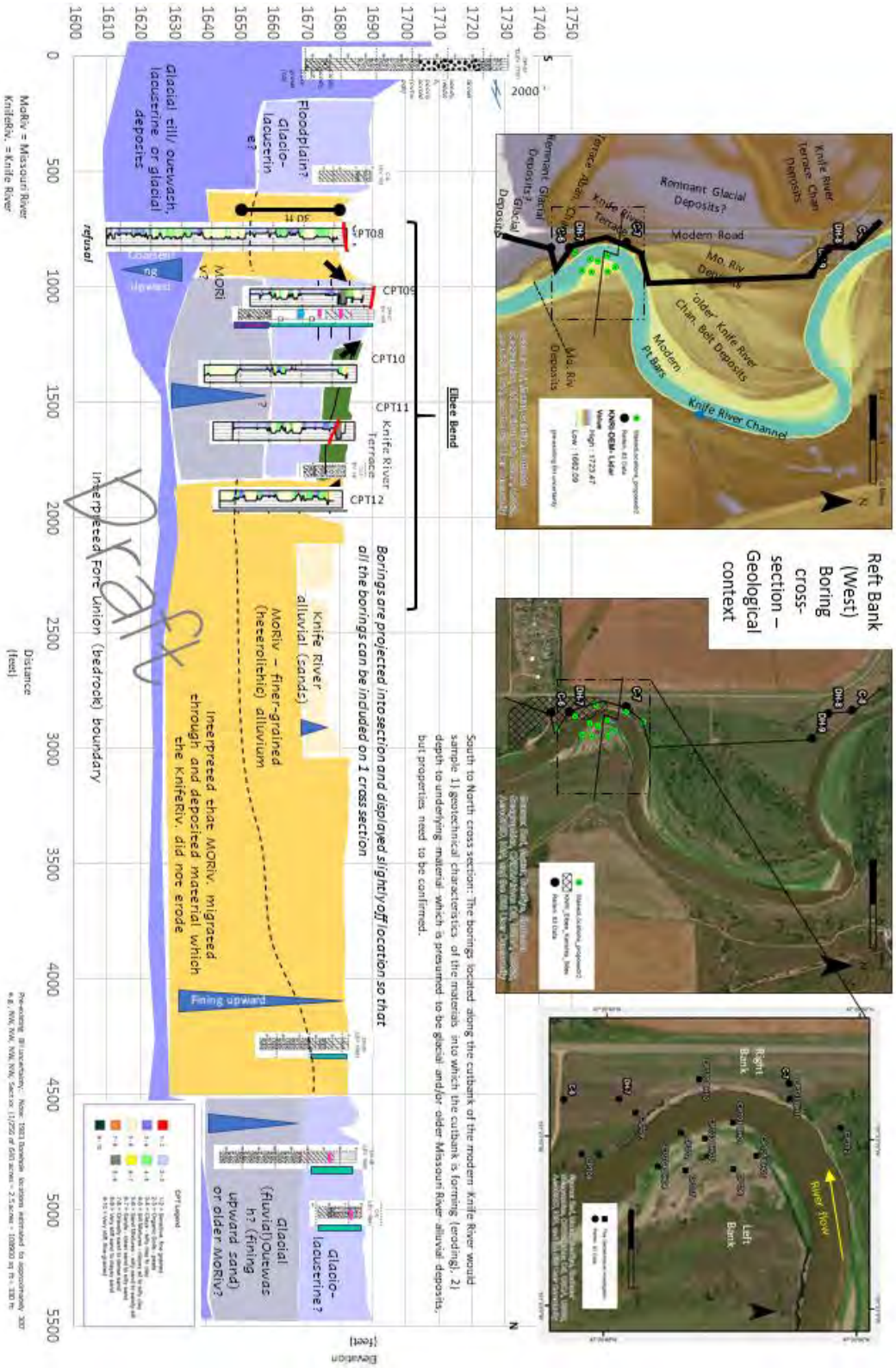


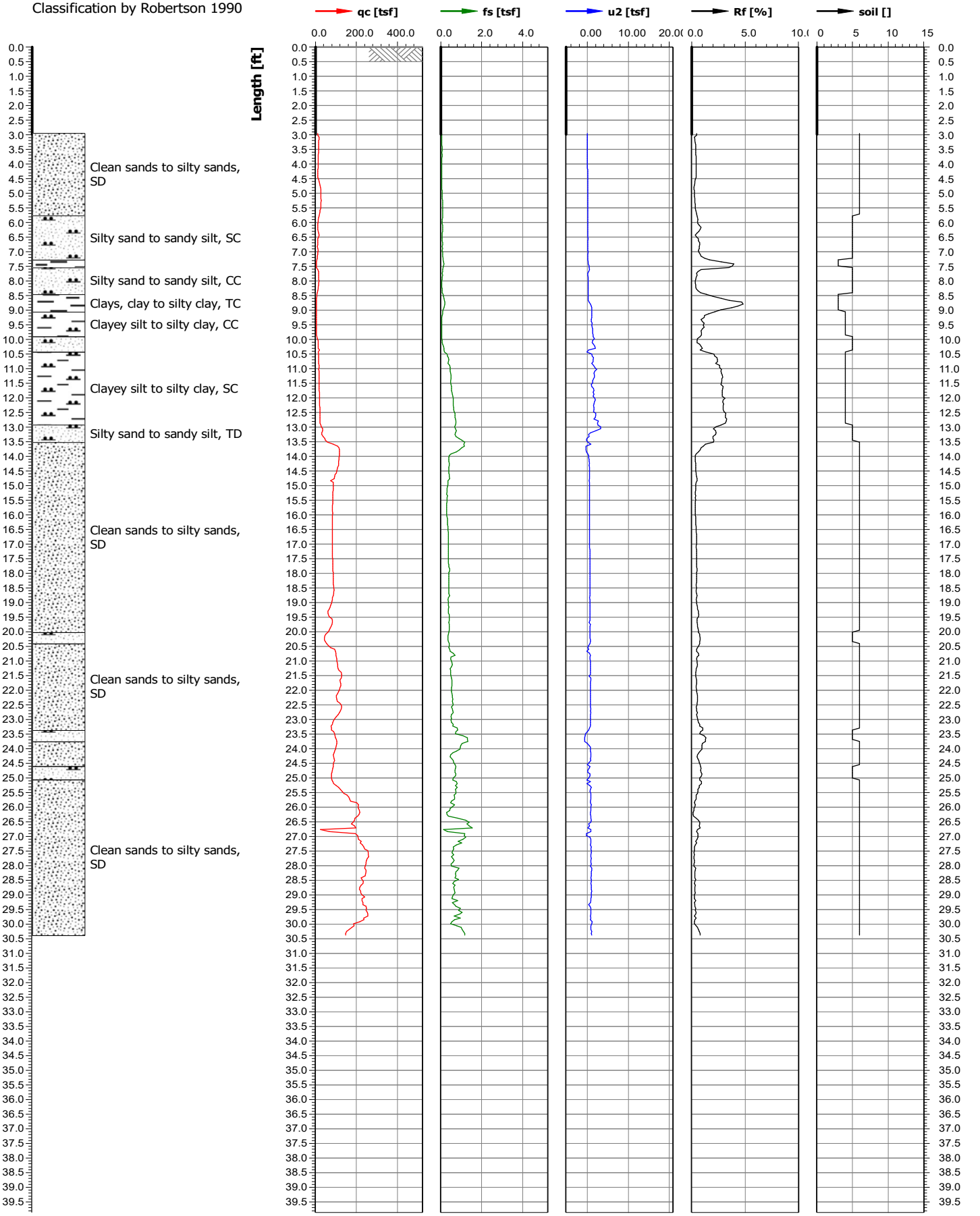
Figure 6. South to North Geological Cross Section with correlations and interpretation along Knife River Elbee Bend Cutbank and through Knife/Missouri Aluvium to bank of Madman Bluff. Cross section oriented as if the observer was standing on the left bank (east) point bar looking west.

Figure 7. Photomosaic image of Elbee Bend cutbank section with observable soil/sediment onlap relationships delineated. Yellow arrows indicate onlap of different units.

ATTACHMENT B: Drill Logs

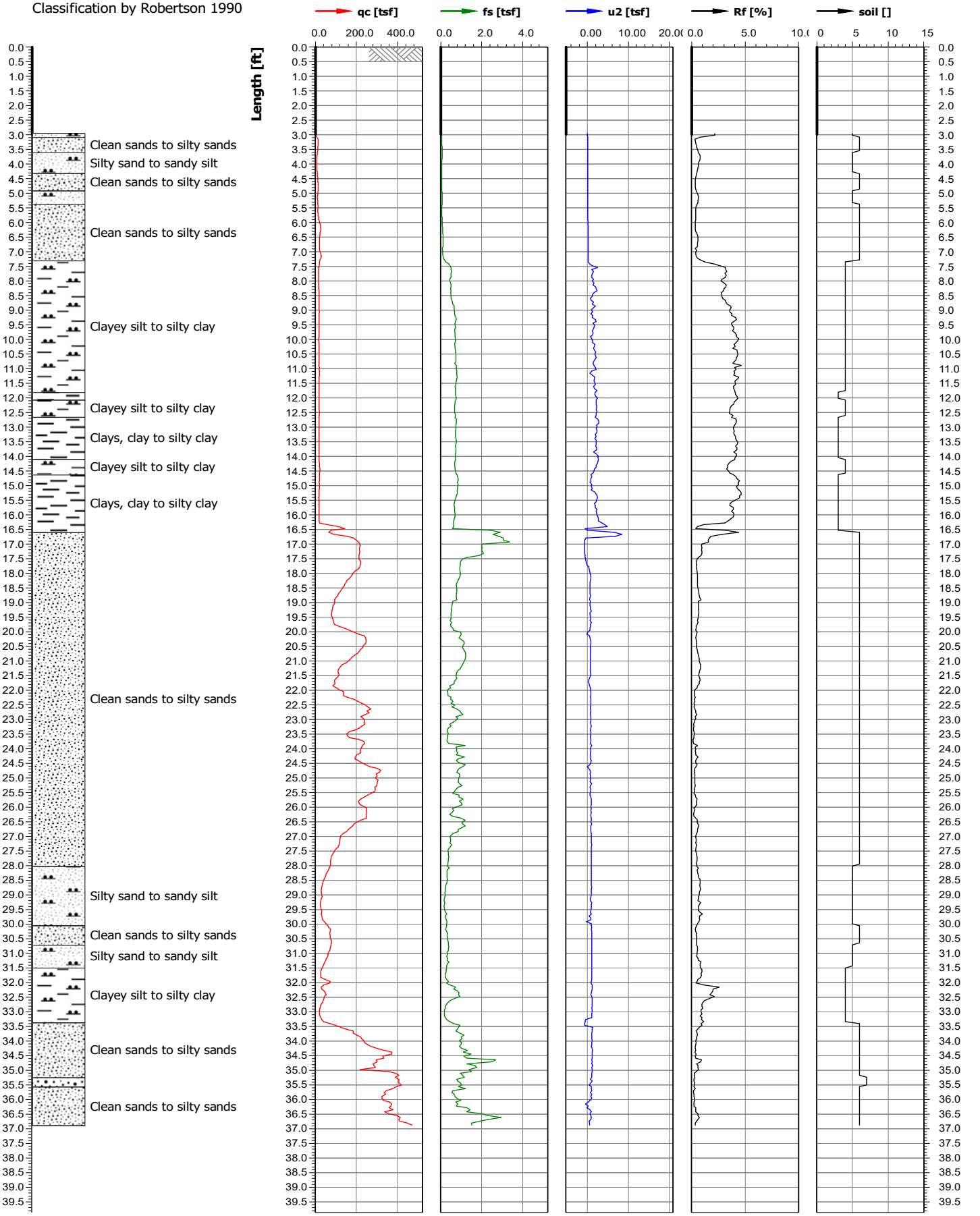
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT1	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/1	1:50	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT2	
Project ID	**Client**	**Investigation start ...**	**Standard/Standar...**	**Nominal surface area of...**
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		**Page**	**Scale**	**Net surface area quotie...**
Knife River Elbee Bend Bank Stabilization		1/1	1:50	0.820/0.000
Remarks1		**Coordinate system used**		**U**
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
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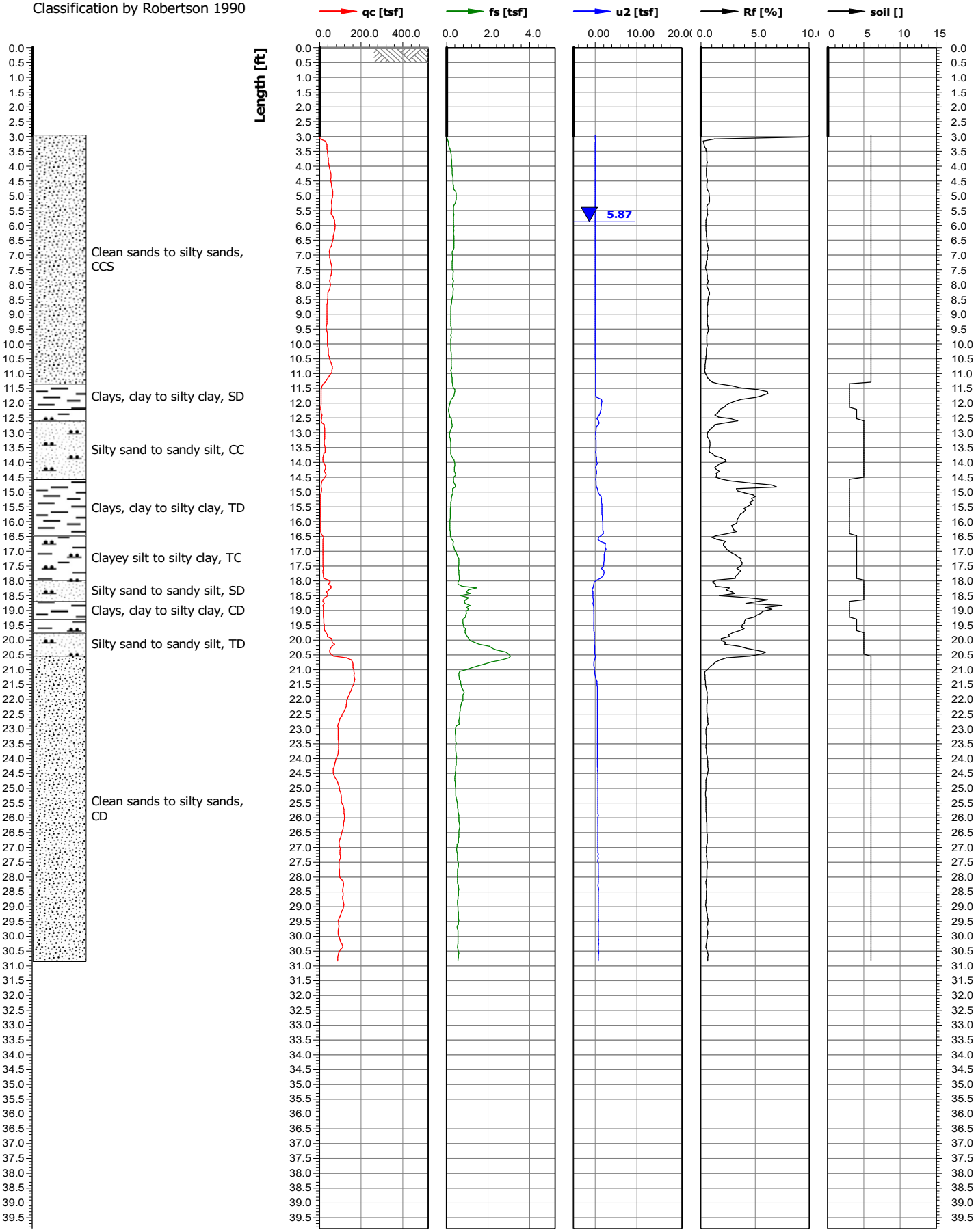
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/1	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
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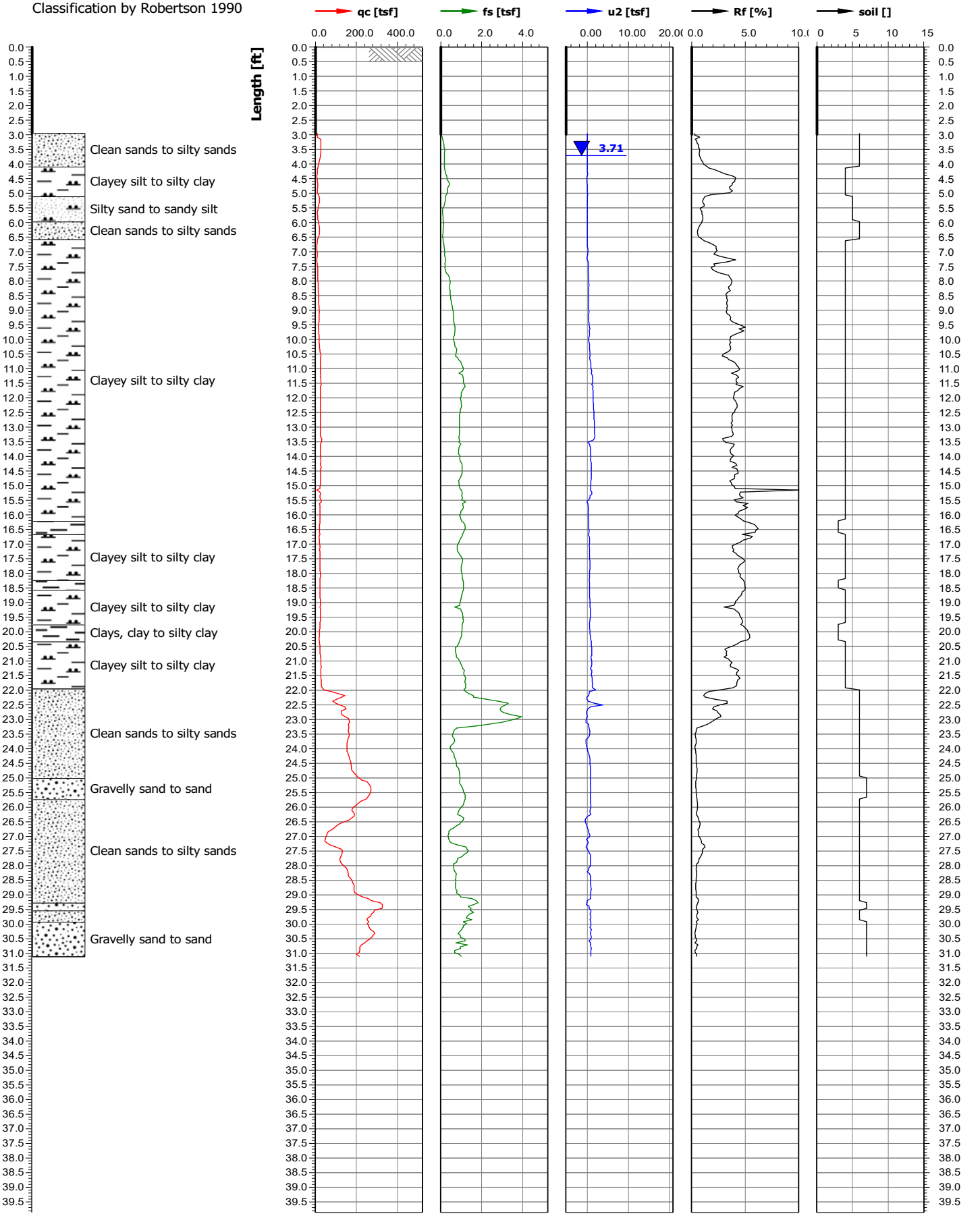
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/1	1:50	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
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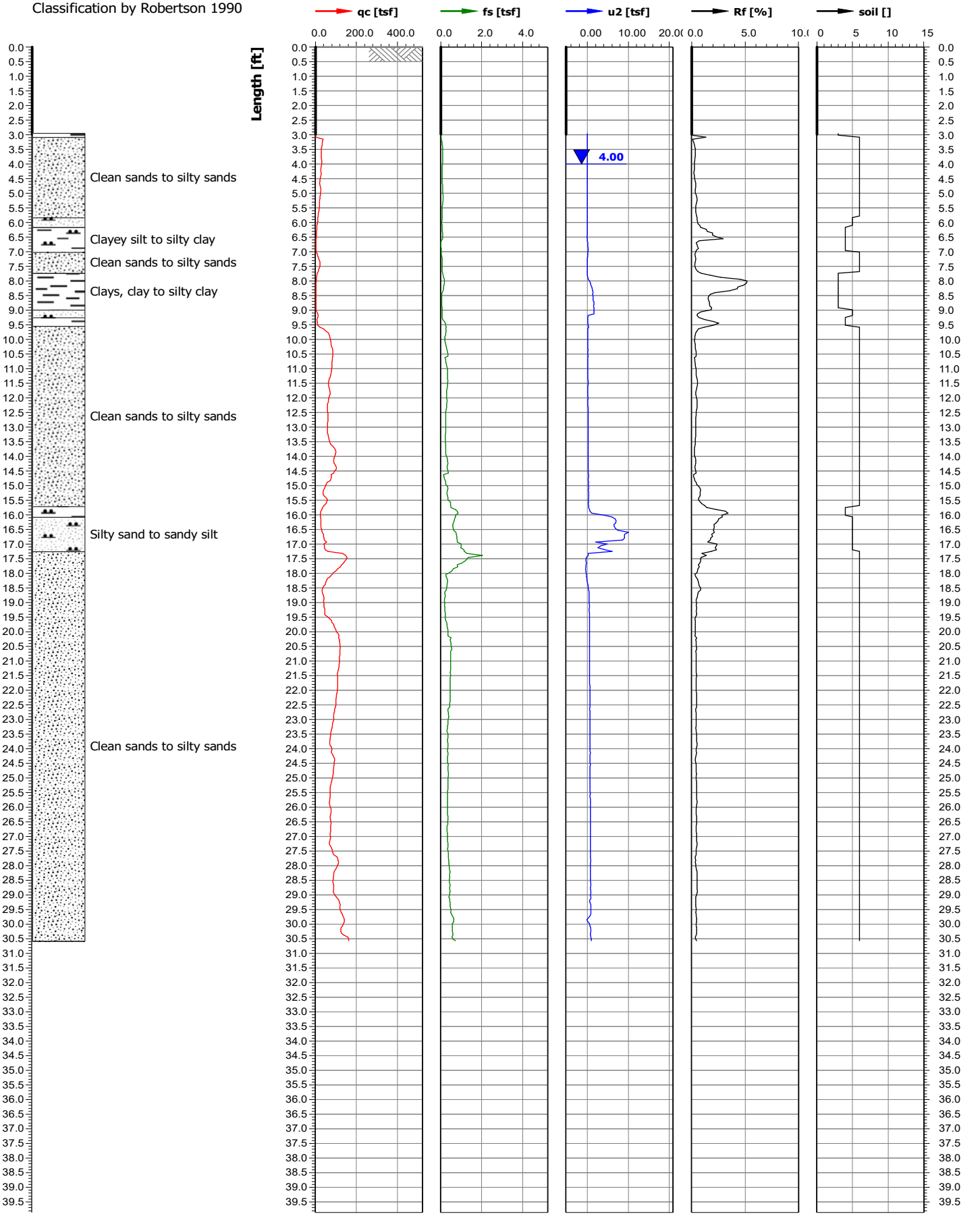
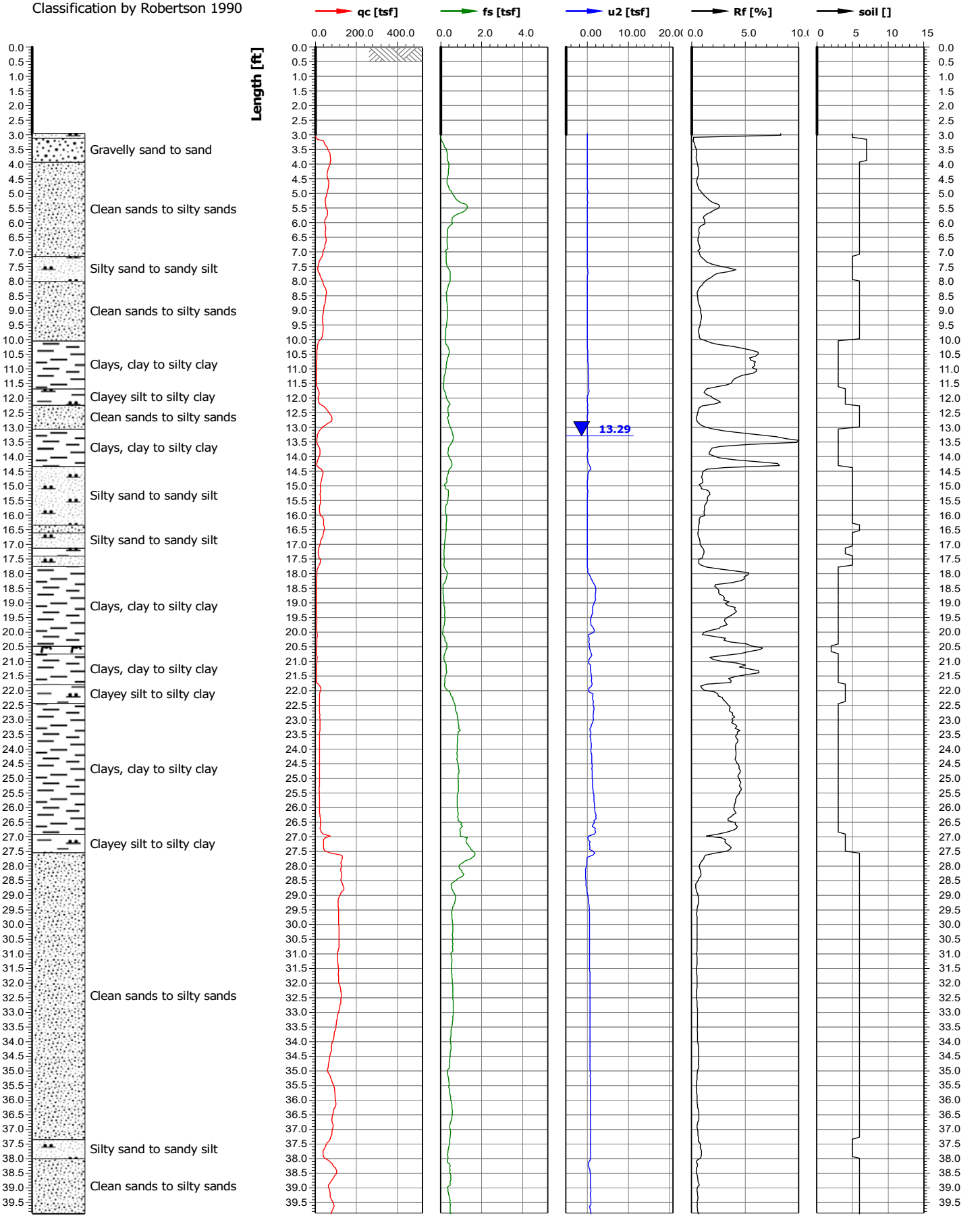
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/1	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



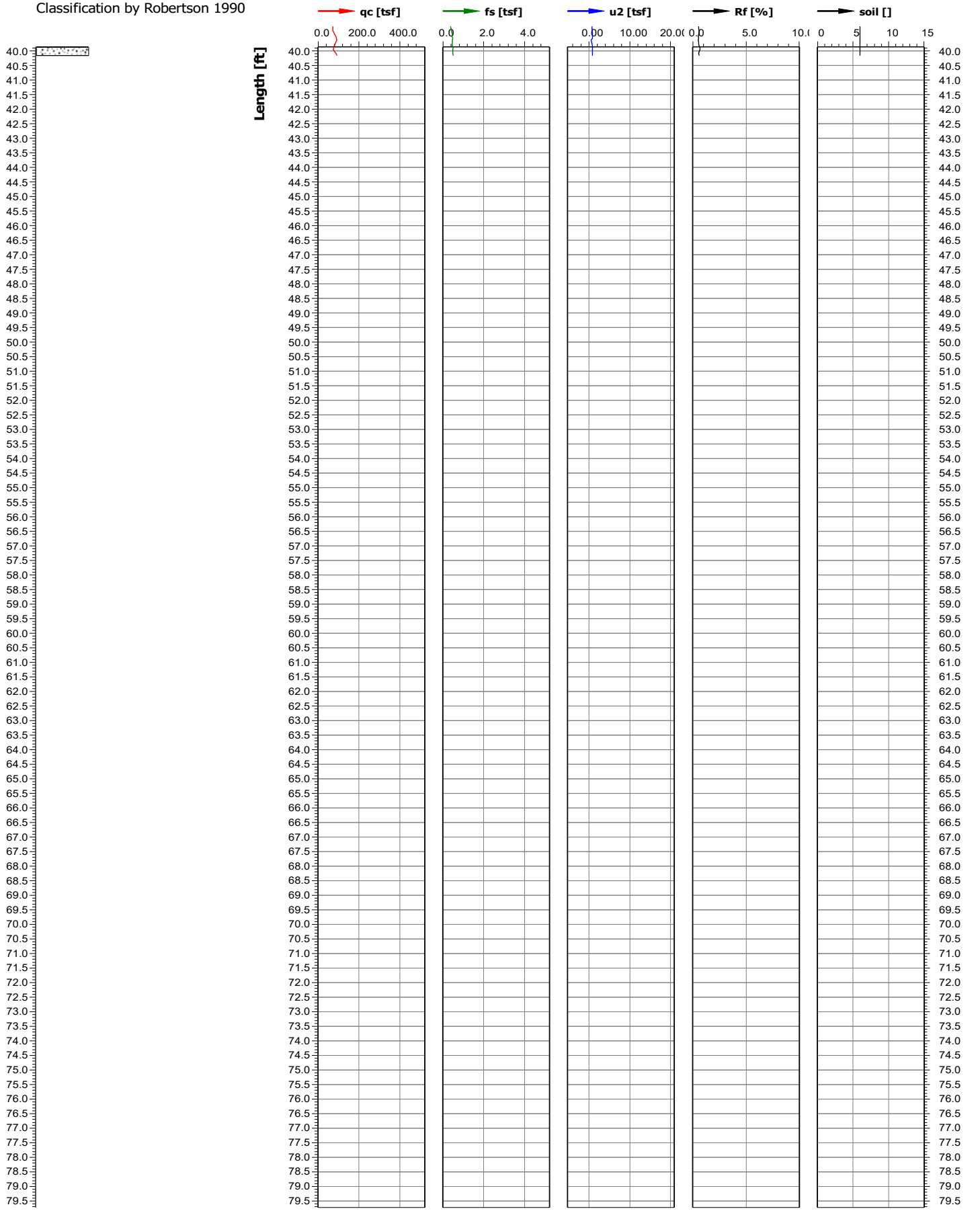
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



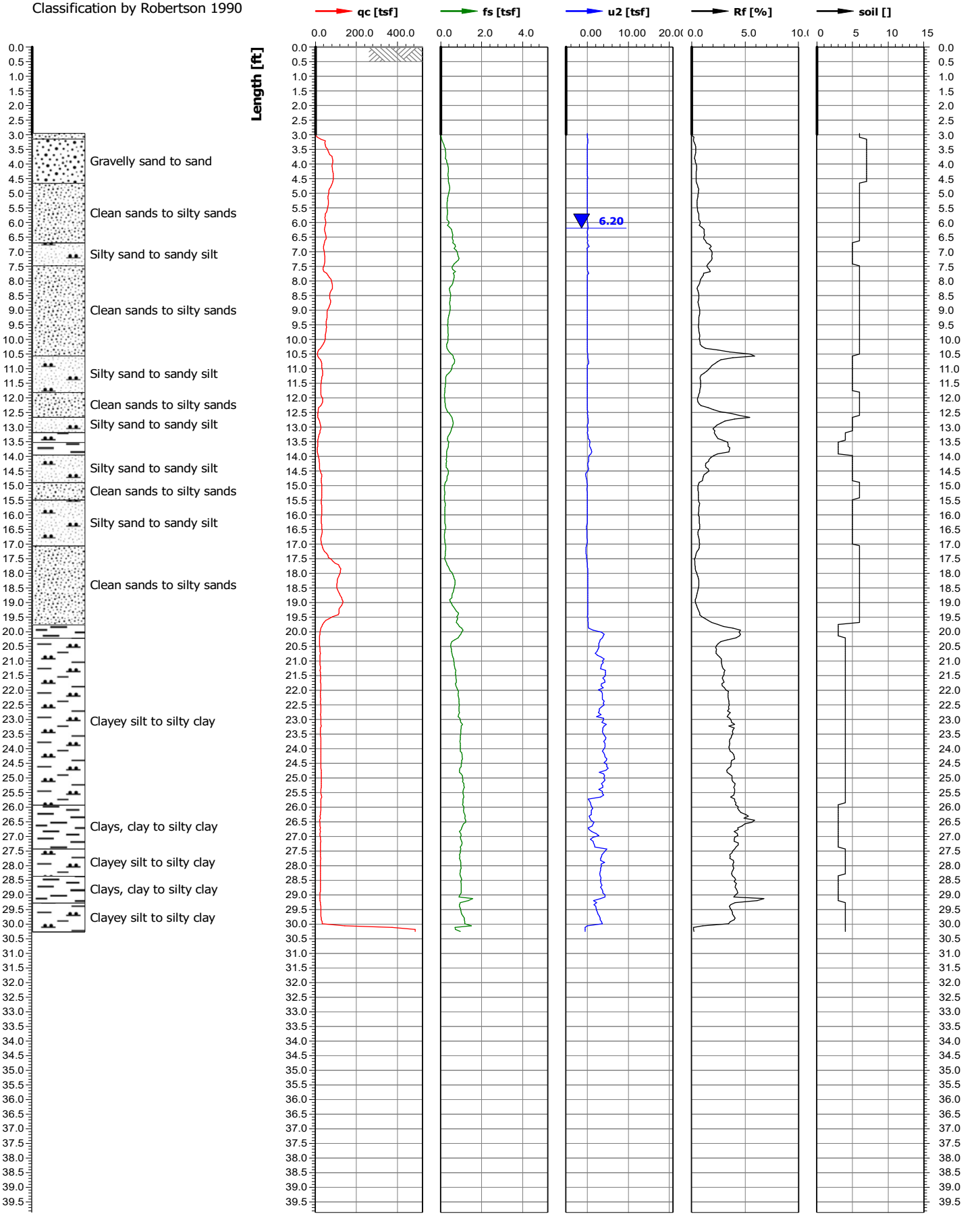
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



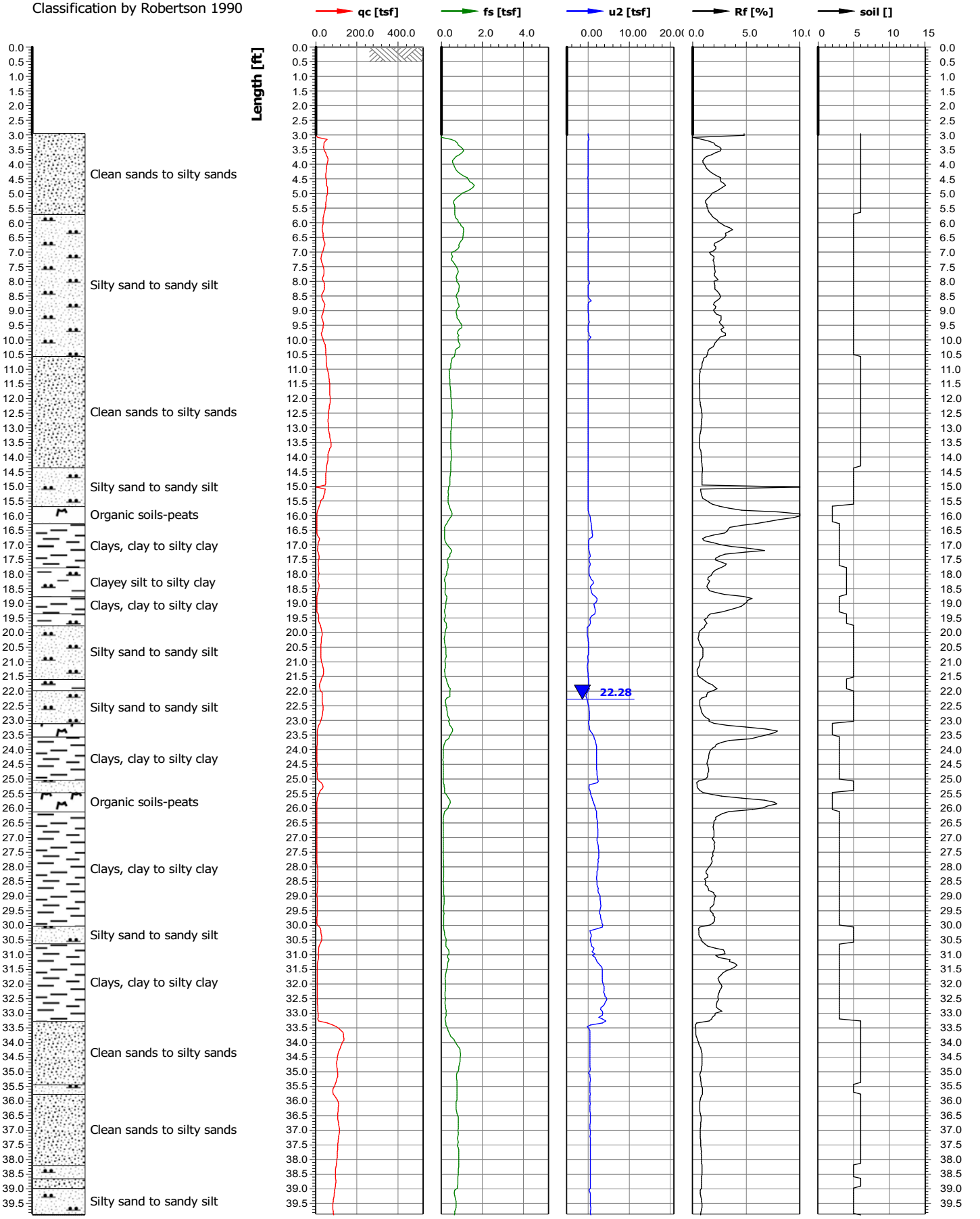
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT7	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/1	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



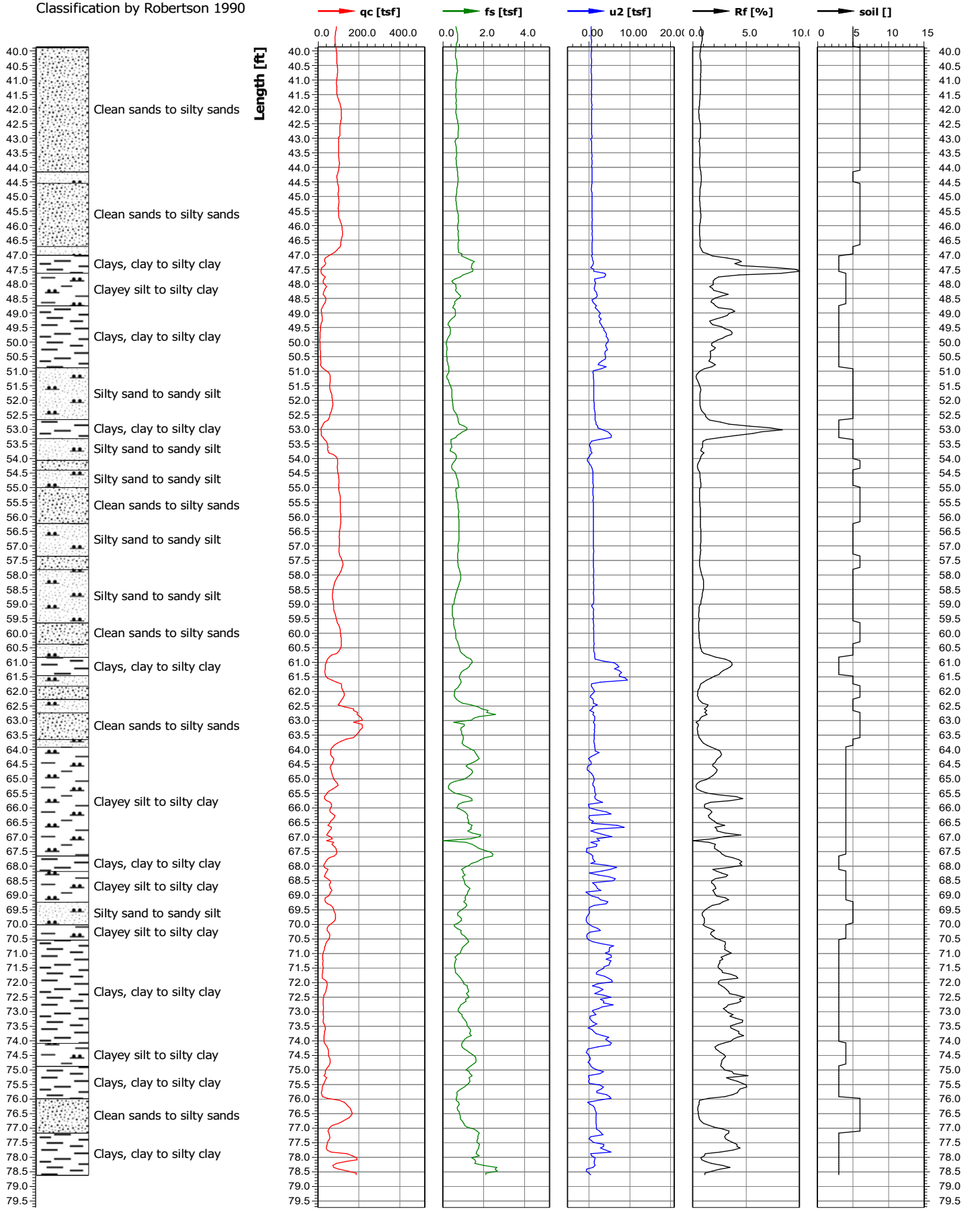
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



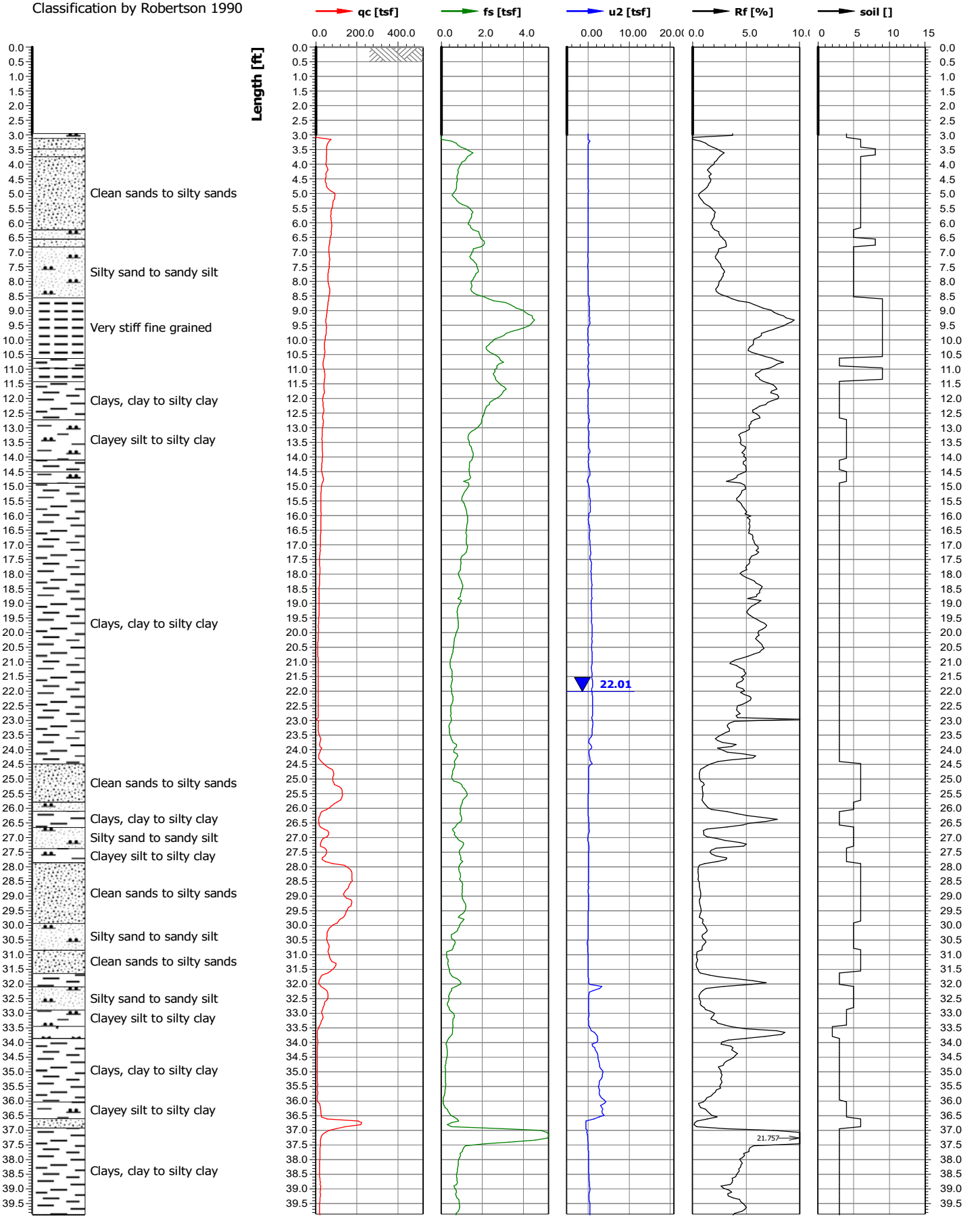
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



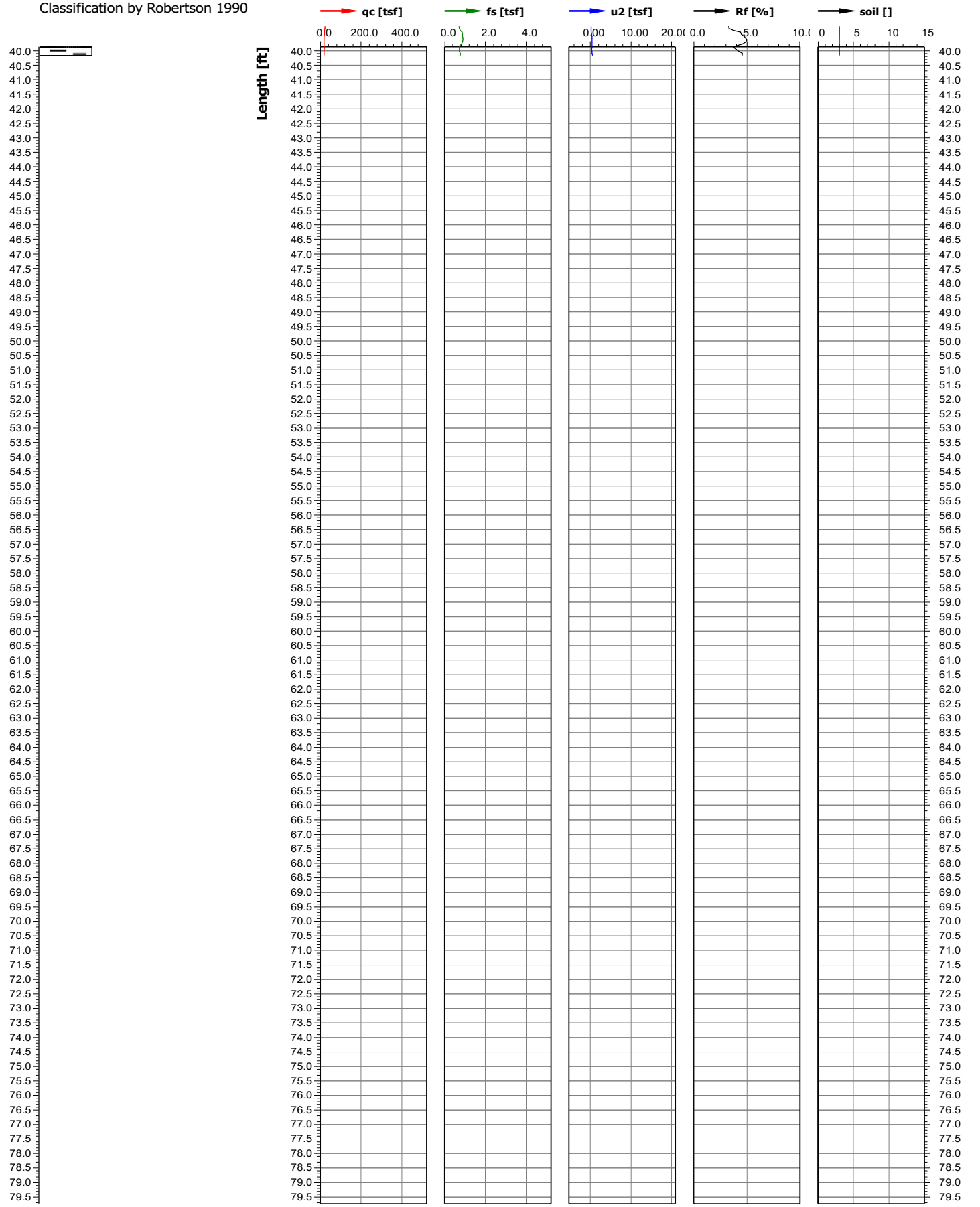
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	**Client**	**Investigation start ...**	**Standard/Standar...**	**Nominal surface area of...**
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		**Page**	**Scale**	**Net surface area quotie...**
Knife River Elbee Bend Bank Stabilization		1/2	1:50	0.840/0.000
Remarks1		**Coordinate system used**		**U**
				u2

Classification by Robertson 1990



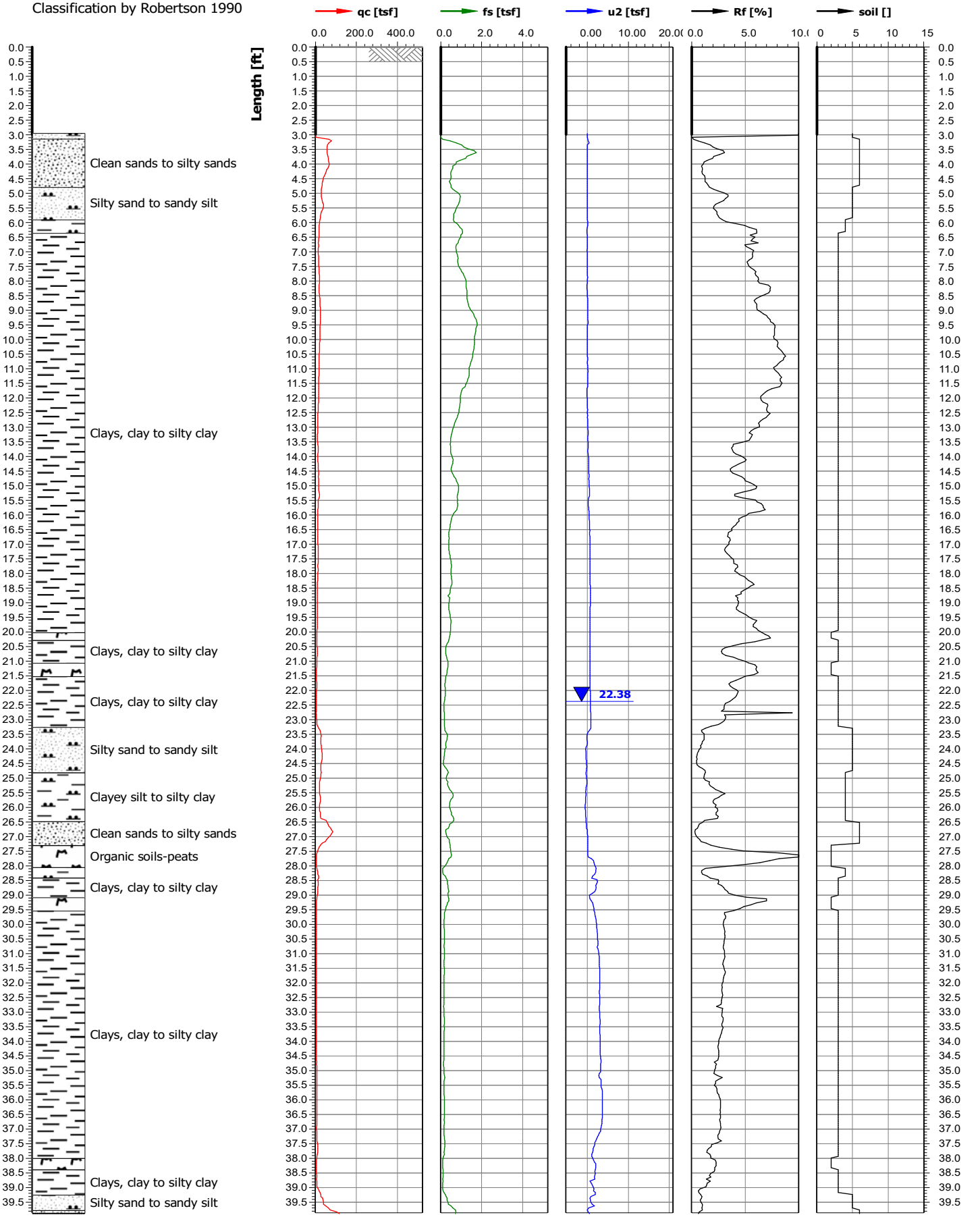
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



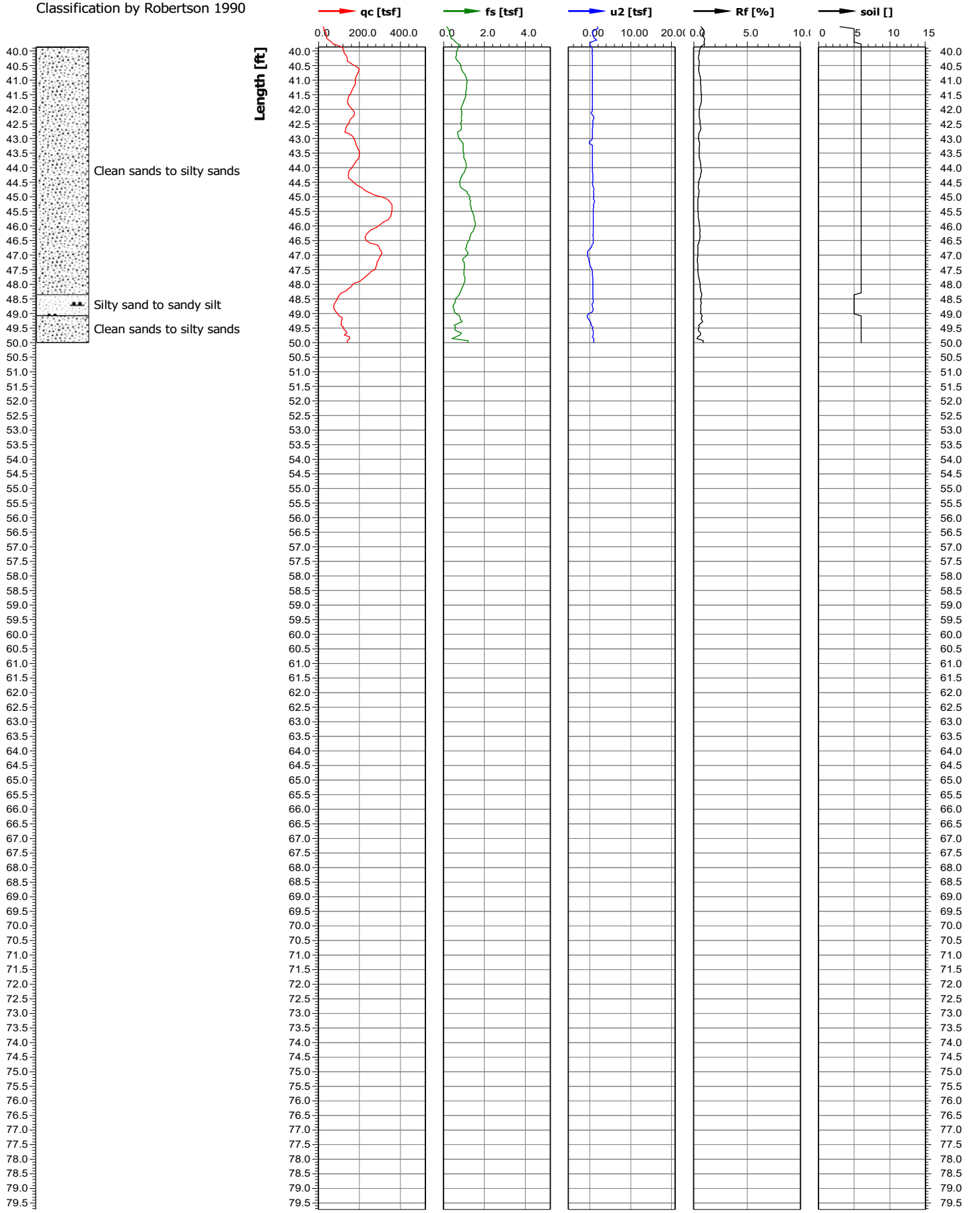
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	**Client**	**Investigation start ...**	**Standard/Standar...**	**Nominal surface area of...**
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		**Page**	**Scale**	**Net surface area quotie...**
Knife River Elbee Bend Bank Stabilization		1/2	1:50	0.840/0.000
Remarks1		**Coordinate system used**		**U**
				u2

Classification by Robertson 1990



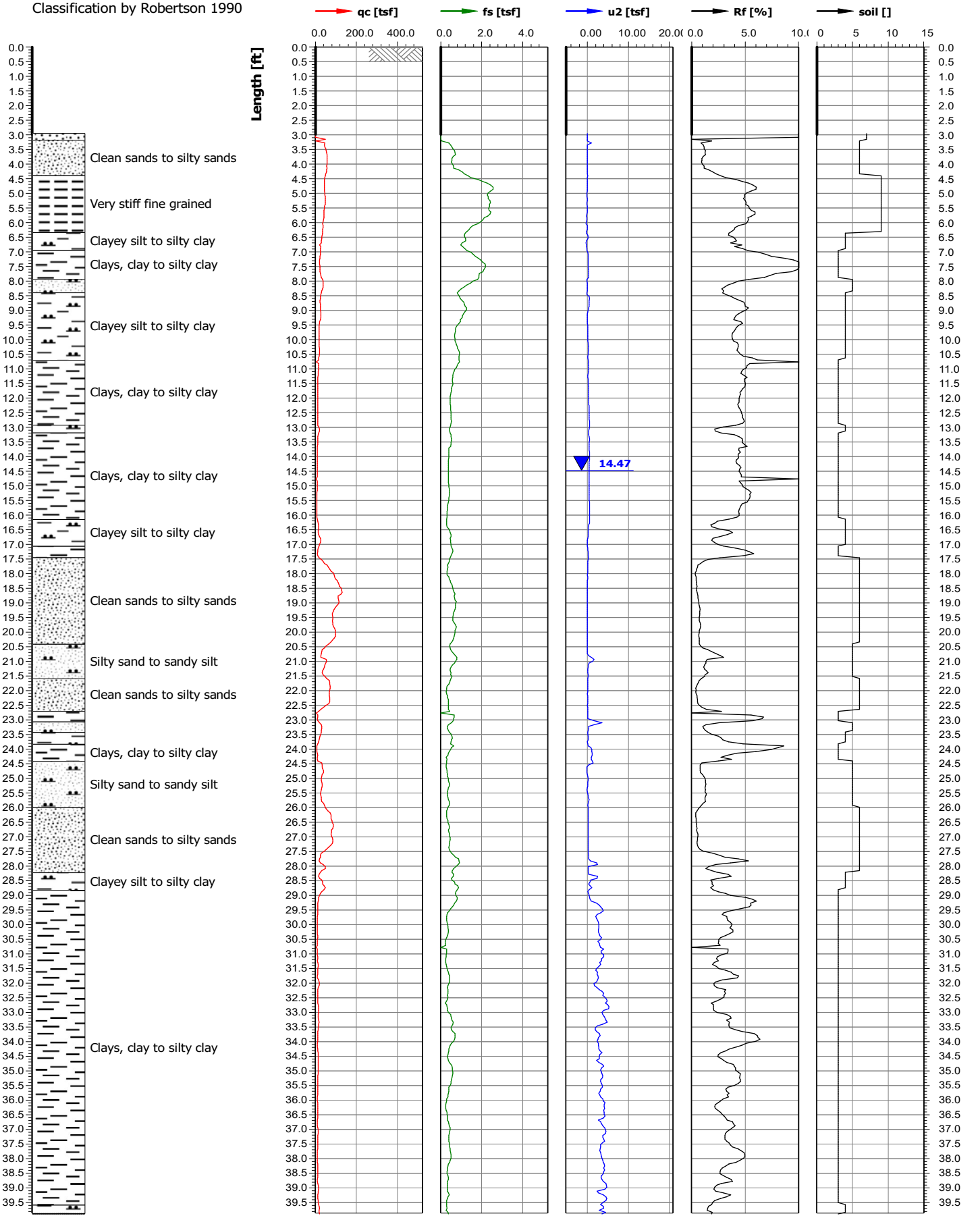
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



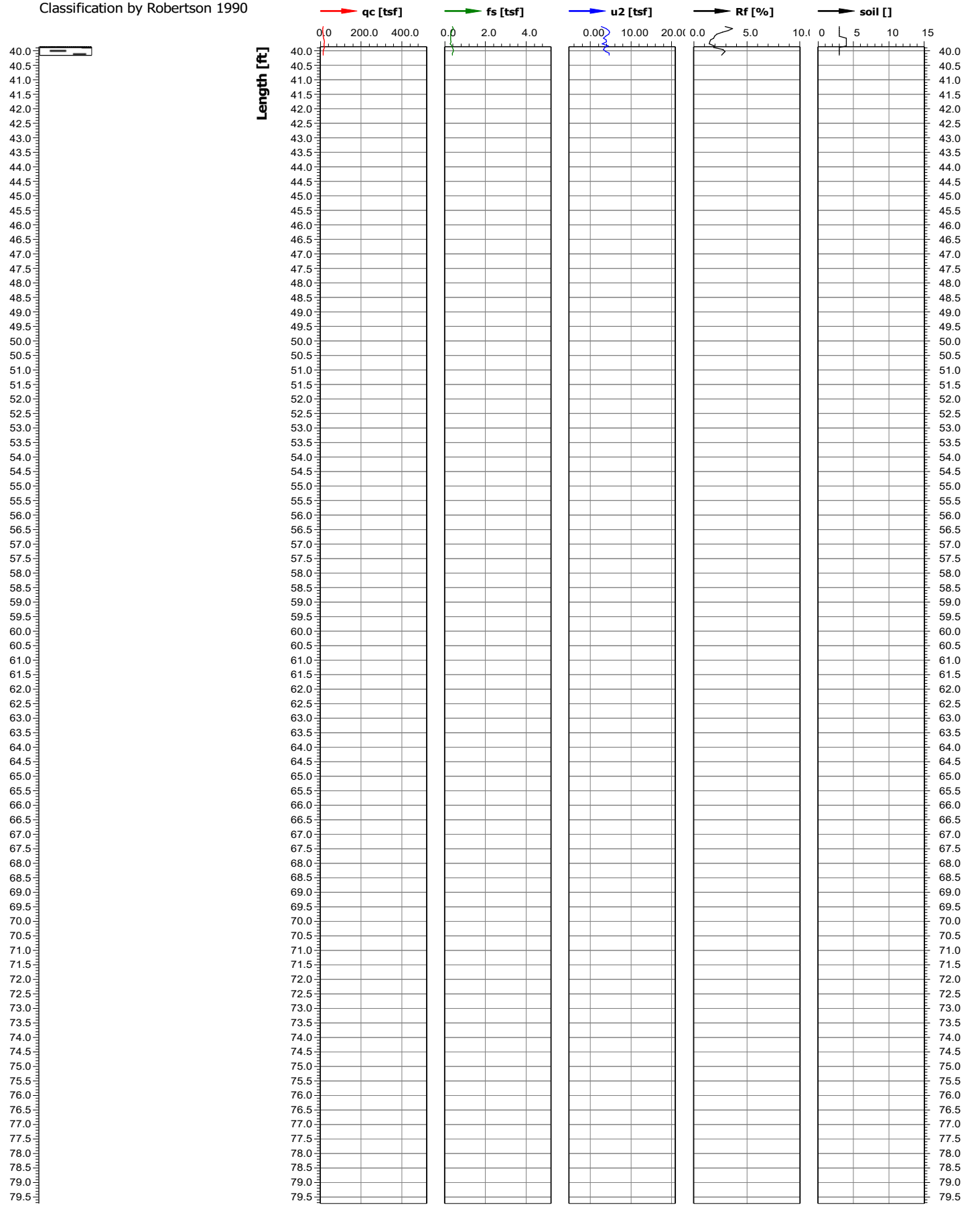
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	**Client**	**Investigation start ...**	**Standard/Standar...**	**Nominal surface area of...**
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		**Page**	**Scale**	**Net surface area quotie...**
Knife River Elbee Bend Bank Stabilization		1/2	1:50	0.840/0.000
Remarks1		**Coordinate system used**		**U**
				u2

Classification by Robertson 1990



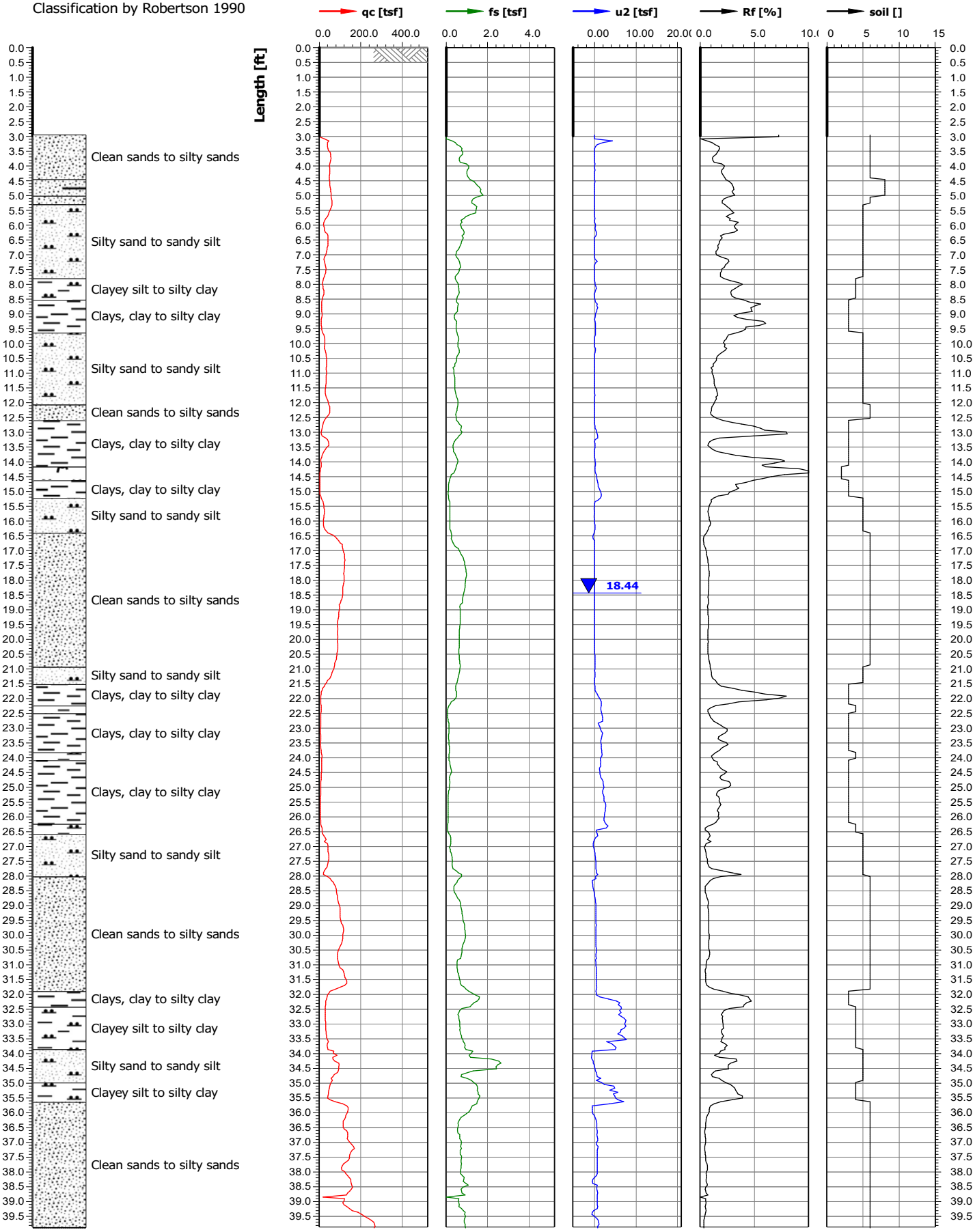
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



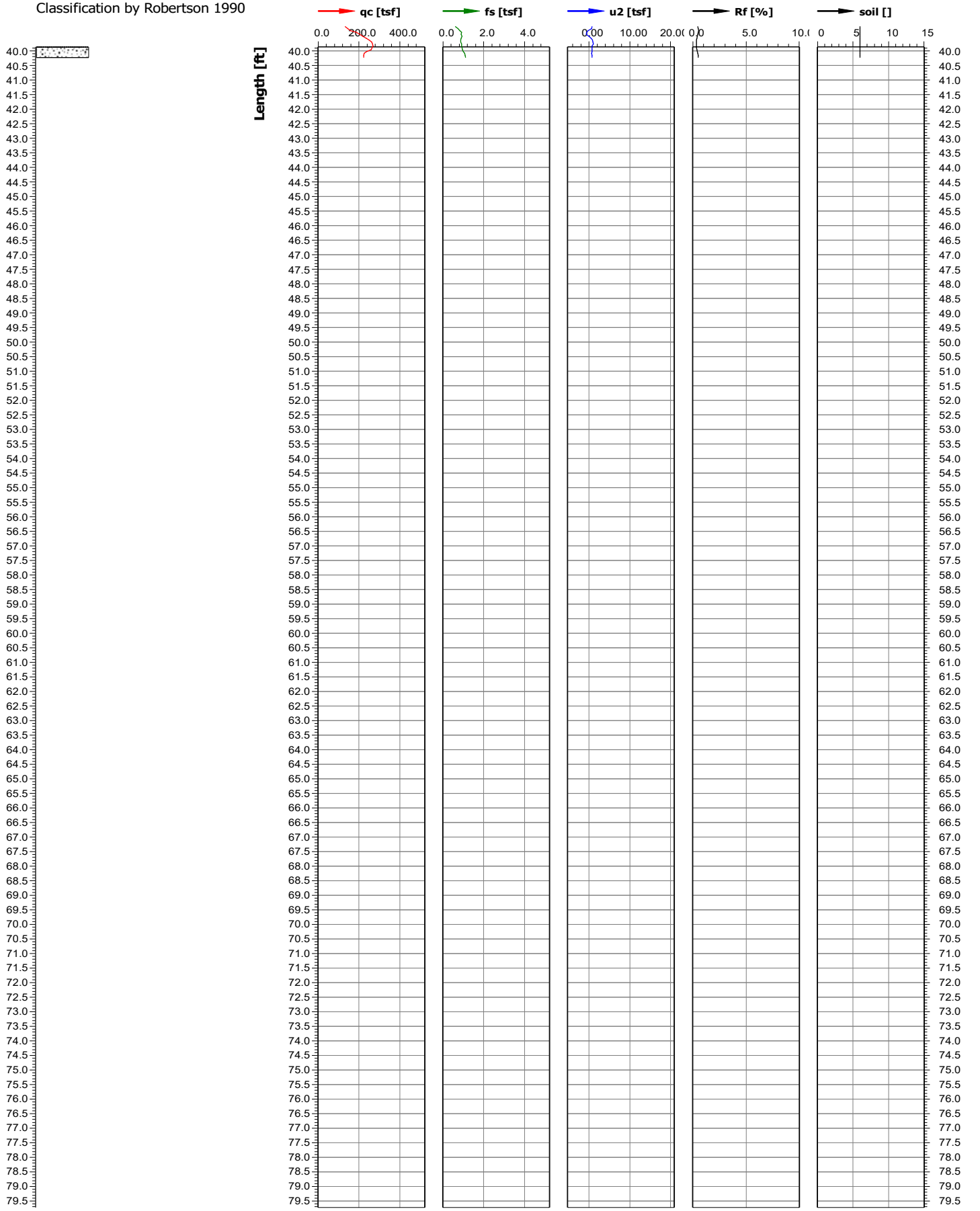
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



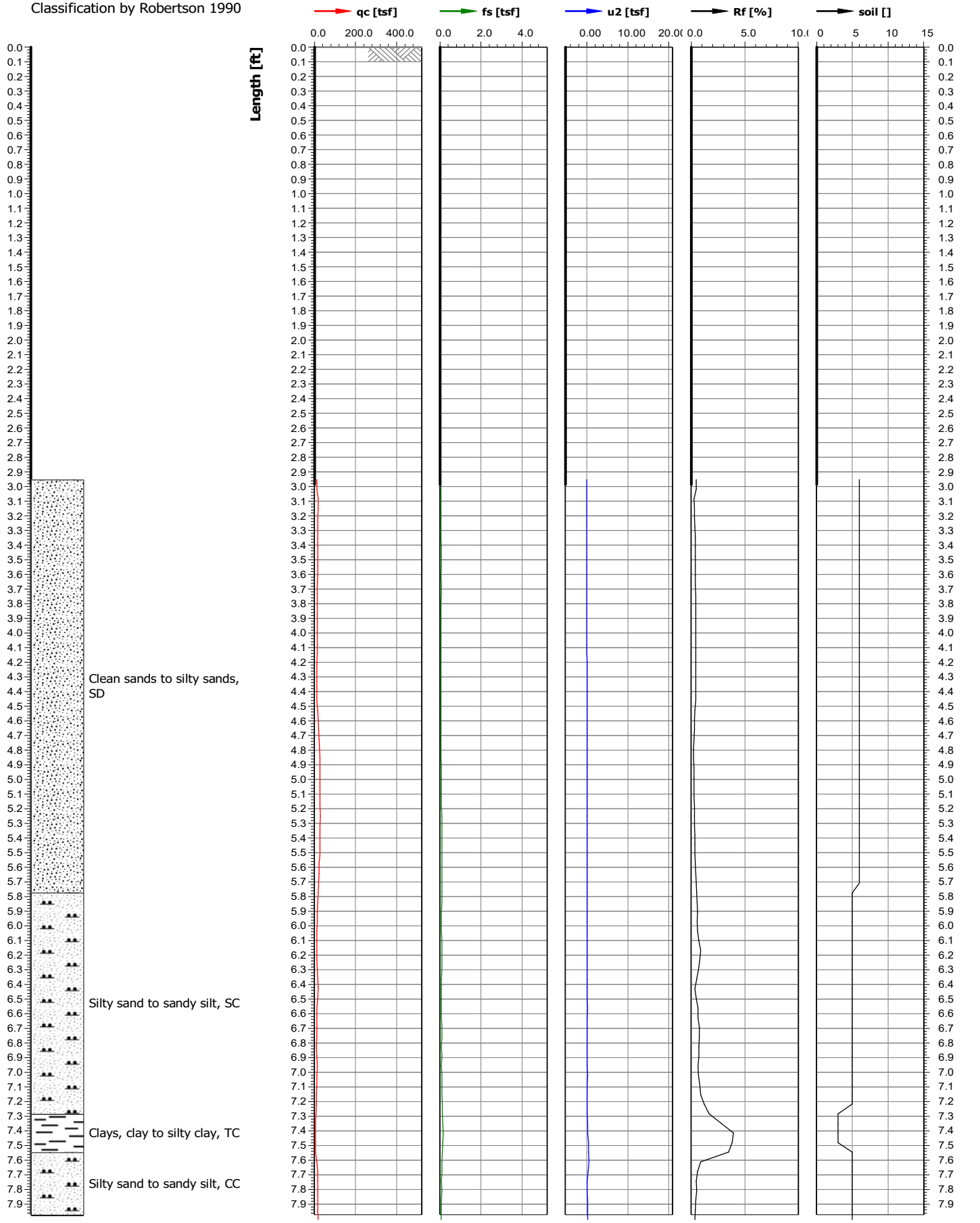
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



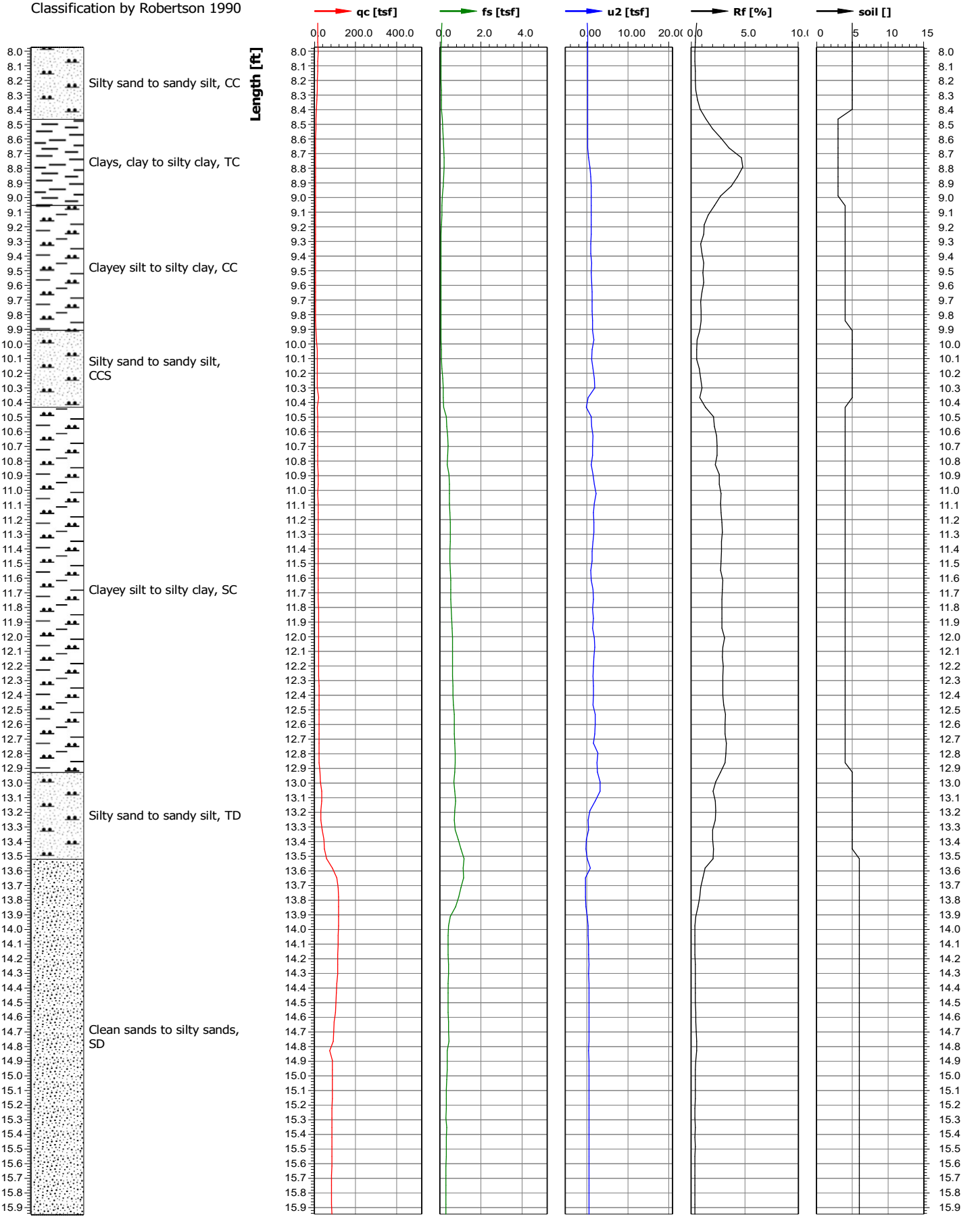
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT1	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



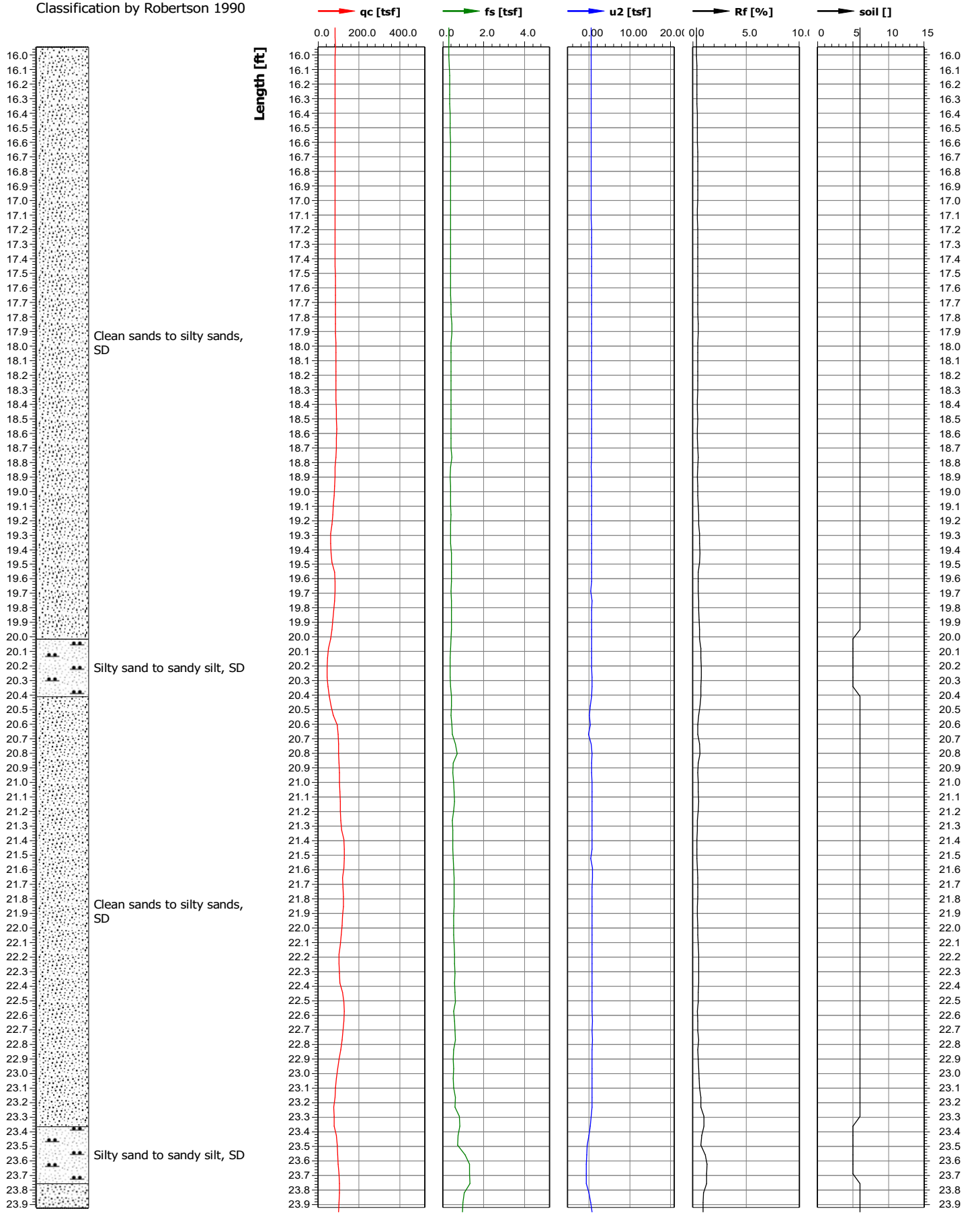
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT1	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



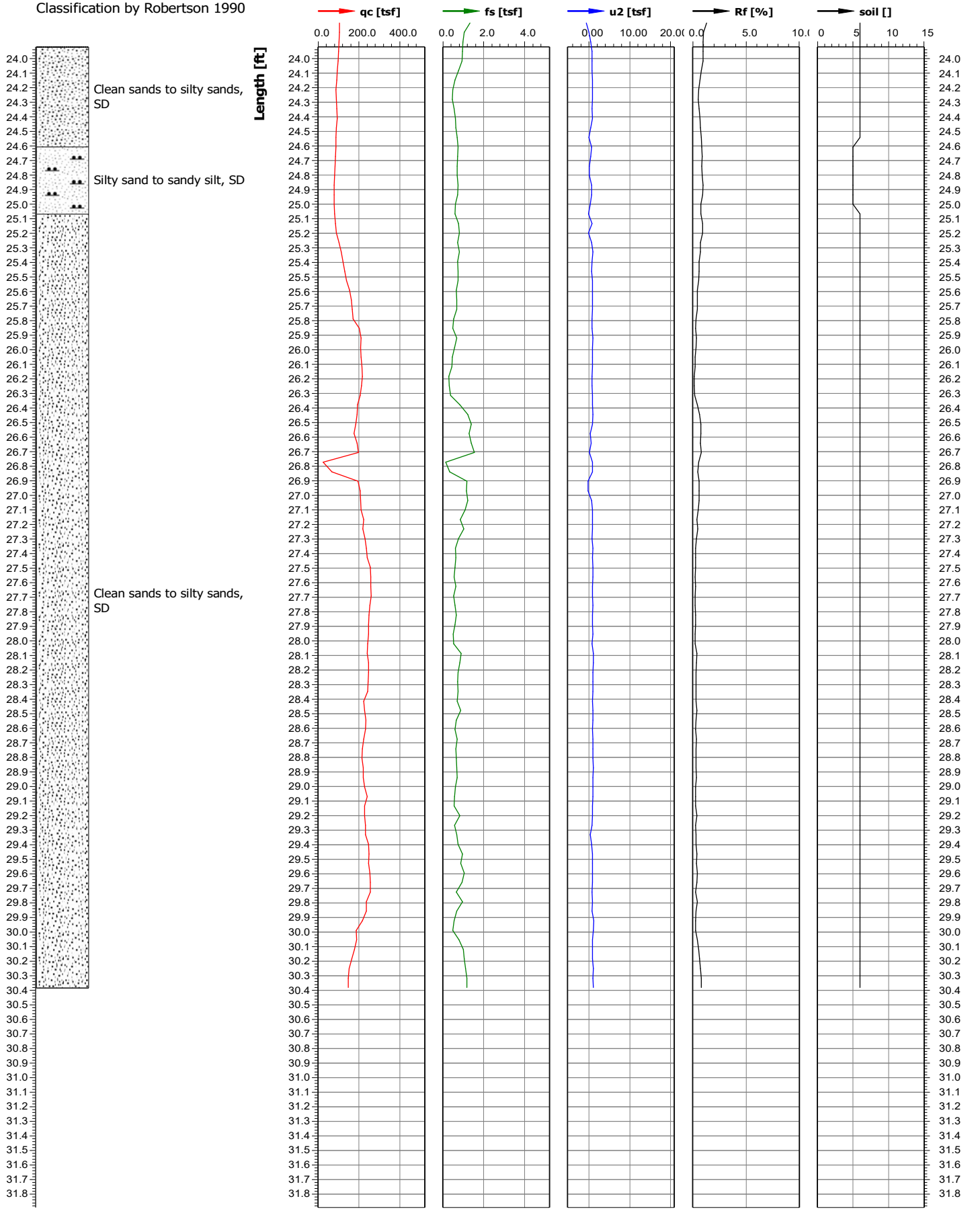
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT1	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



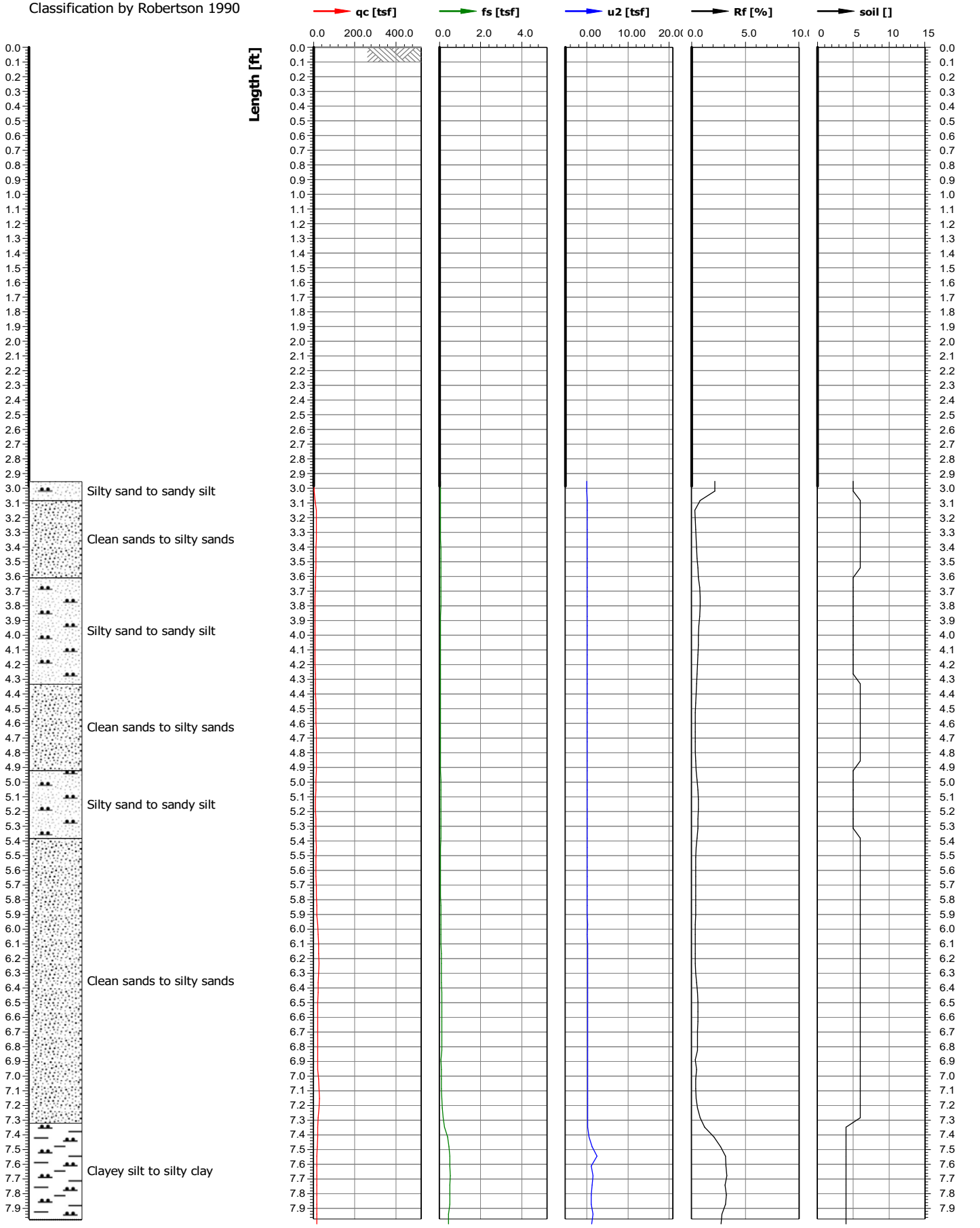
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT1	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



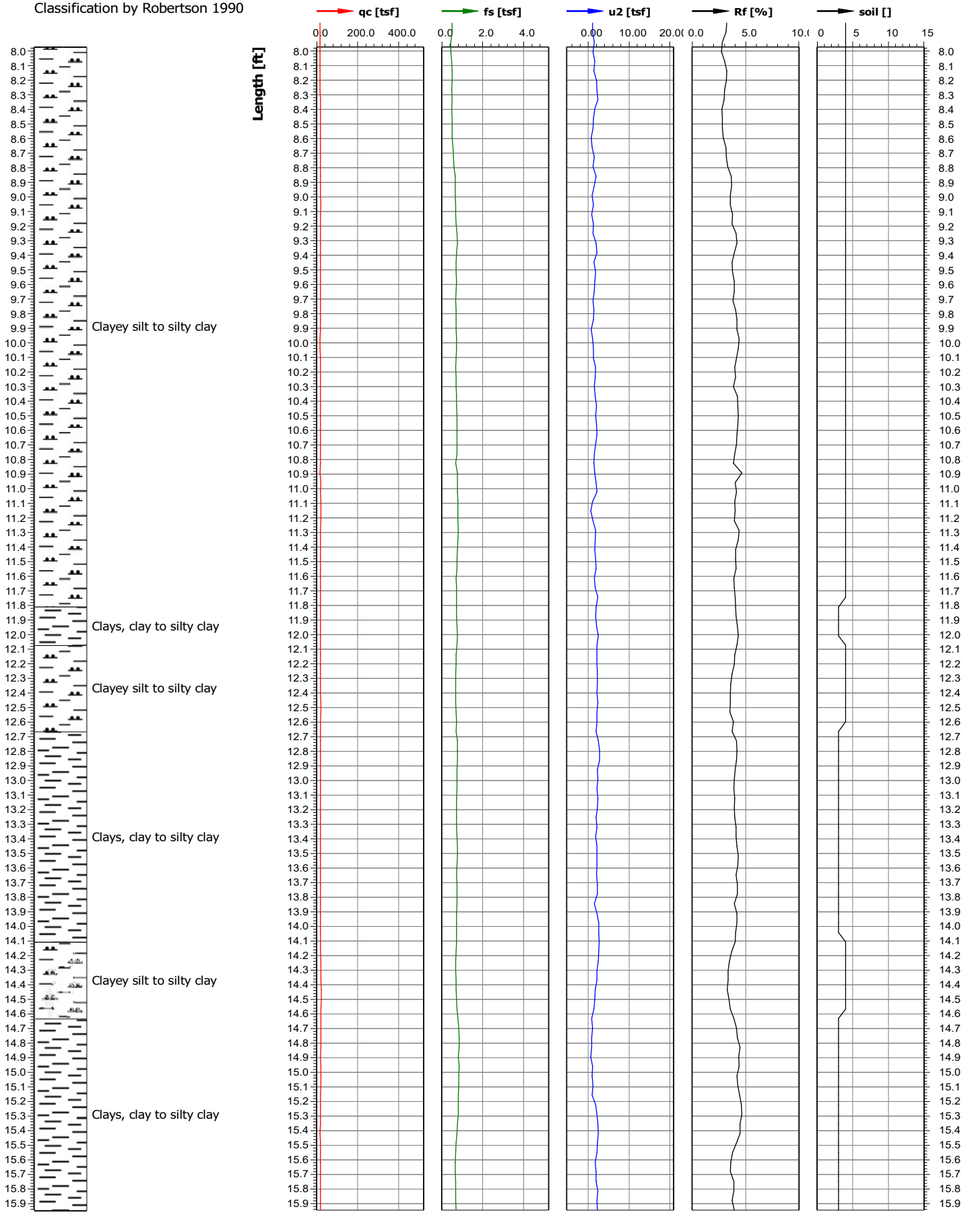
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT2	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/5	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



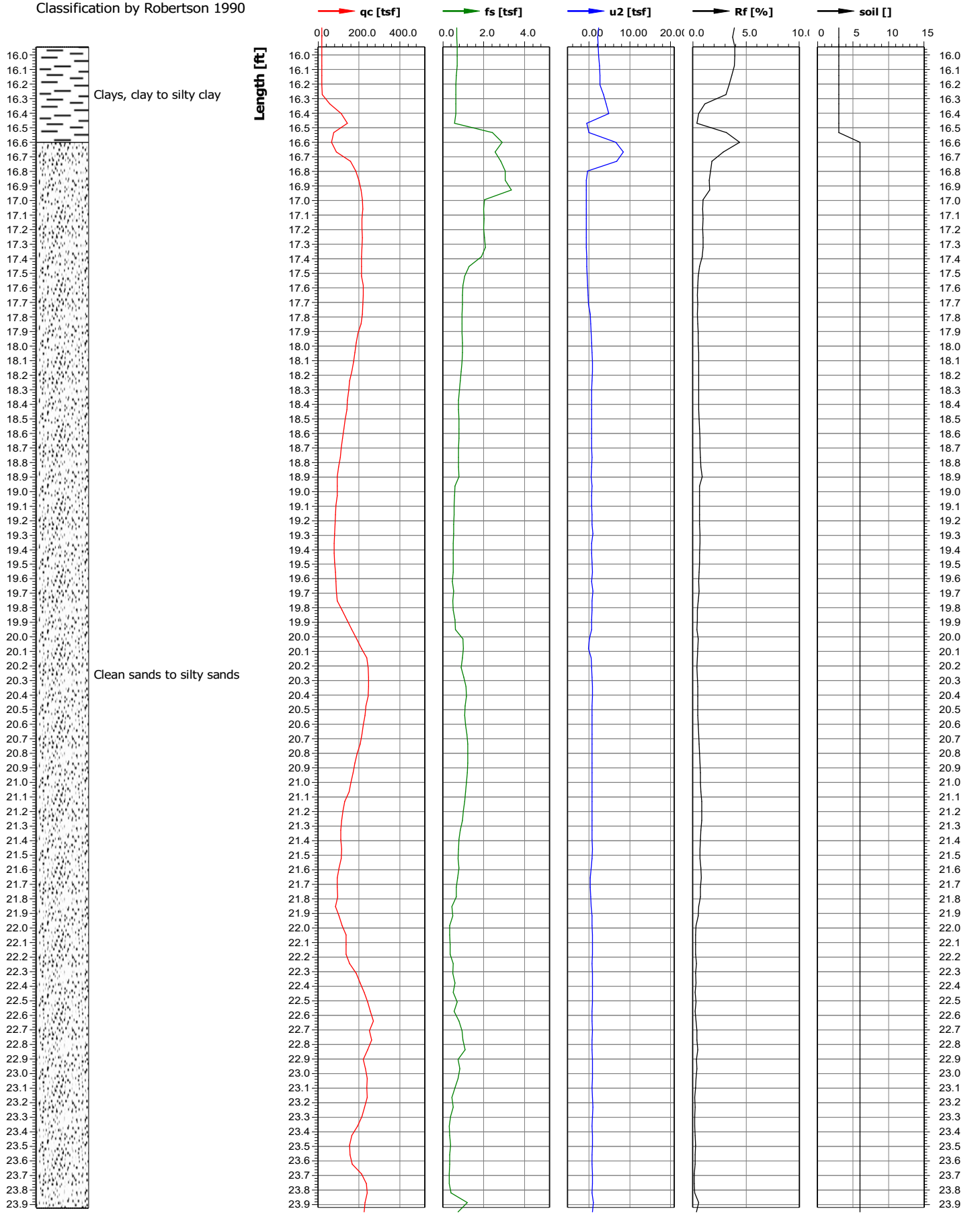
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT2	
Project ID	**Client**	**Investigation start ...**	**Standard/Standar...**	**Nominal surface area of...**
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		**Page**	**Scale**	**Net surface area quotie...**
Knife River Elbee Bend Bank Stabilization		2/5	1:10	0.820/0.000
Remarks1		**Coordinate system used**		**U**
				u2

Classification by Robertson 1990



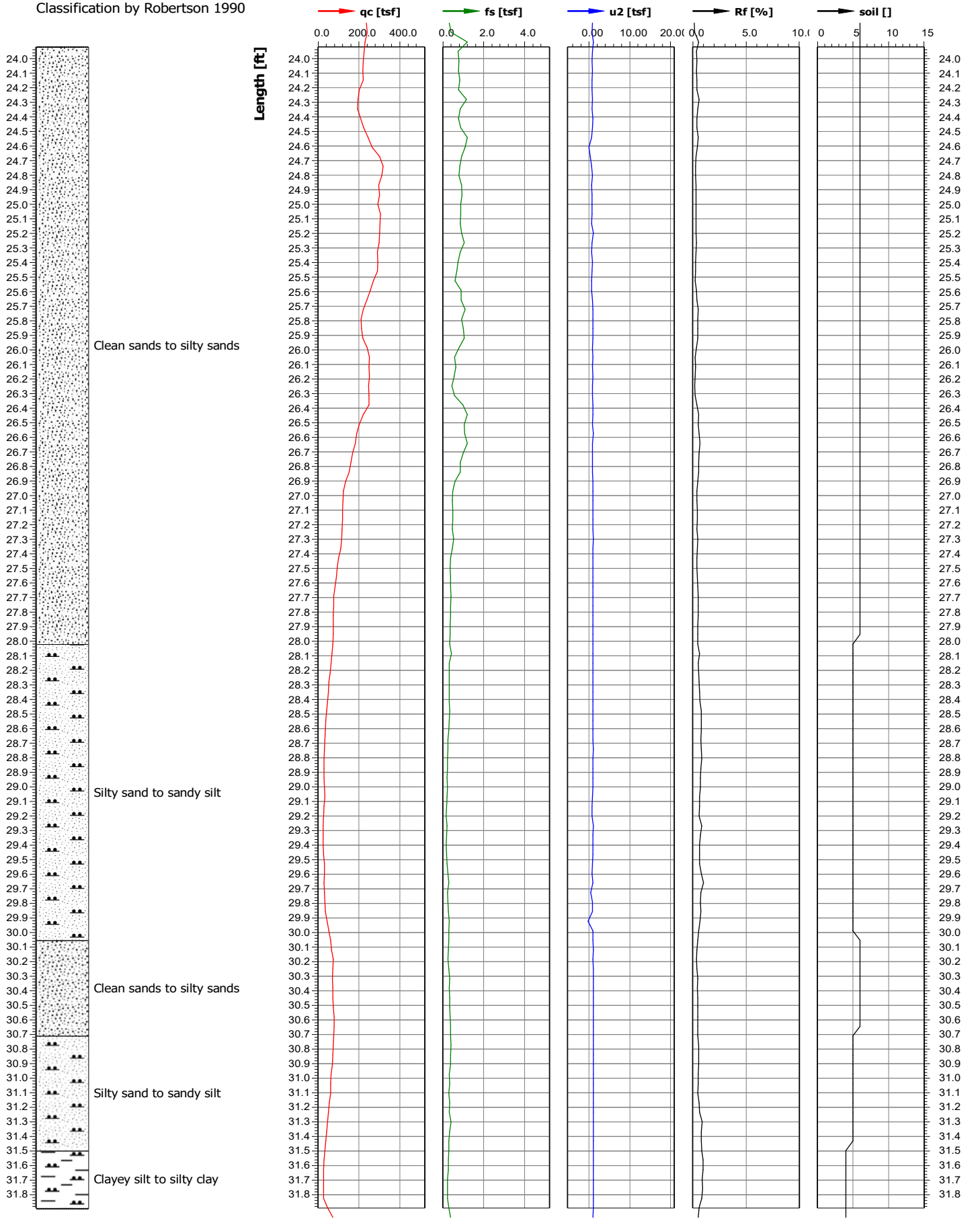
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT2	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/5	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



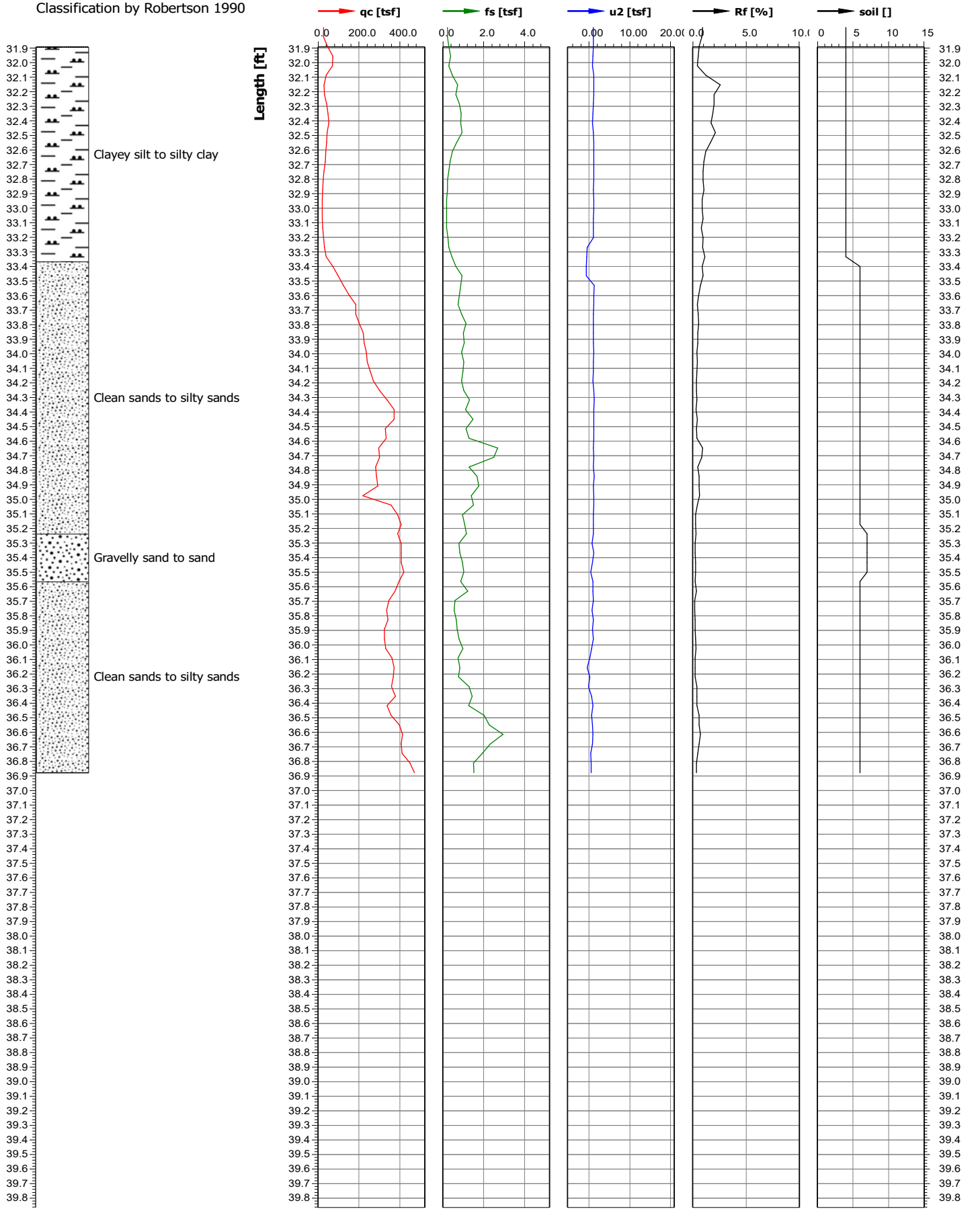
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT2	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/5	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



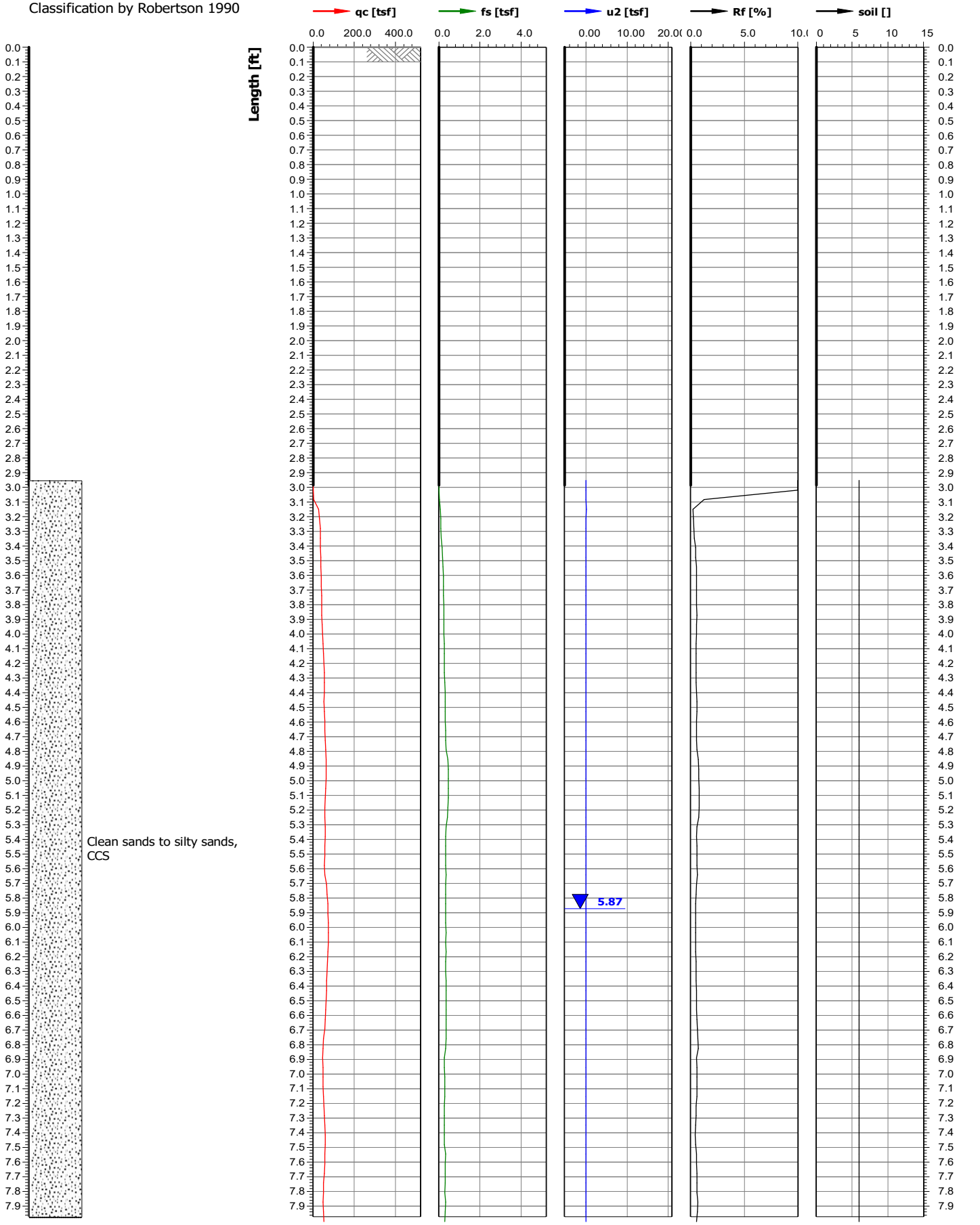
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT2	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/5	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



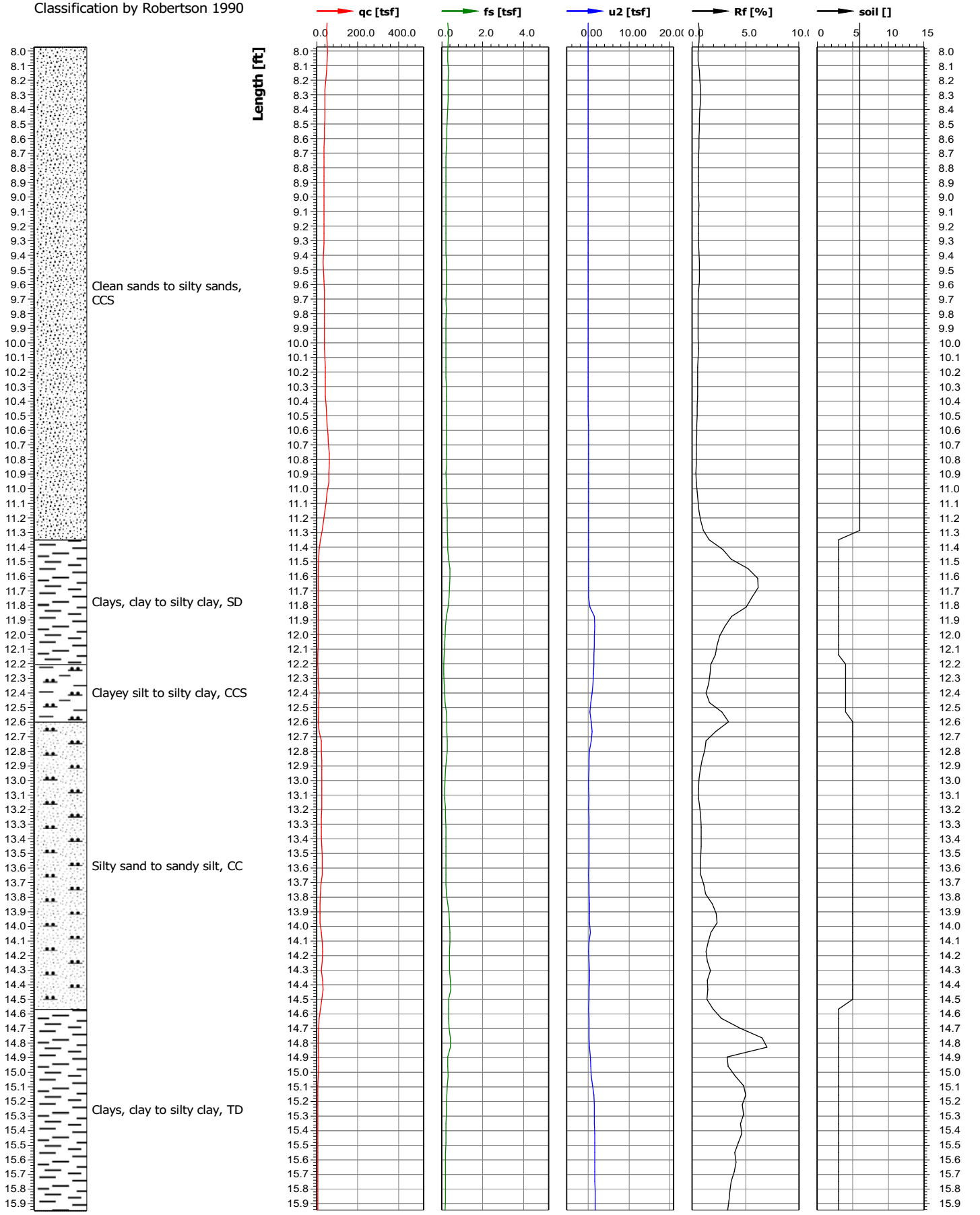
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT3	
Project ID	**Client**	**Investigation start ...**	**Standard/Standar...**	**Nominal surface area of...**
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		**Page**	**Scale**	**Net surface area quotie...**
Knife River Elbee Bend Bank Stabilization		1/4	1:10	0.840/0.000
Remarks1		**Coordinate system used**		**U**
				u2

Classification by Robertson 1990



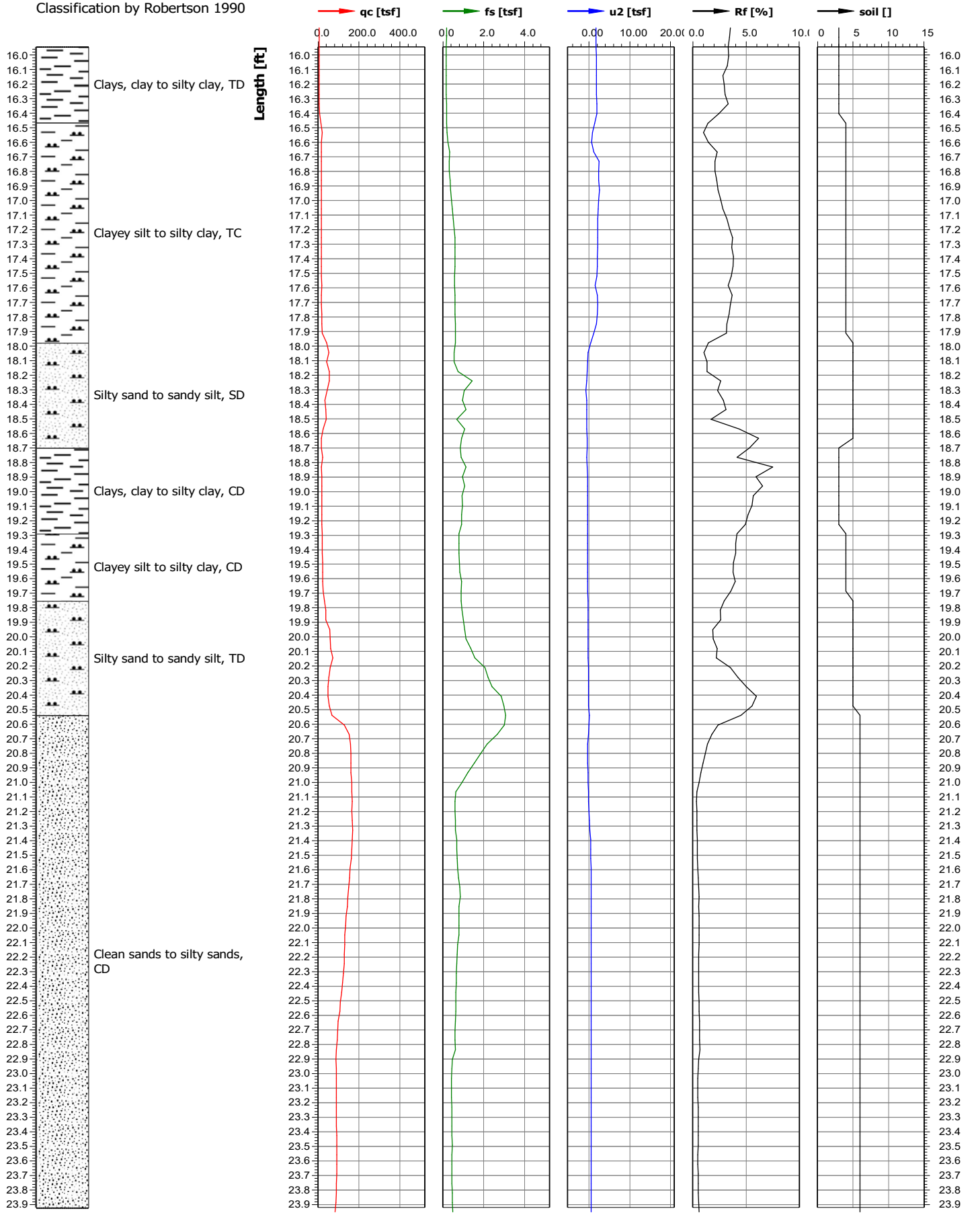
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT3	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



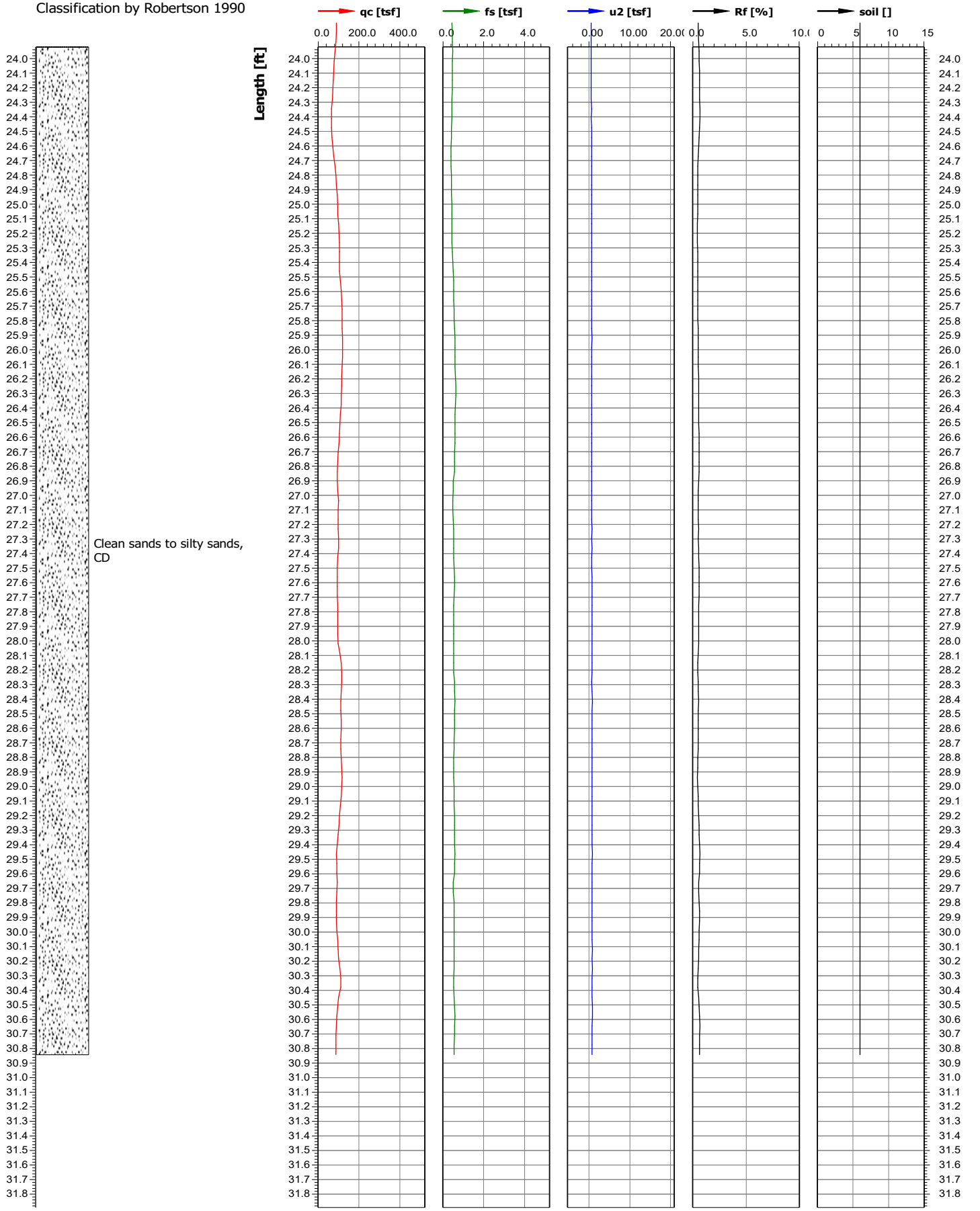
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT3	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



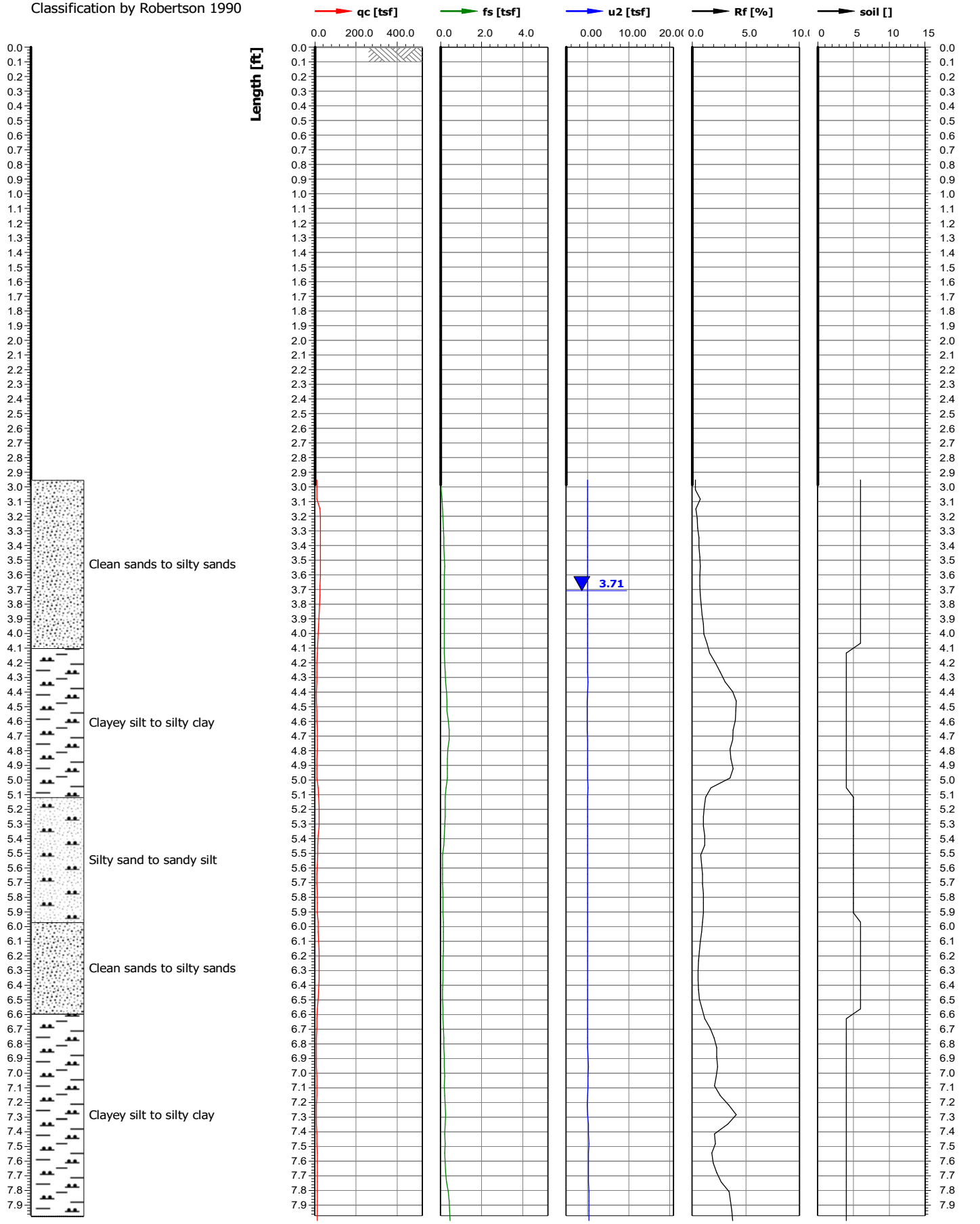
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT3	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



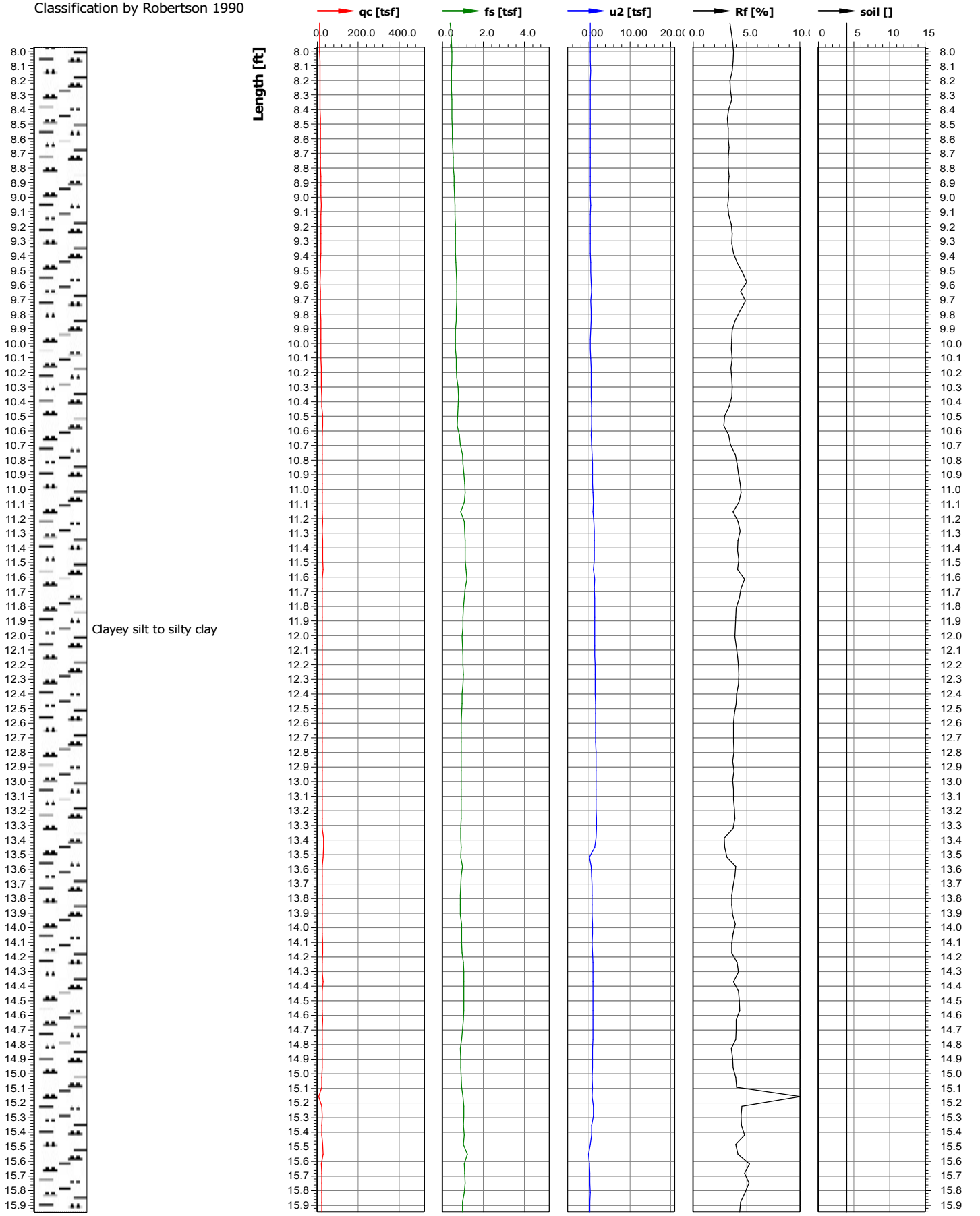
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT4	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



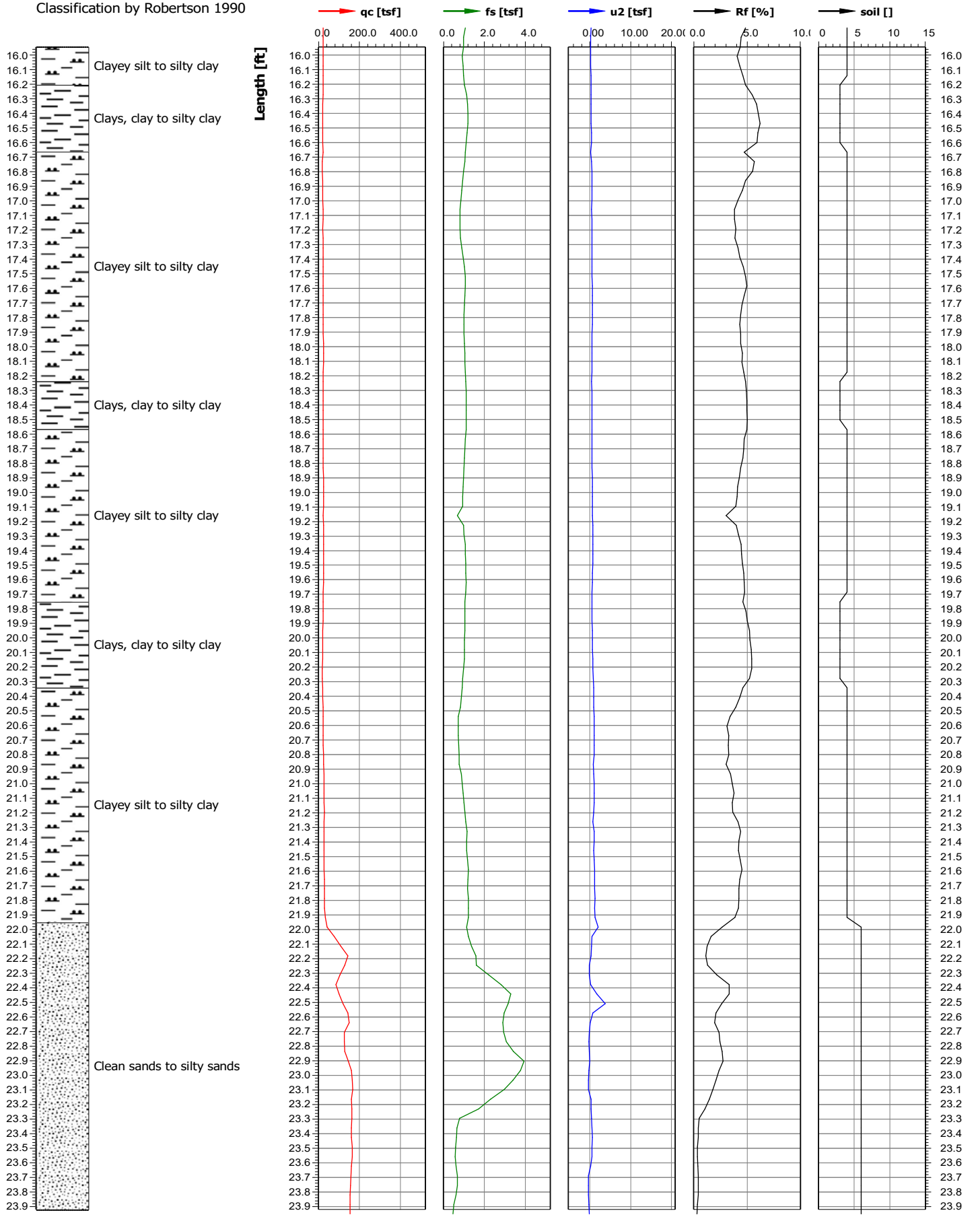
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT4	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



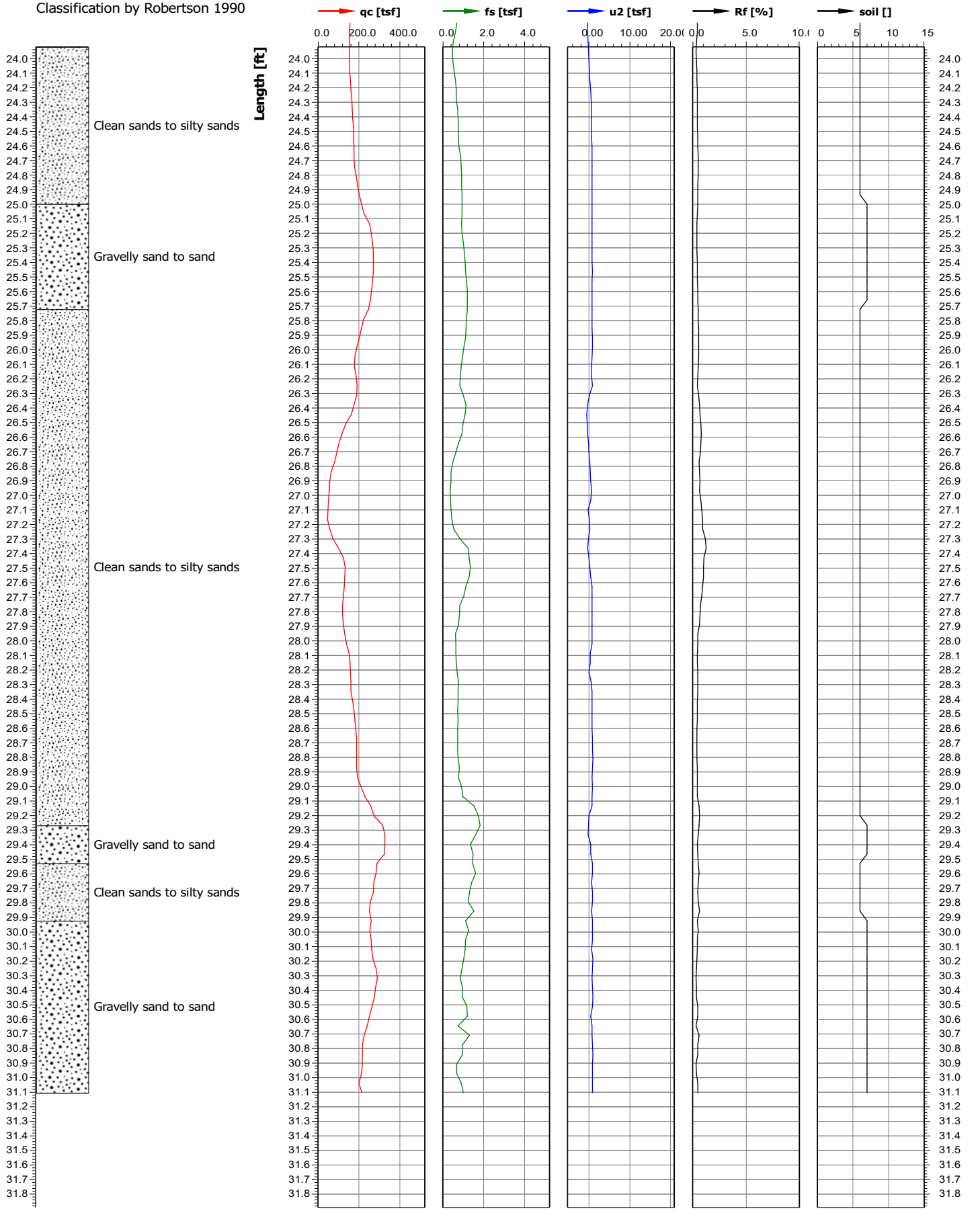
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT4	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



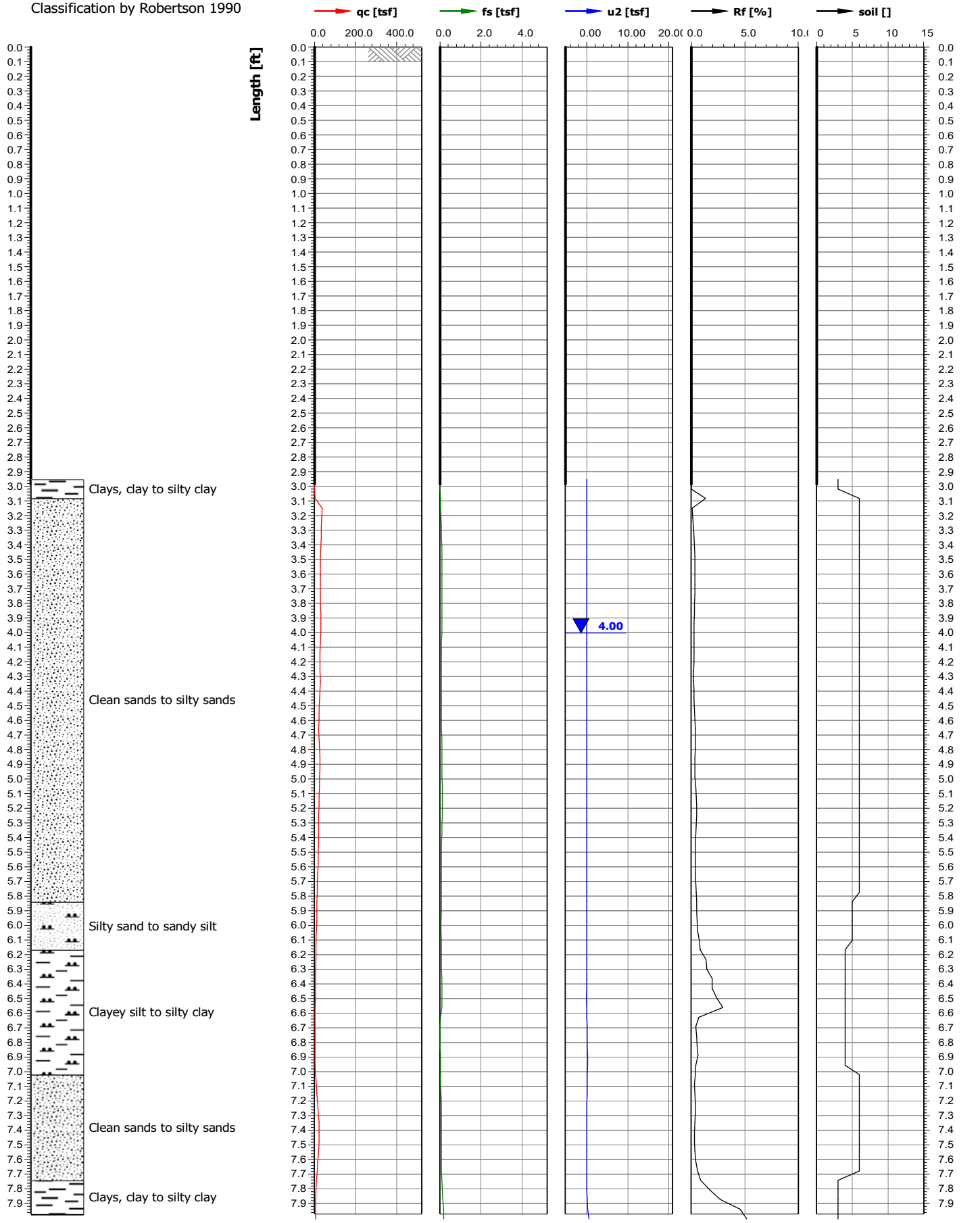
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT4	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



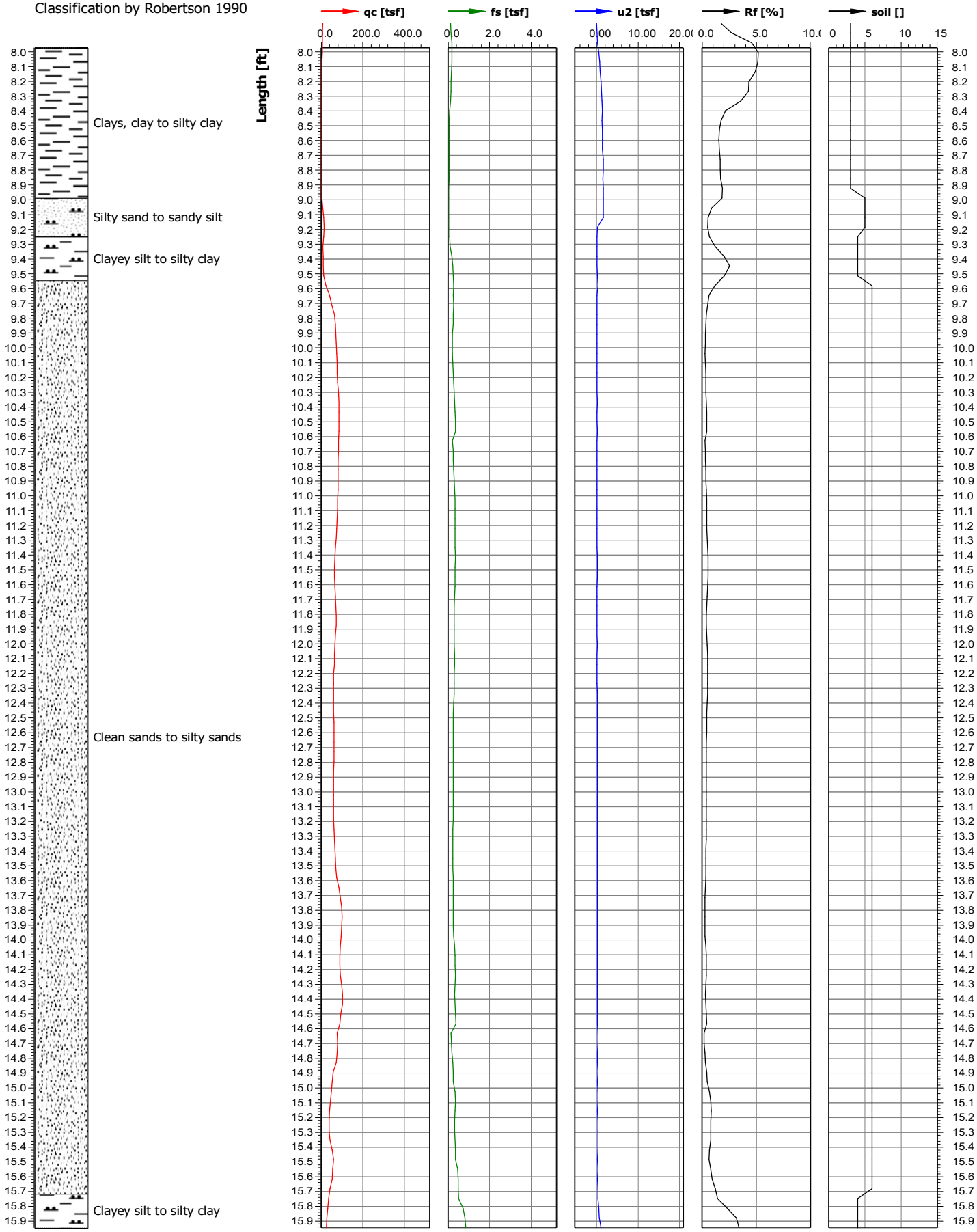
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT5	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



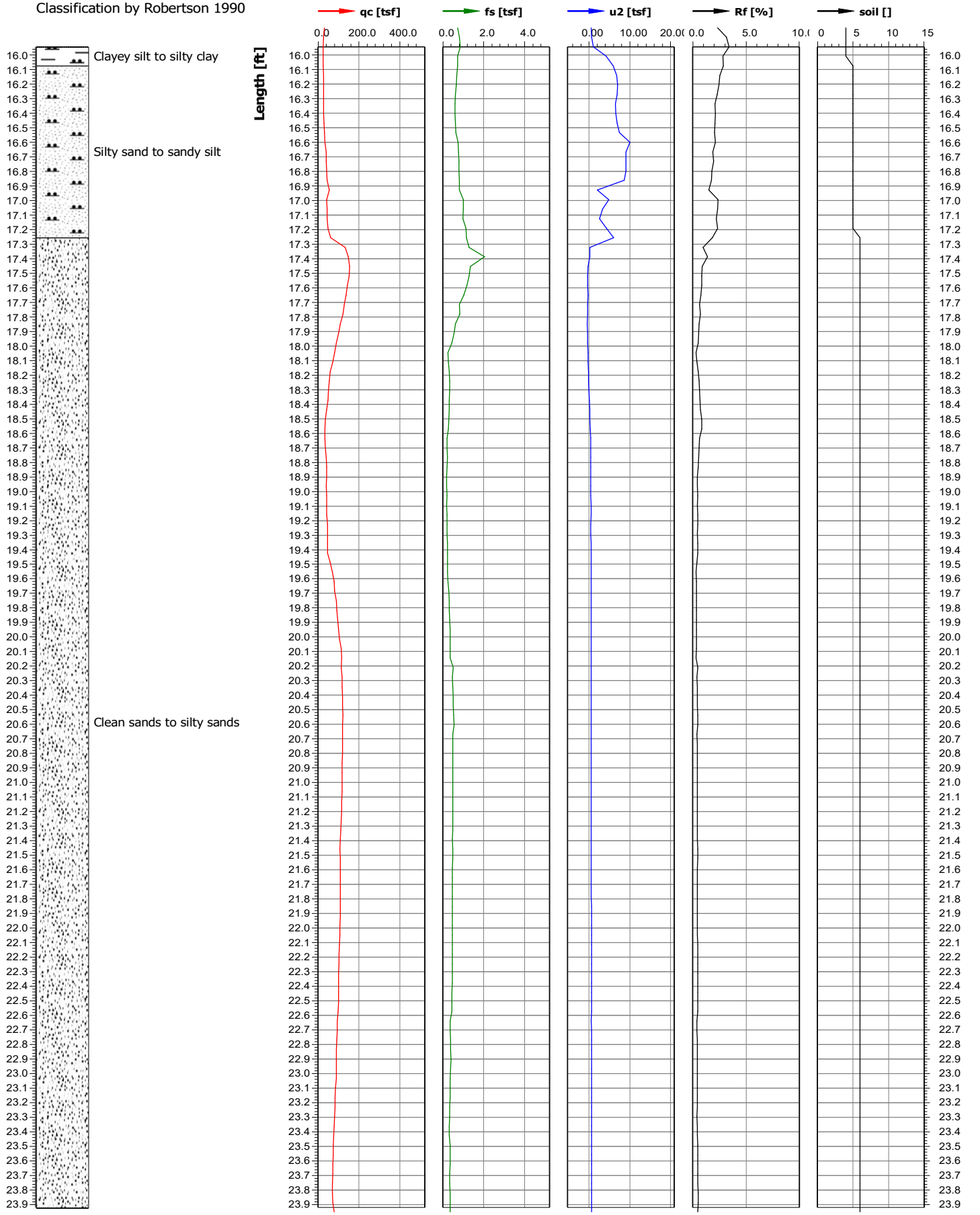
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT5	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



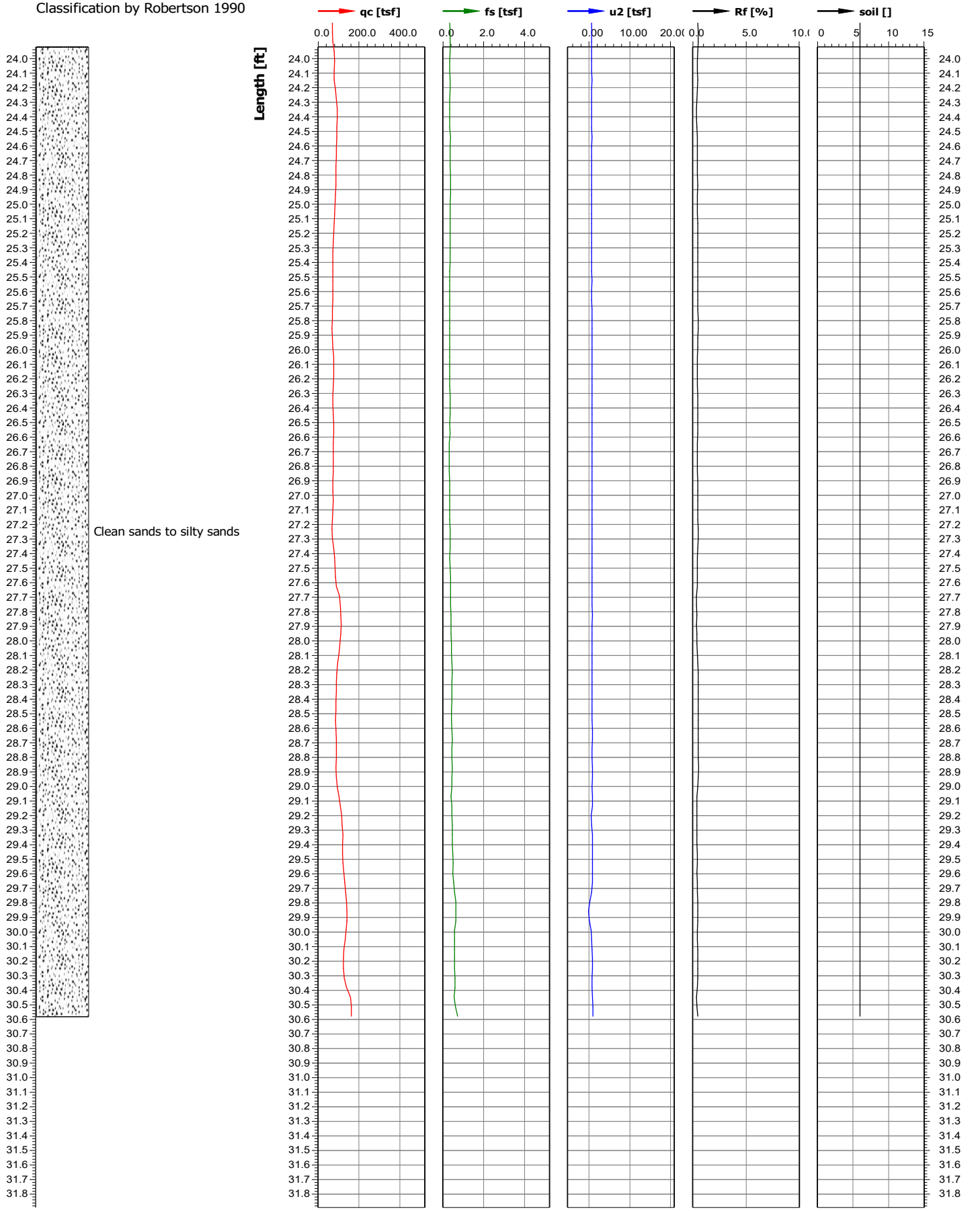
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT5	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



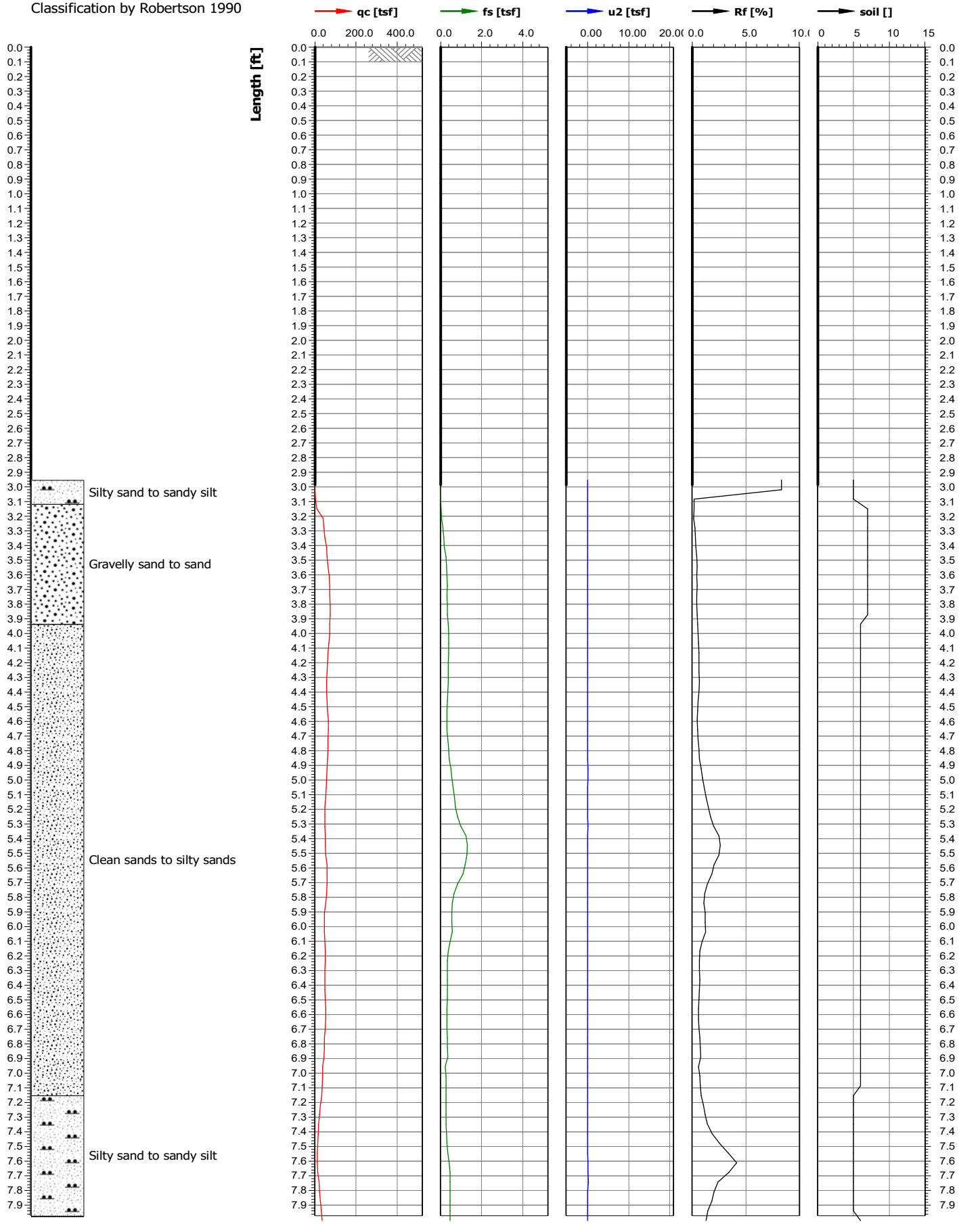
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT5	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



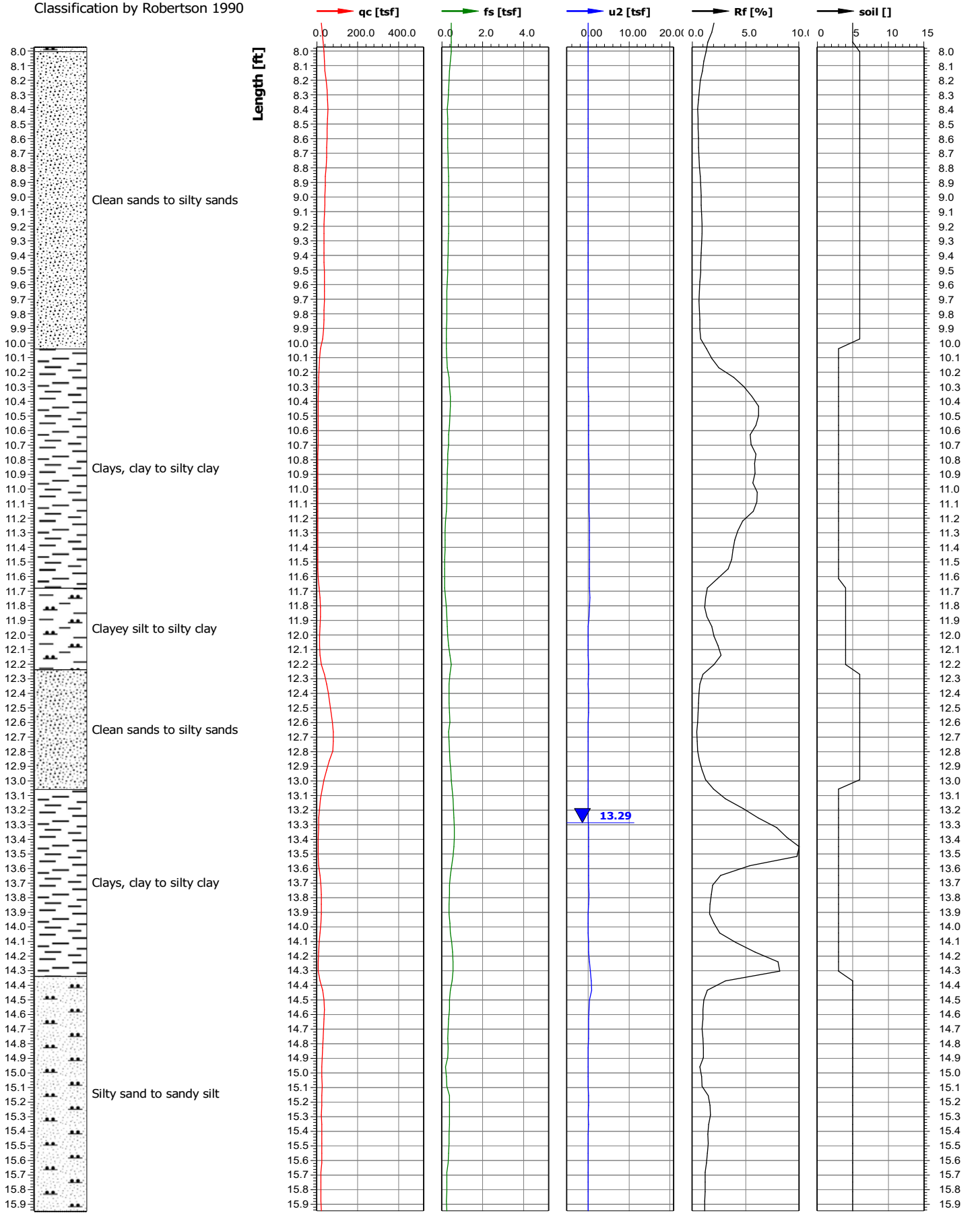
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



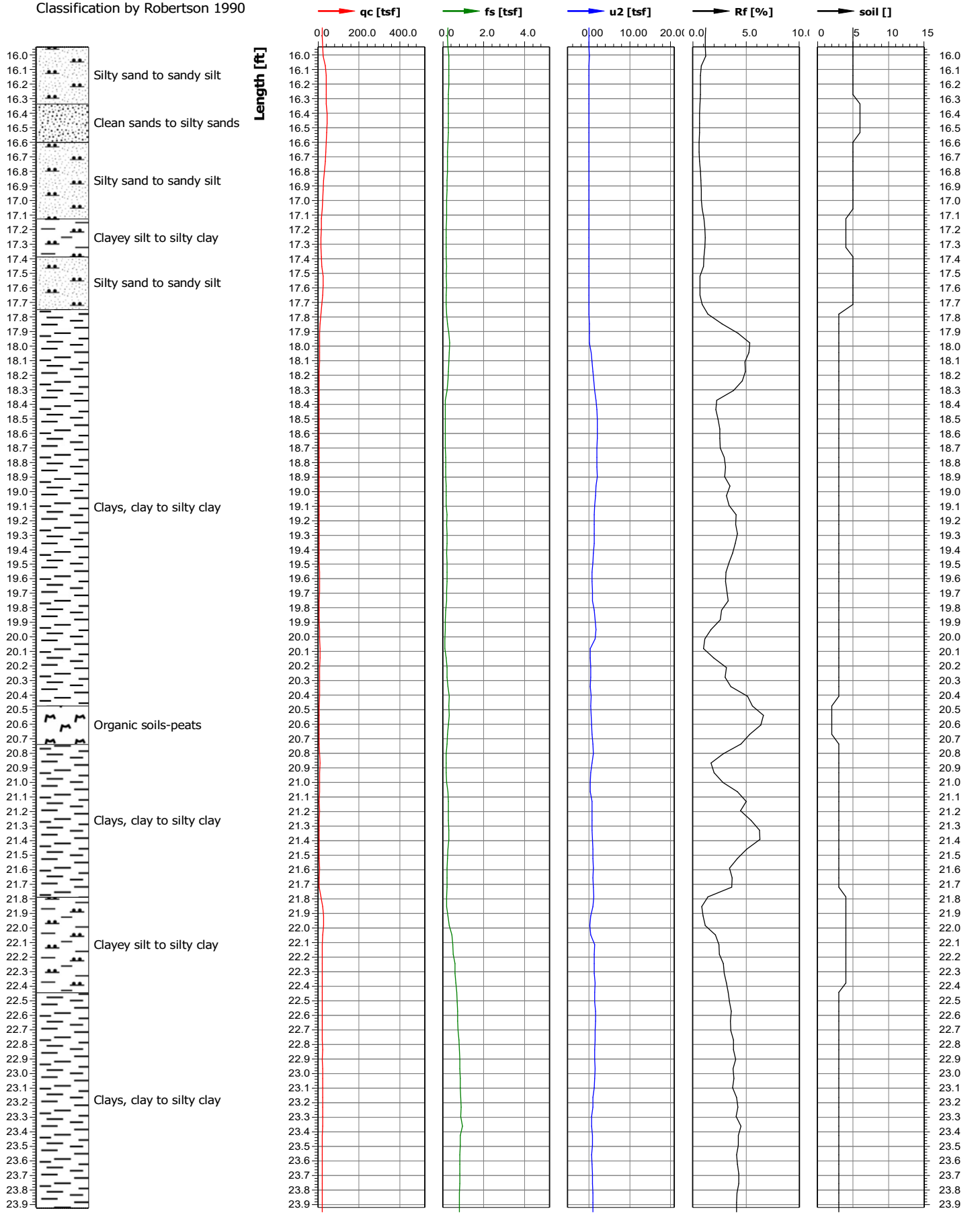
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



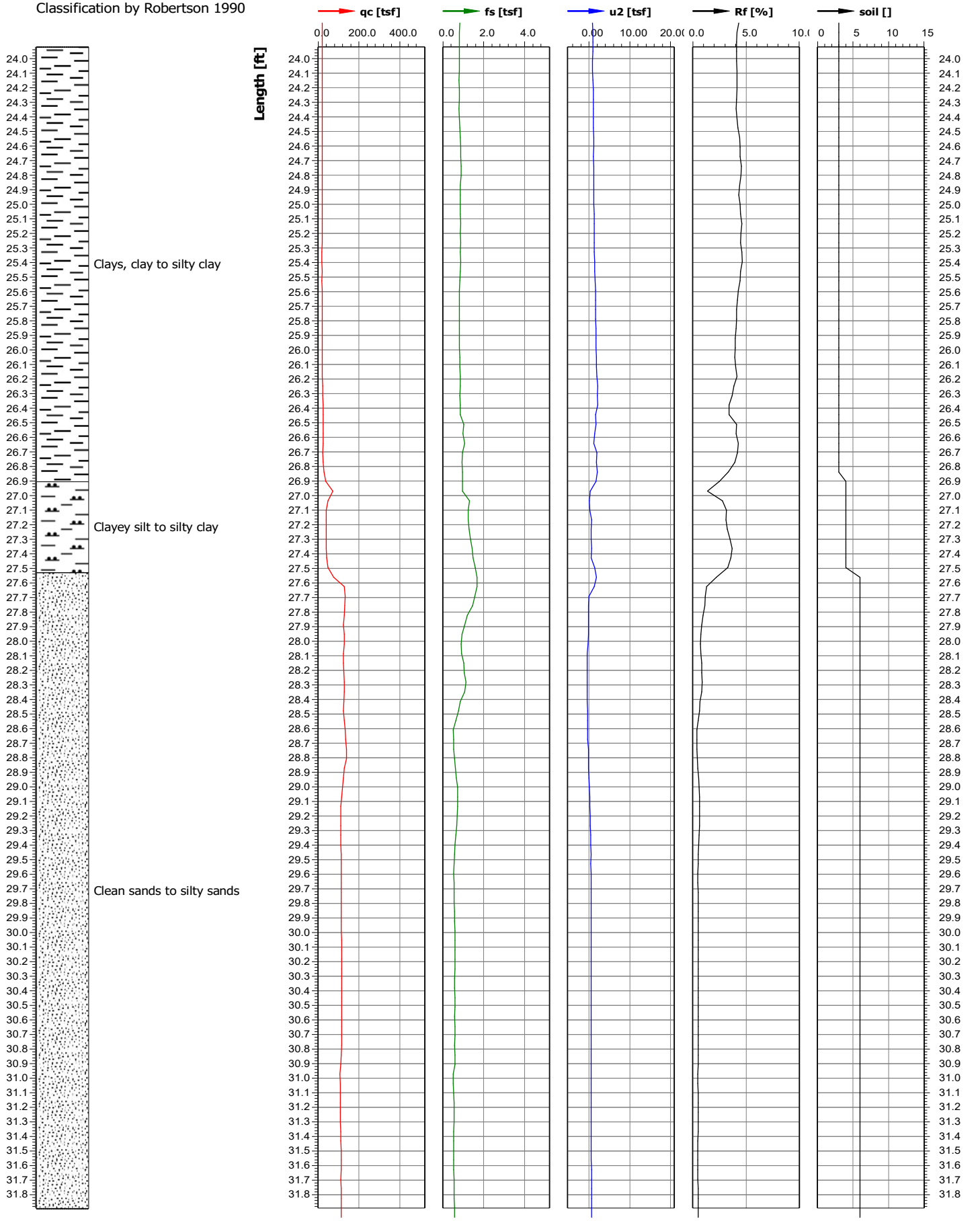
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



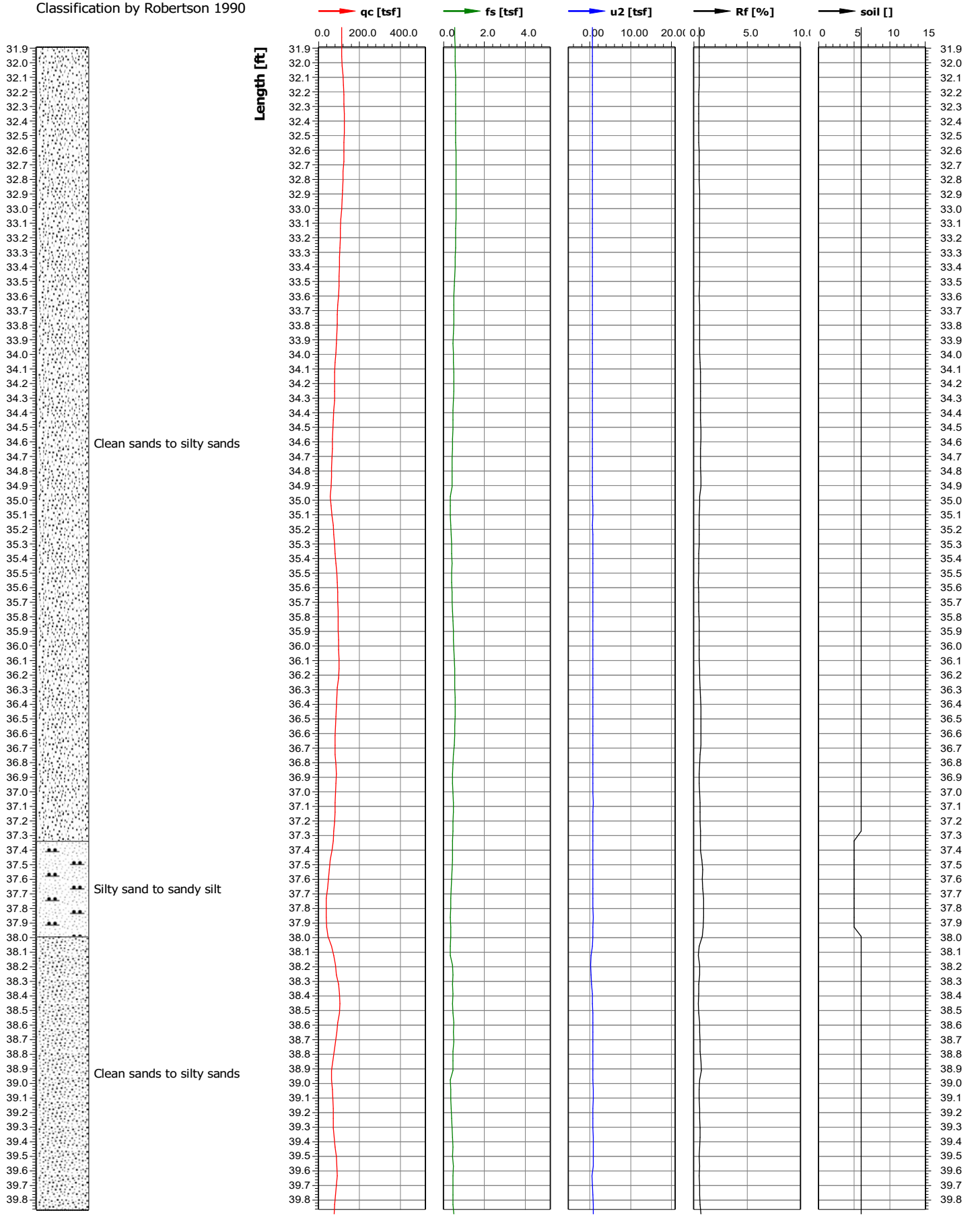
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



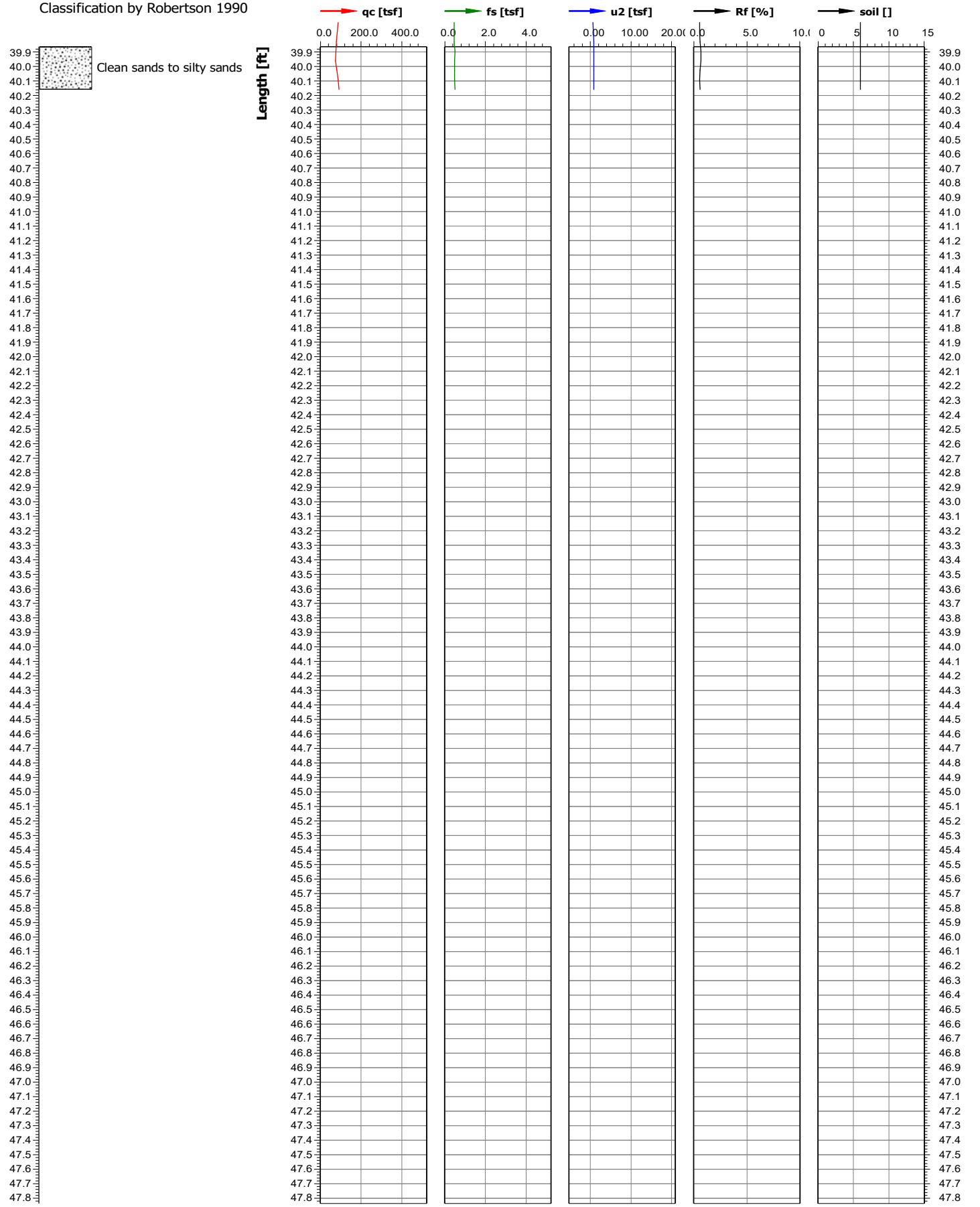
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



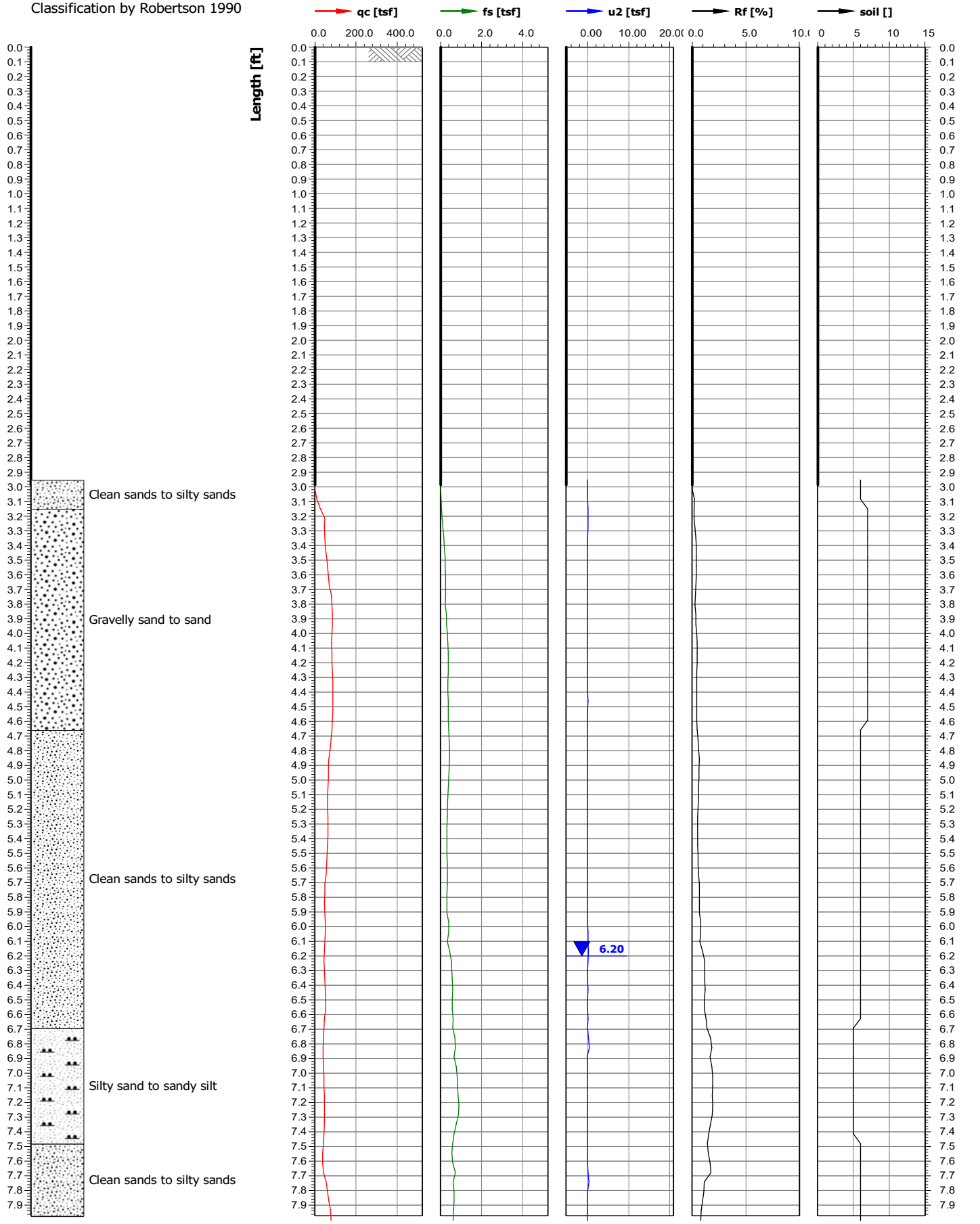
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		6/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



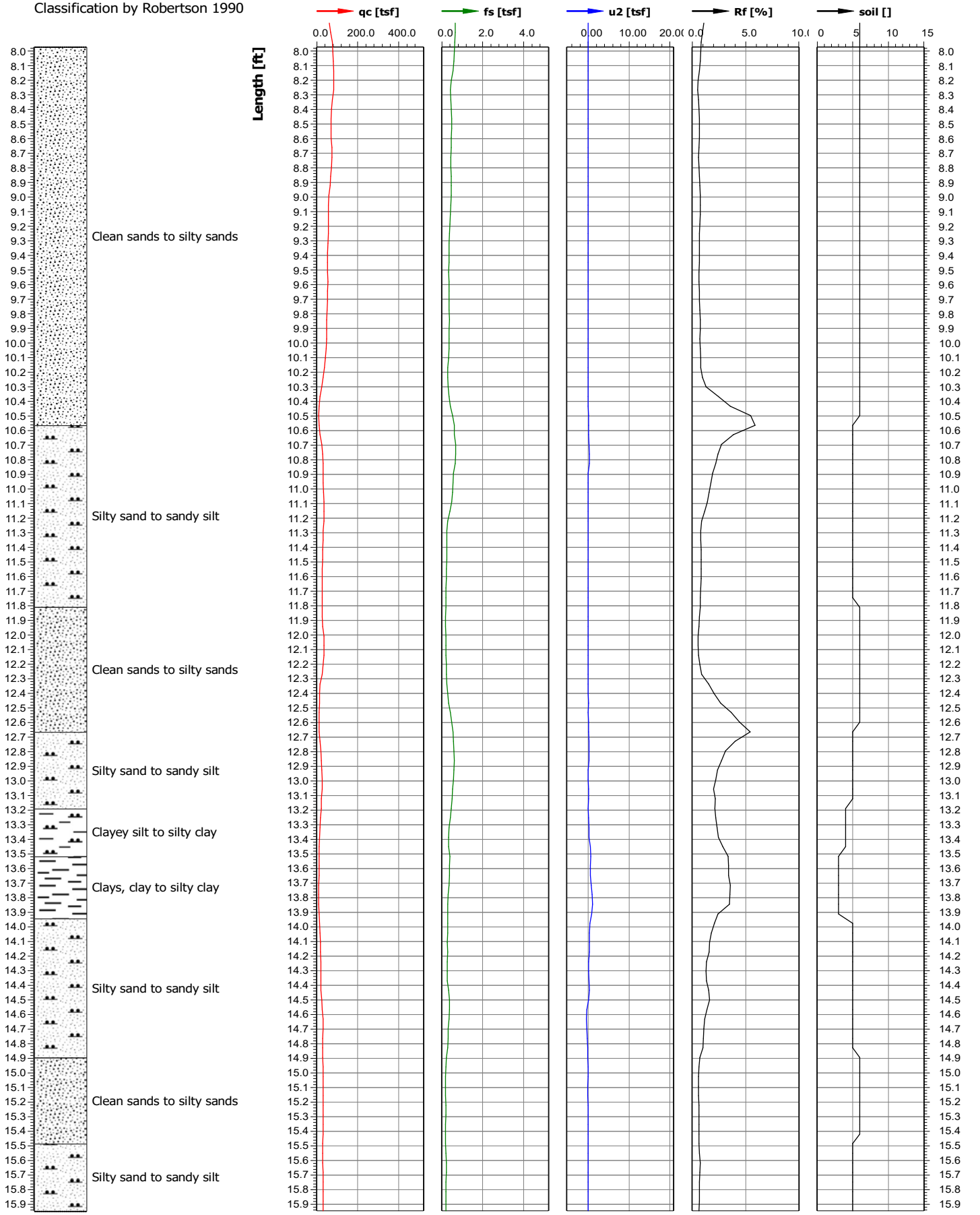
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT7	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



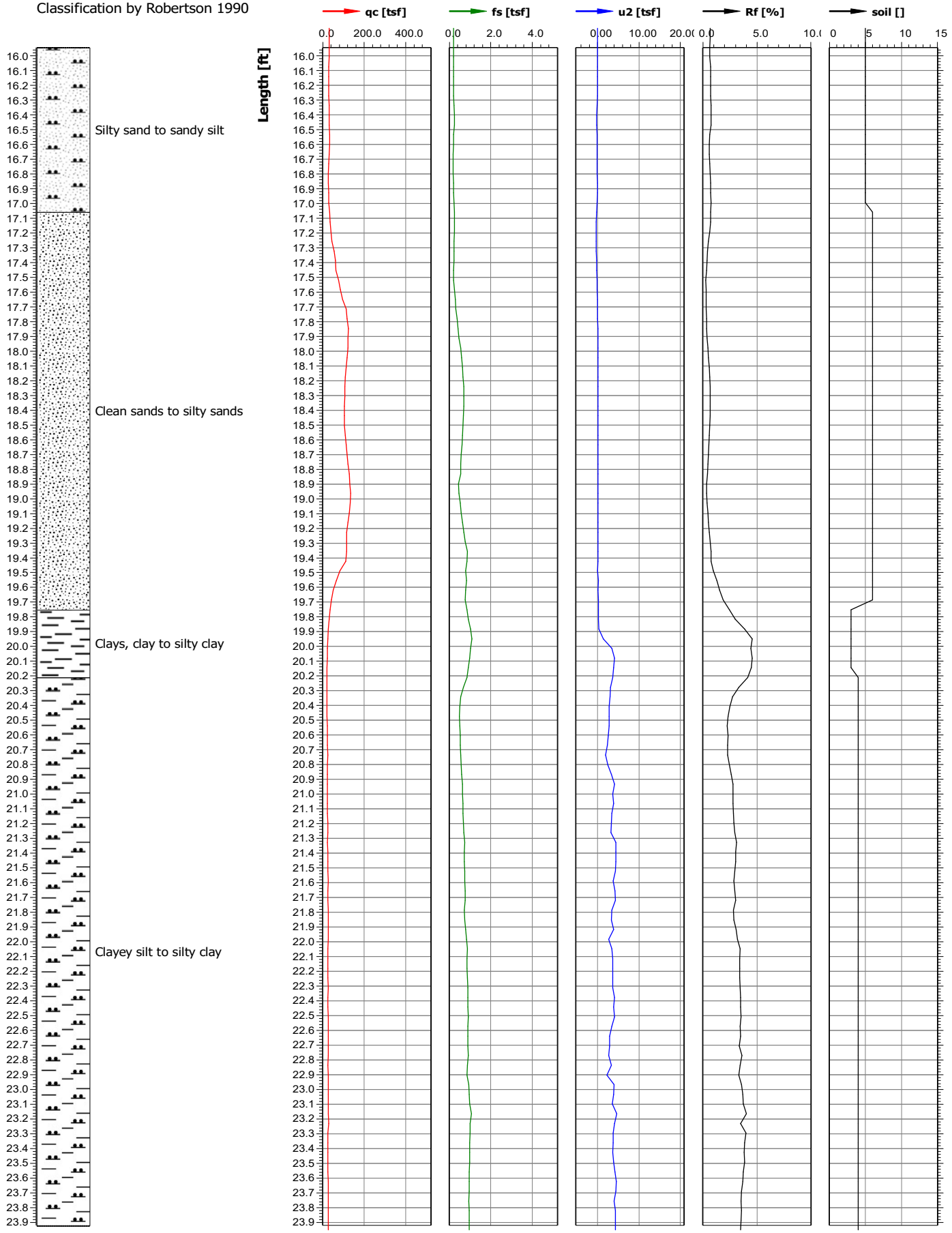
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT7	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



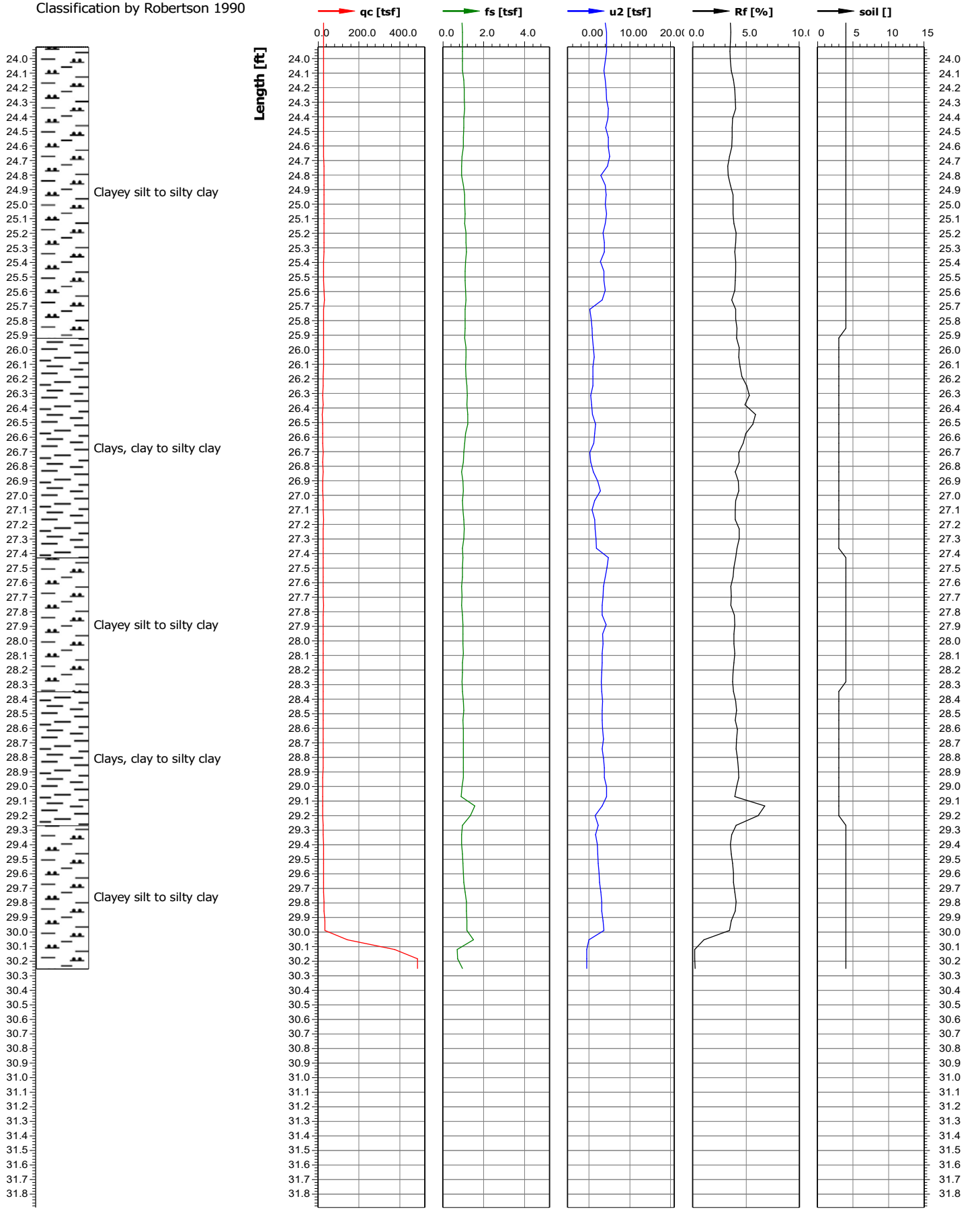
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT7	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



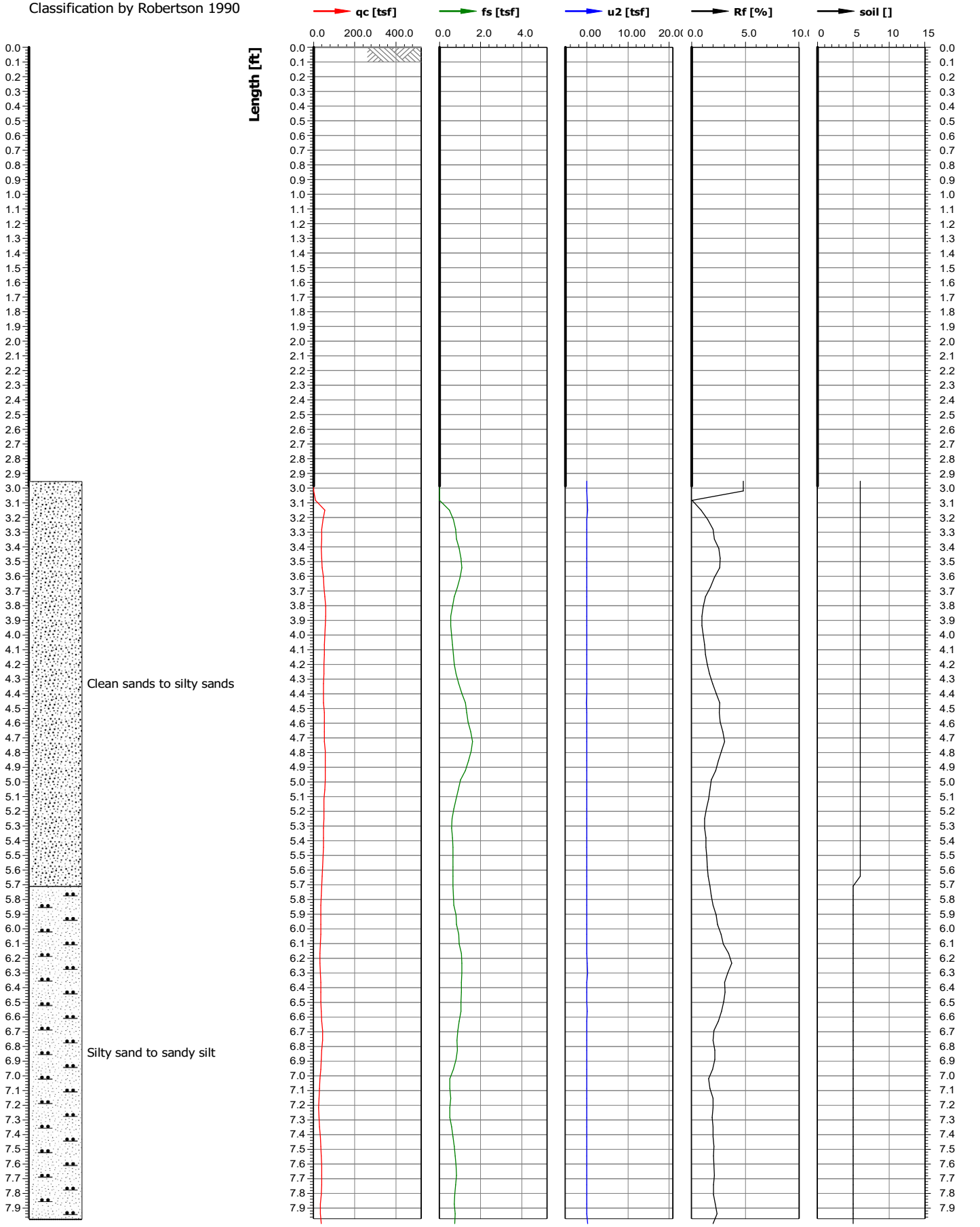
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT7	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



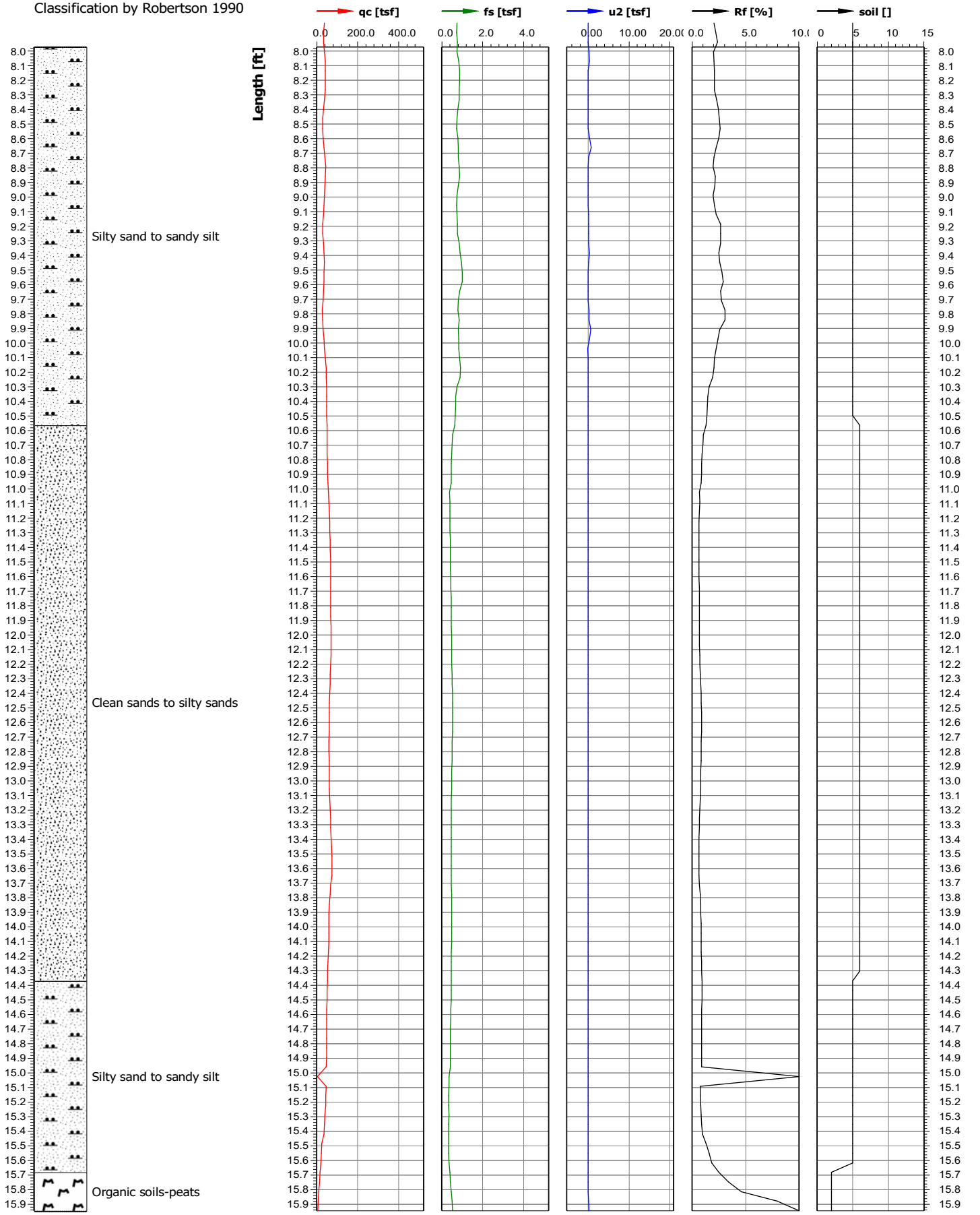
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



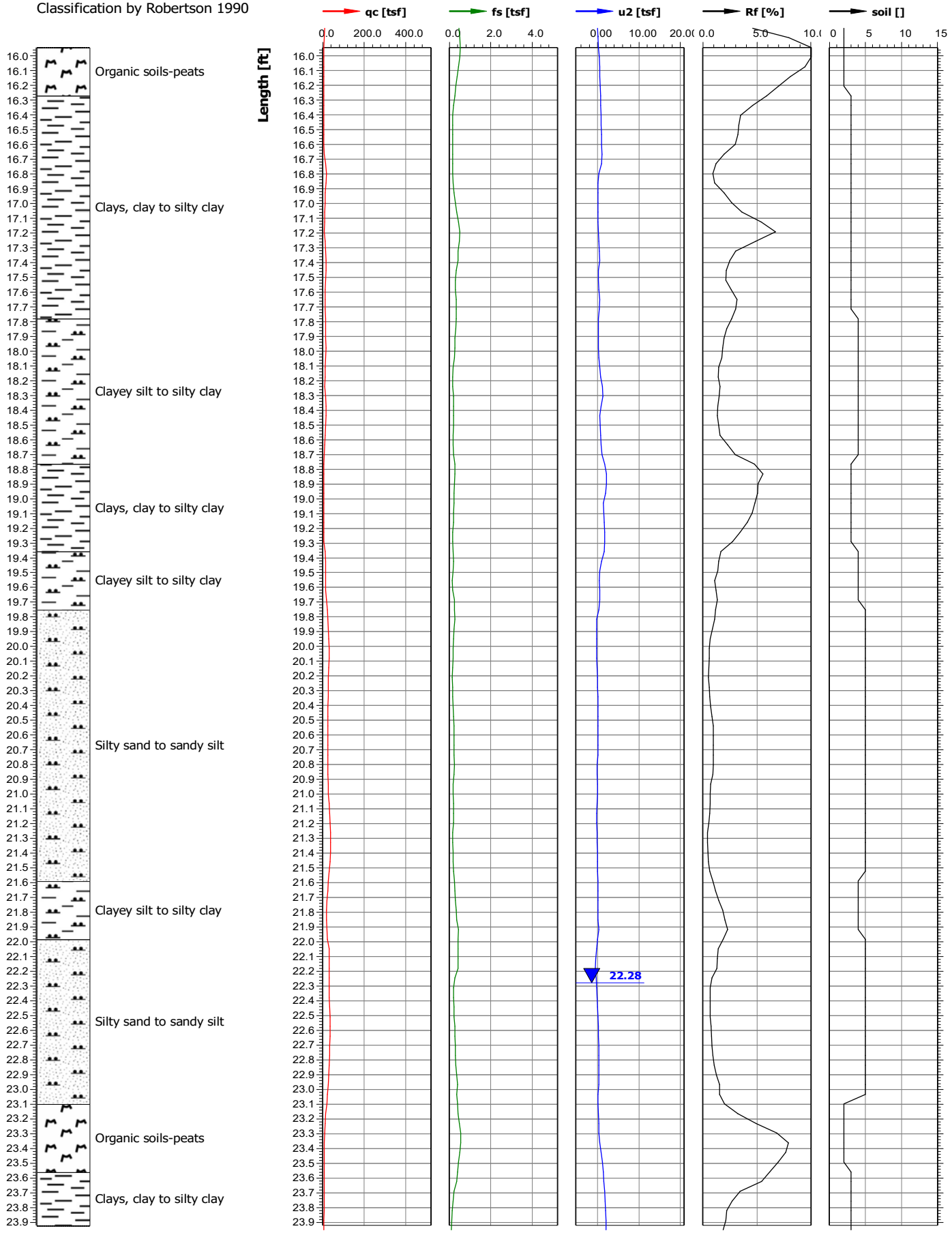
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



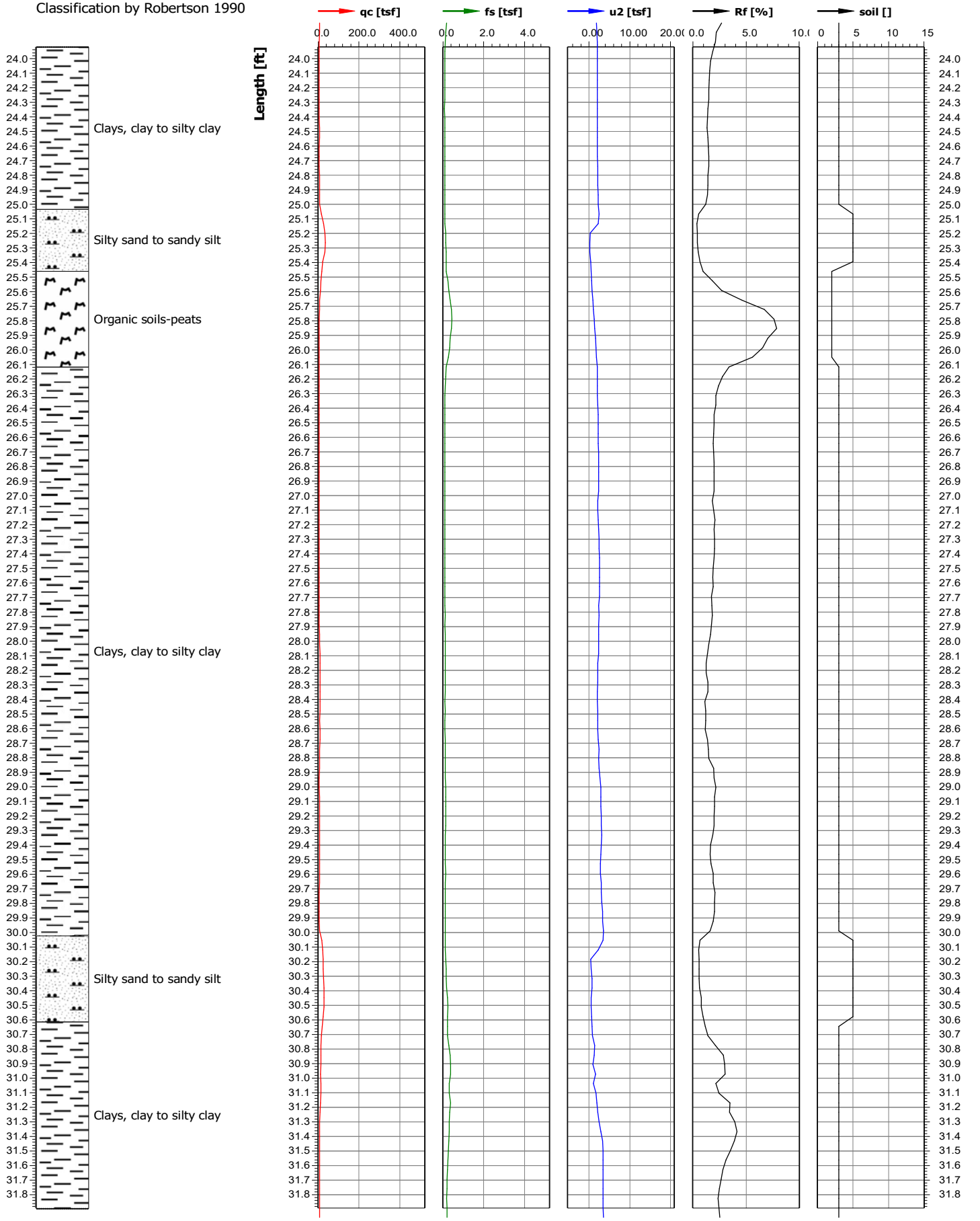
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



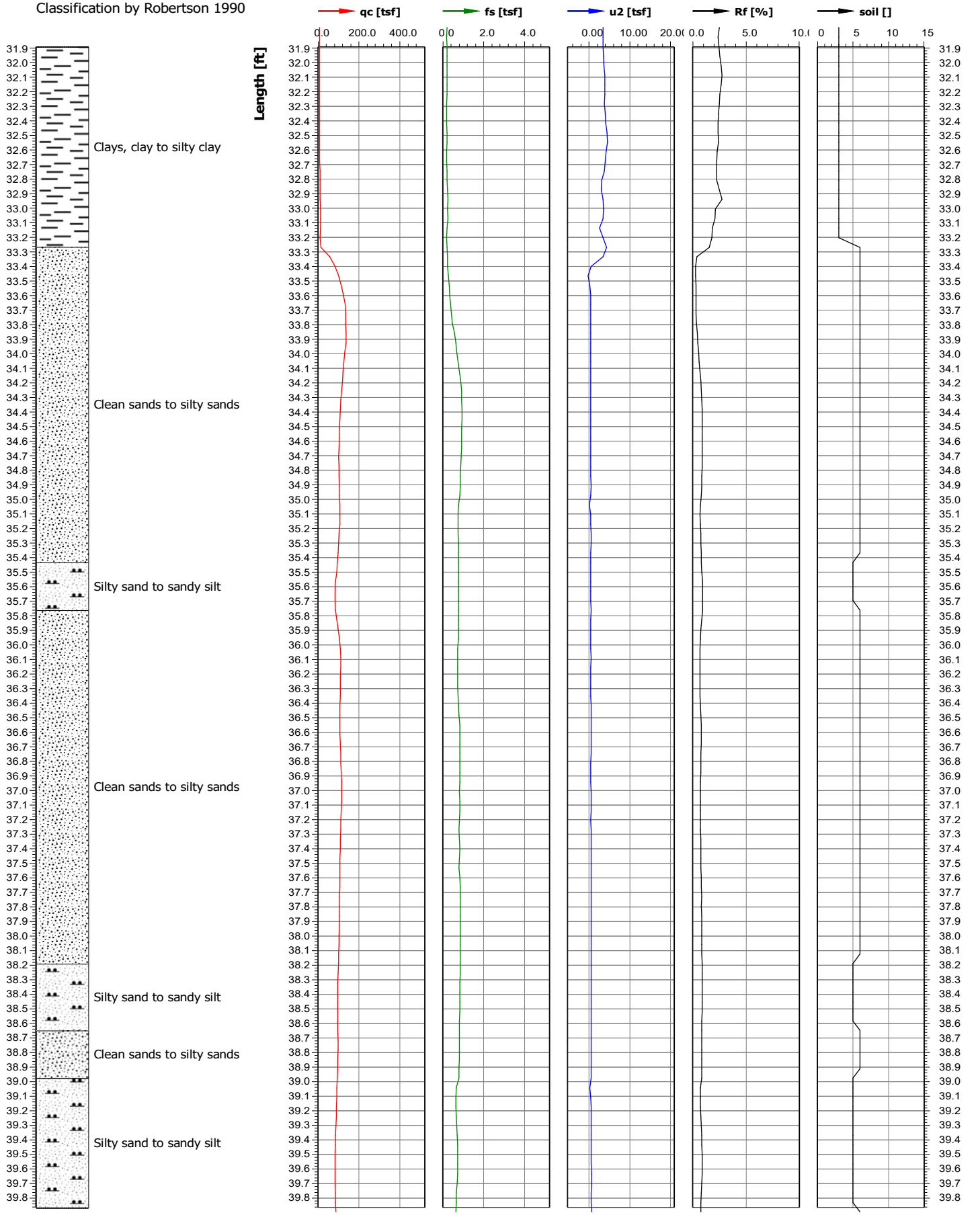
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



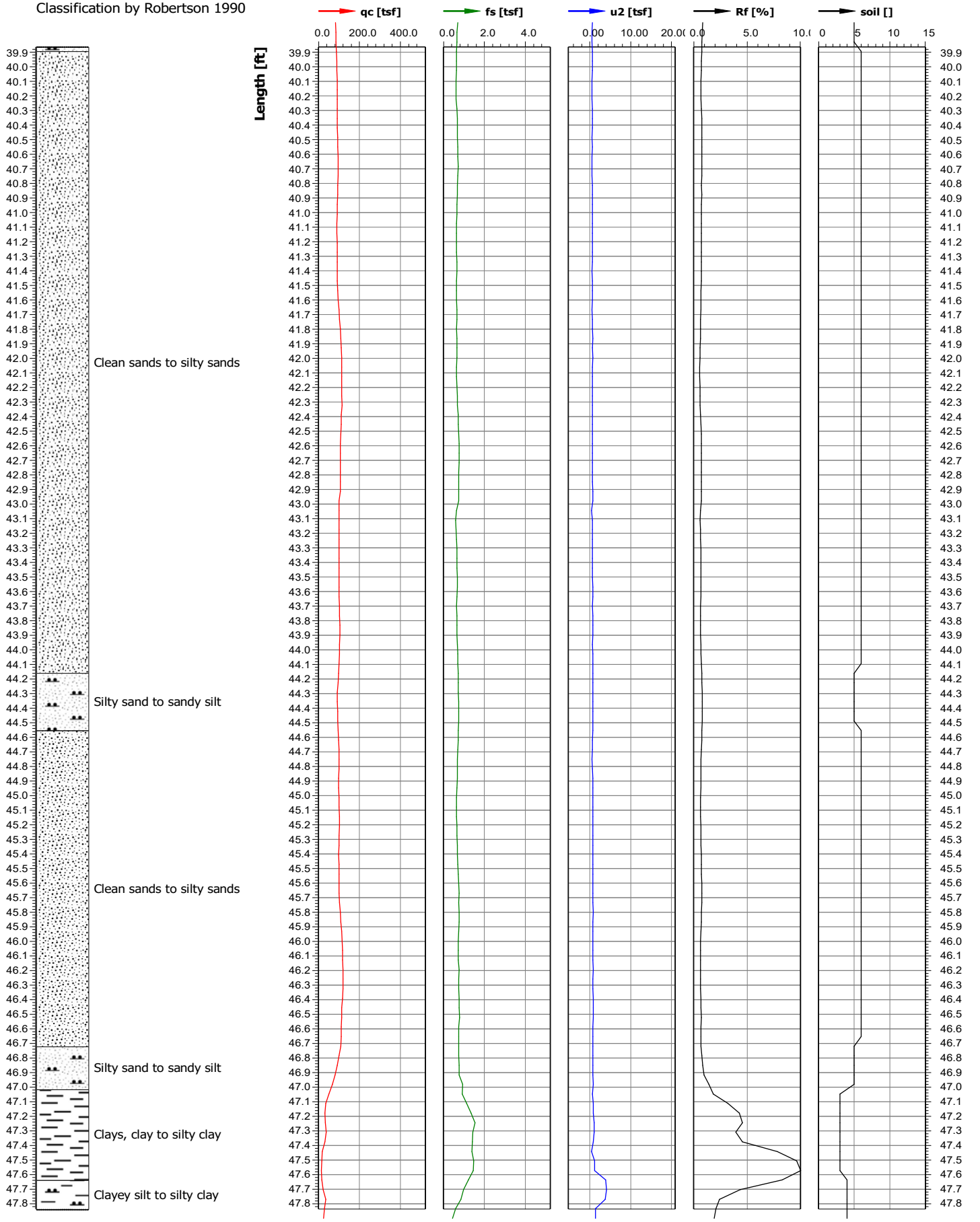
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



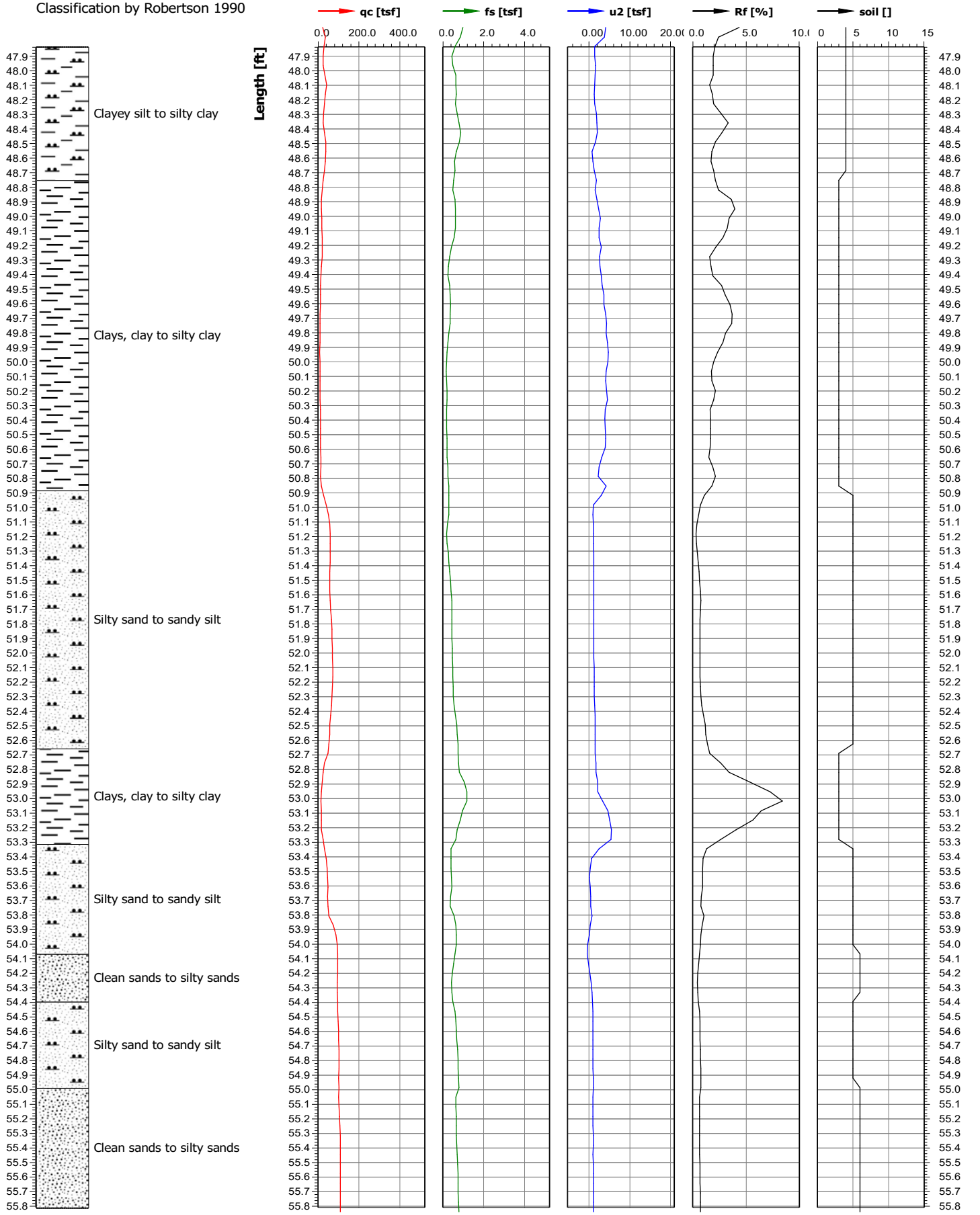
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		6/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



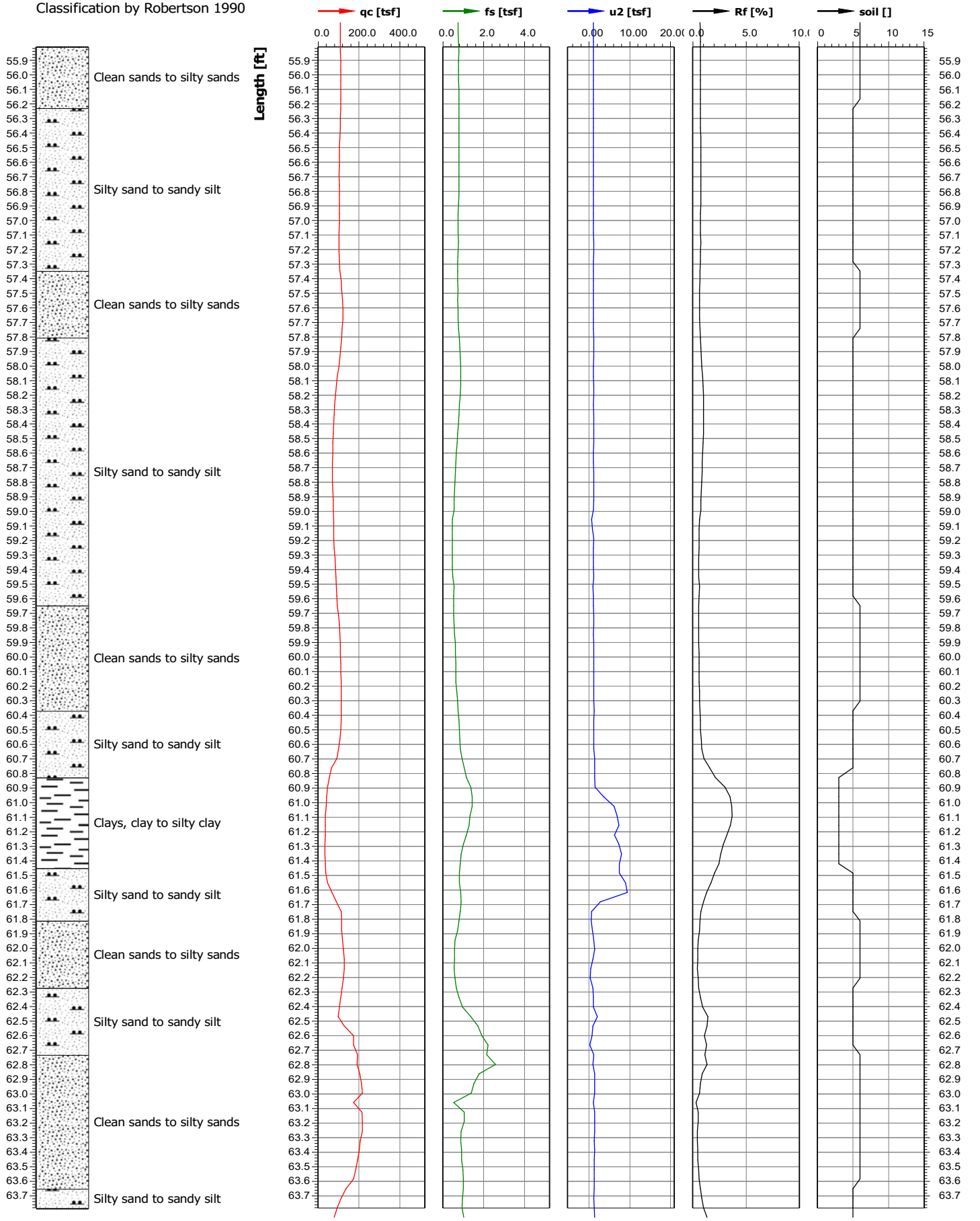
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		7/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



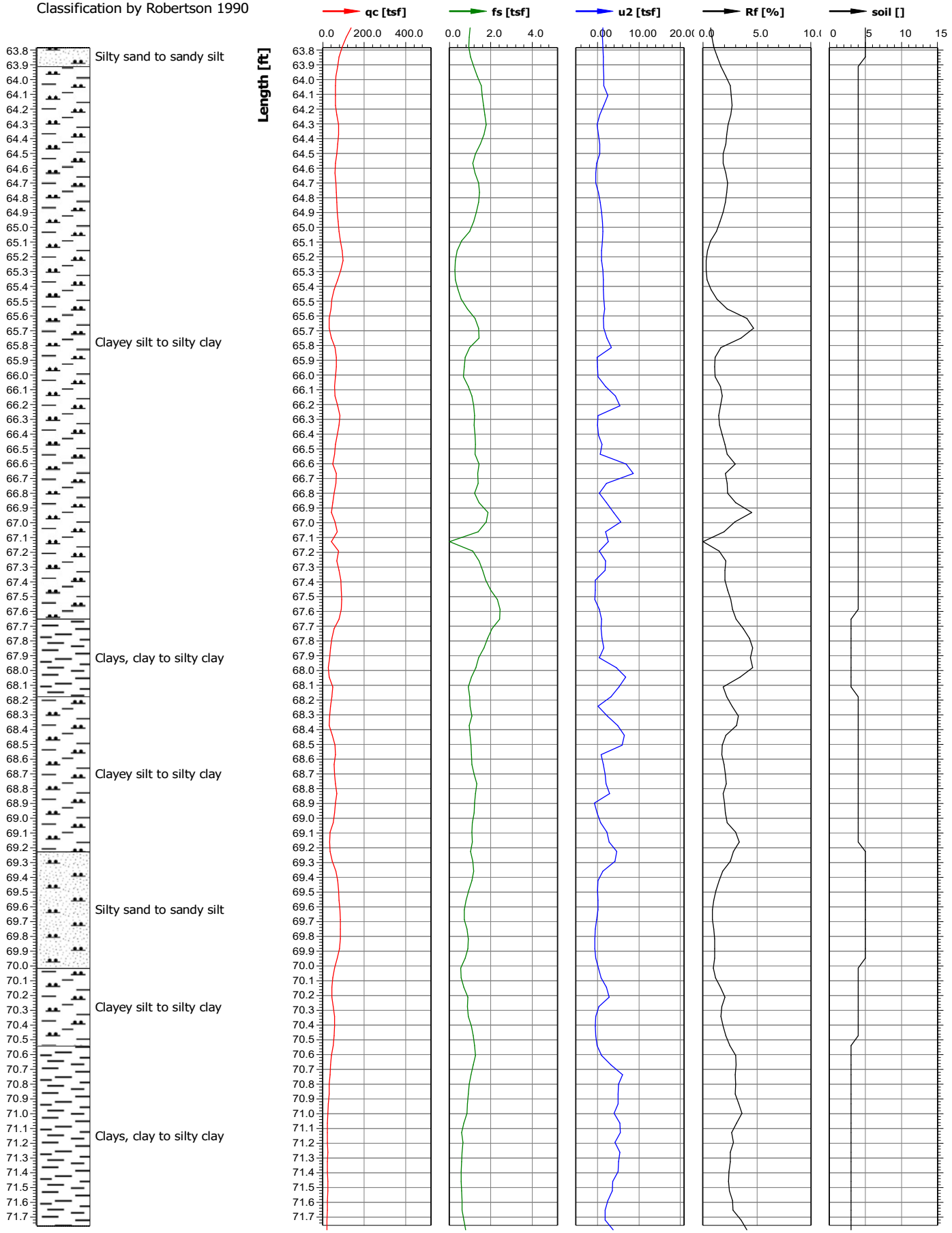
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		8/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



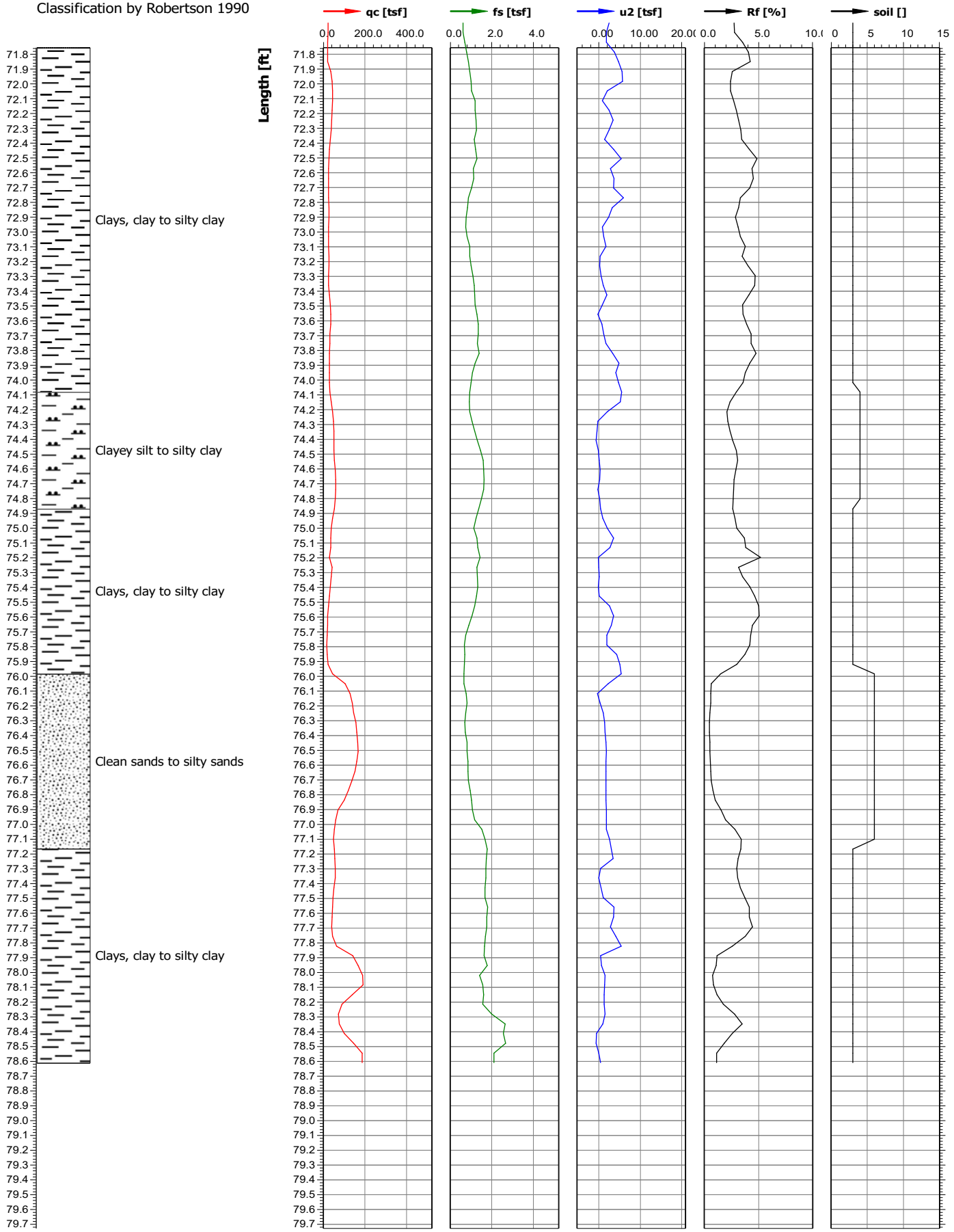
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		9/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



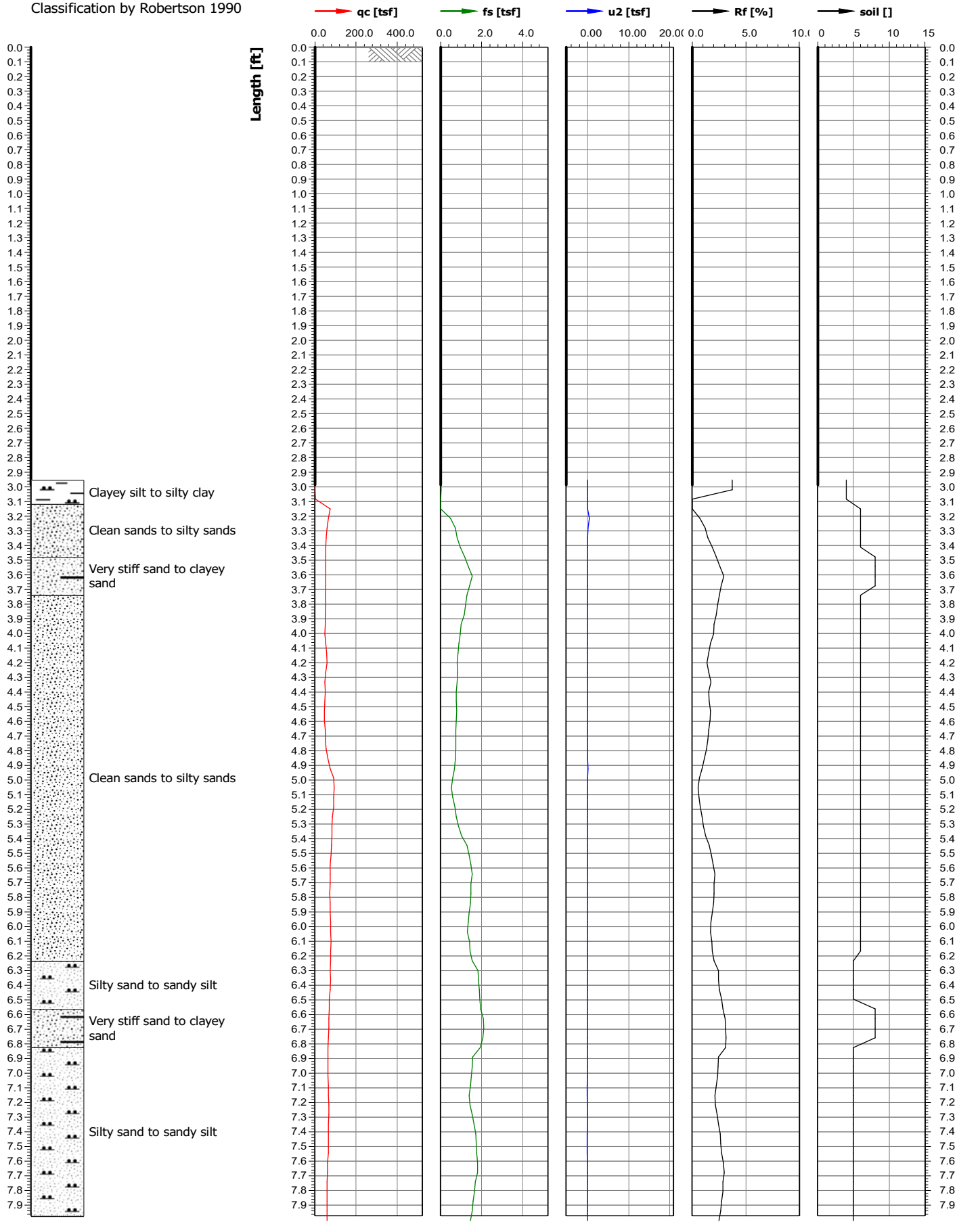
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		10/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



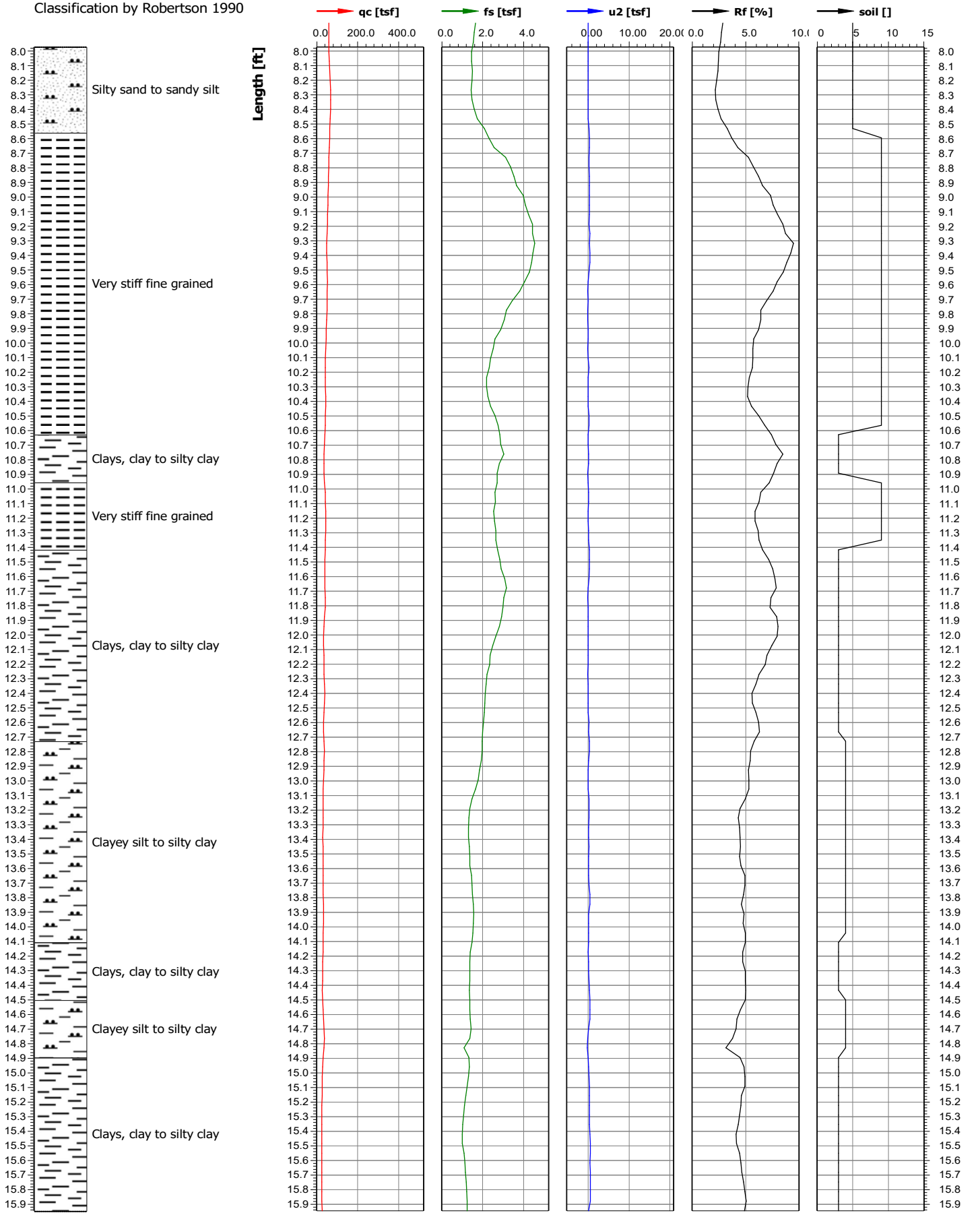
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



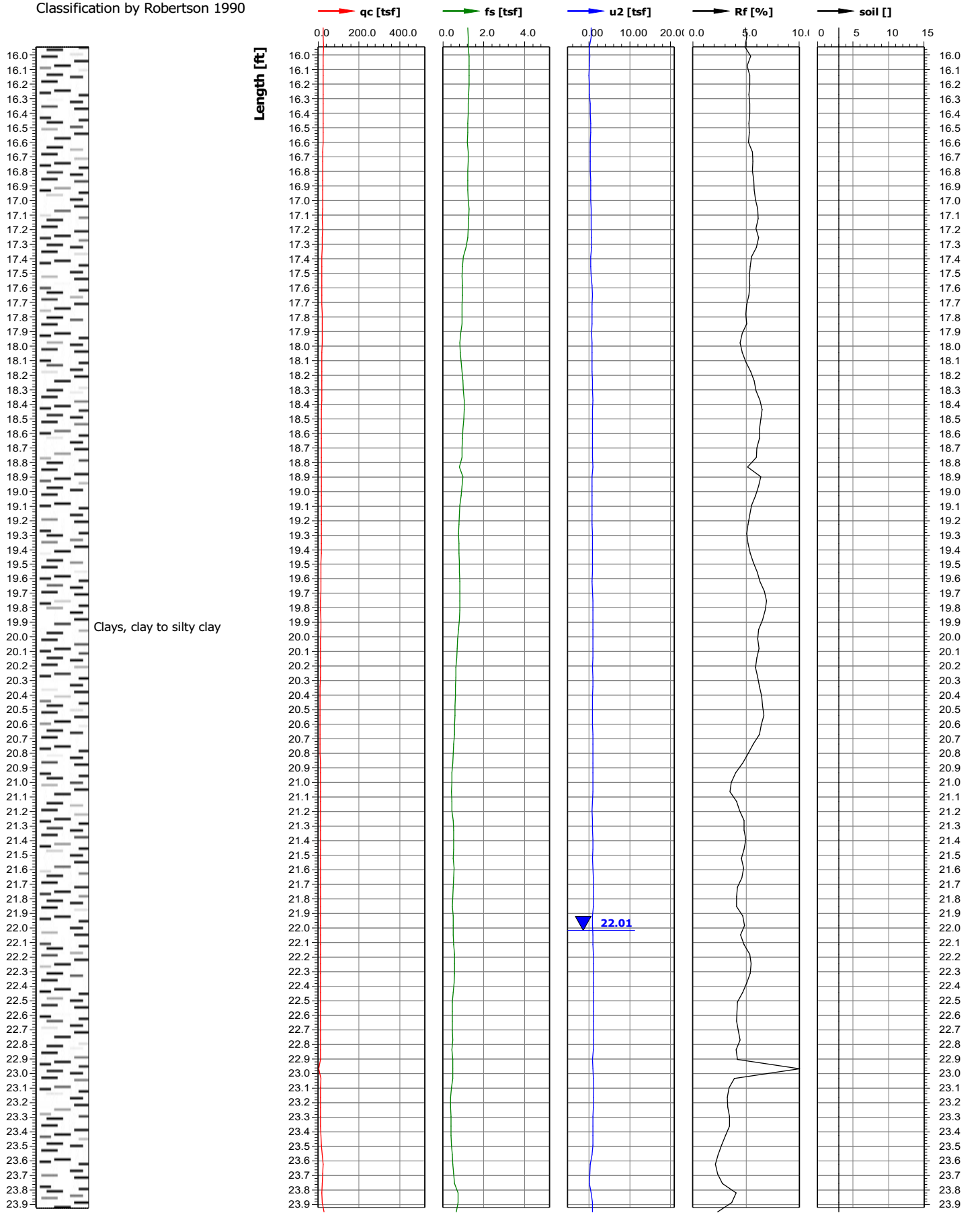
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



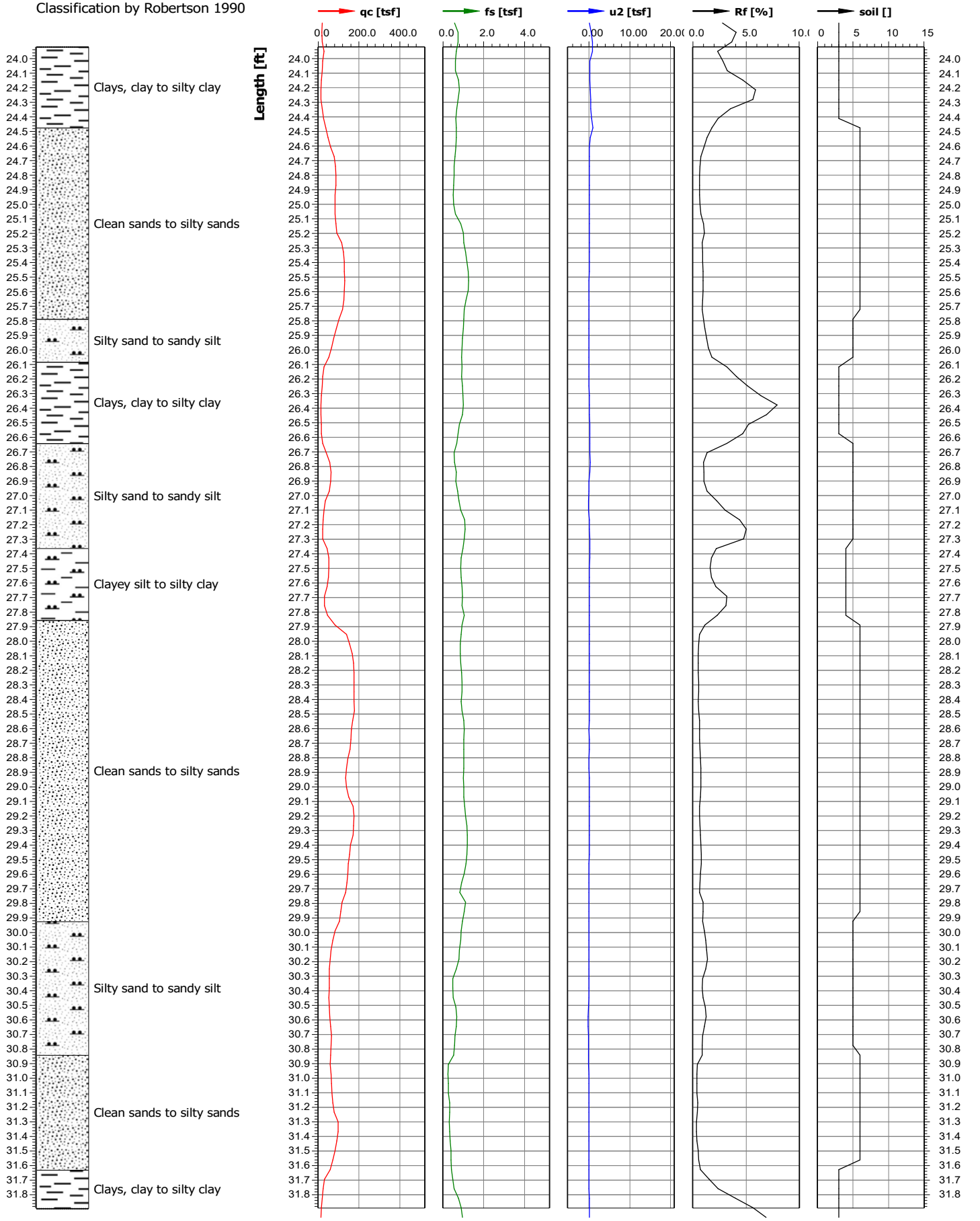
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



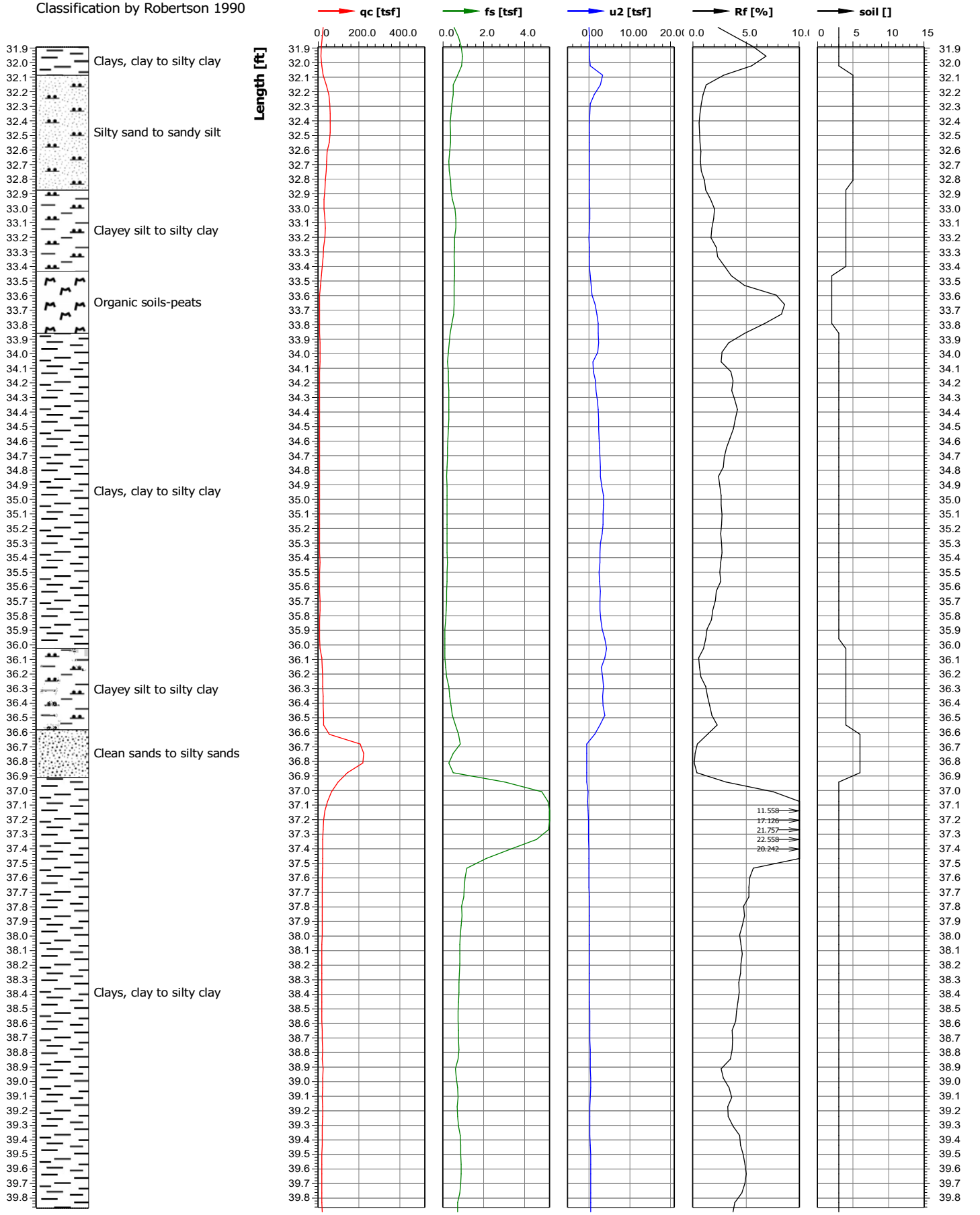
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



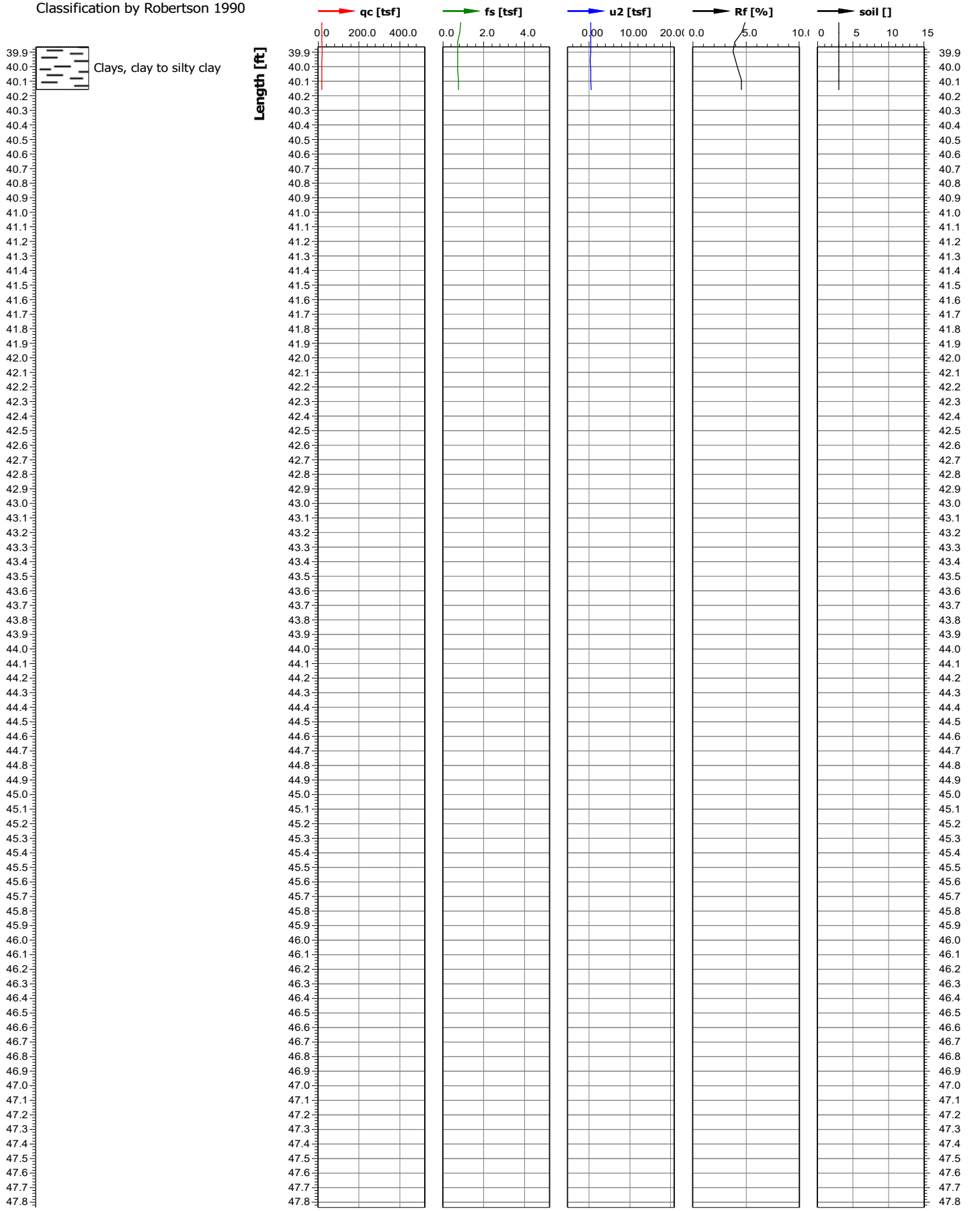
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



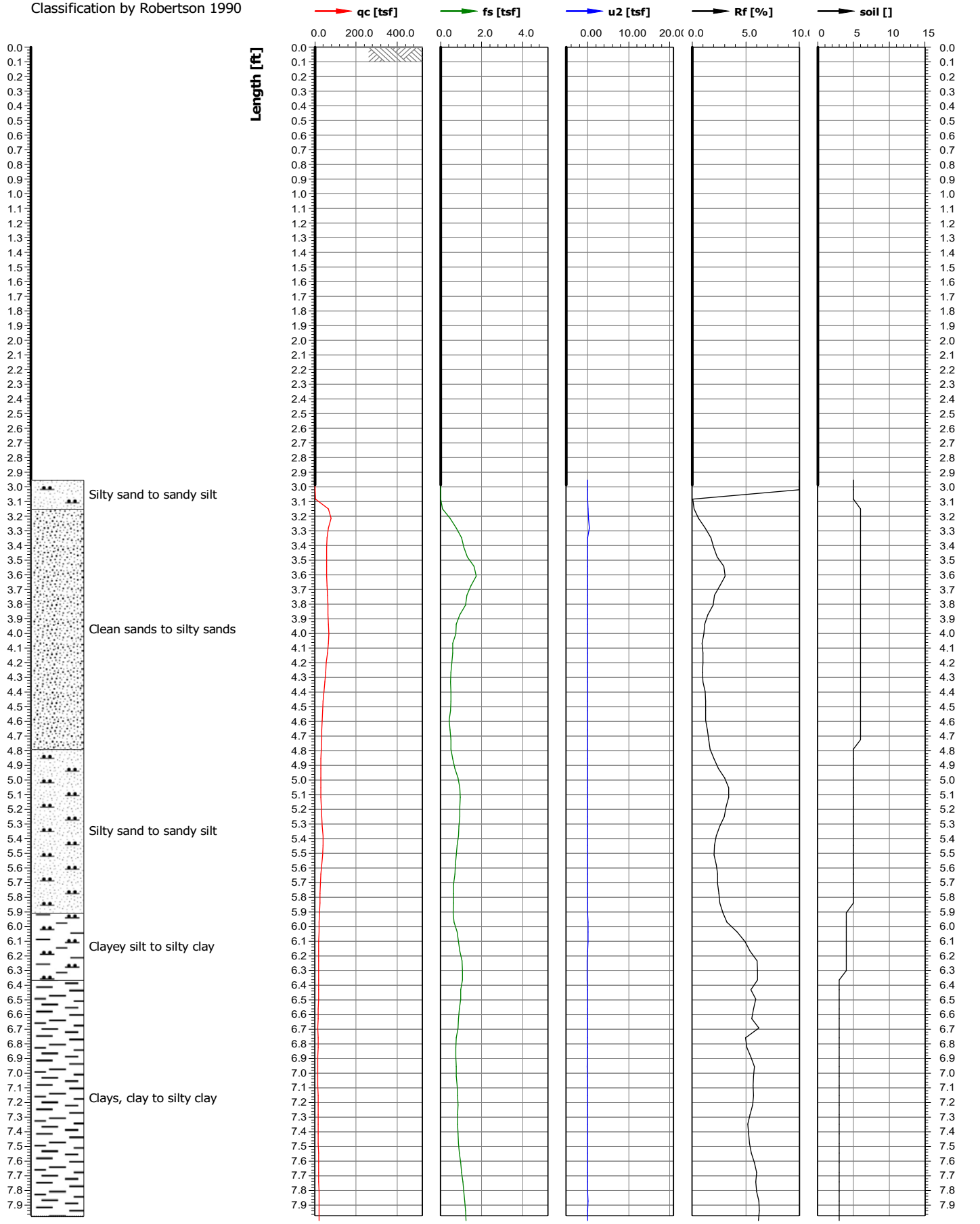
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		6/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



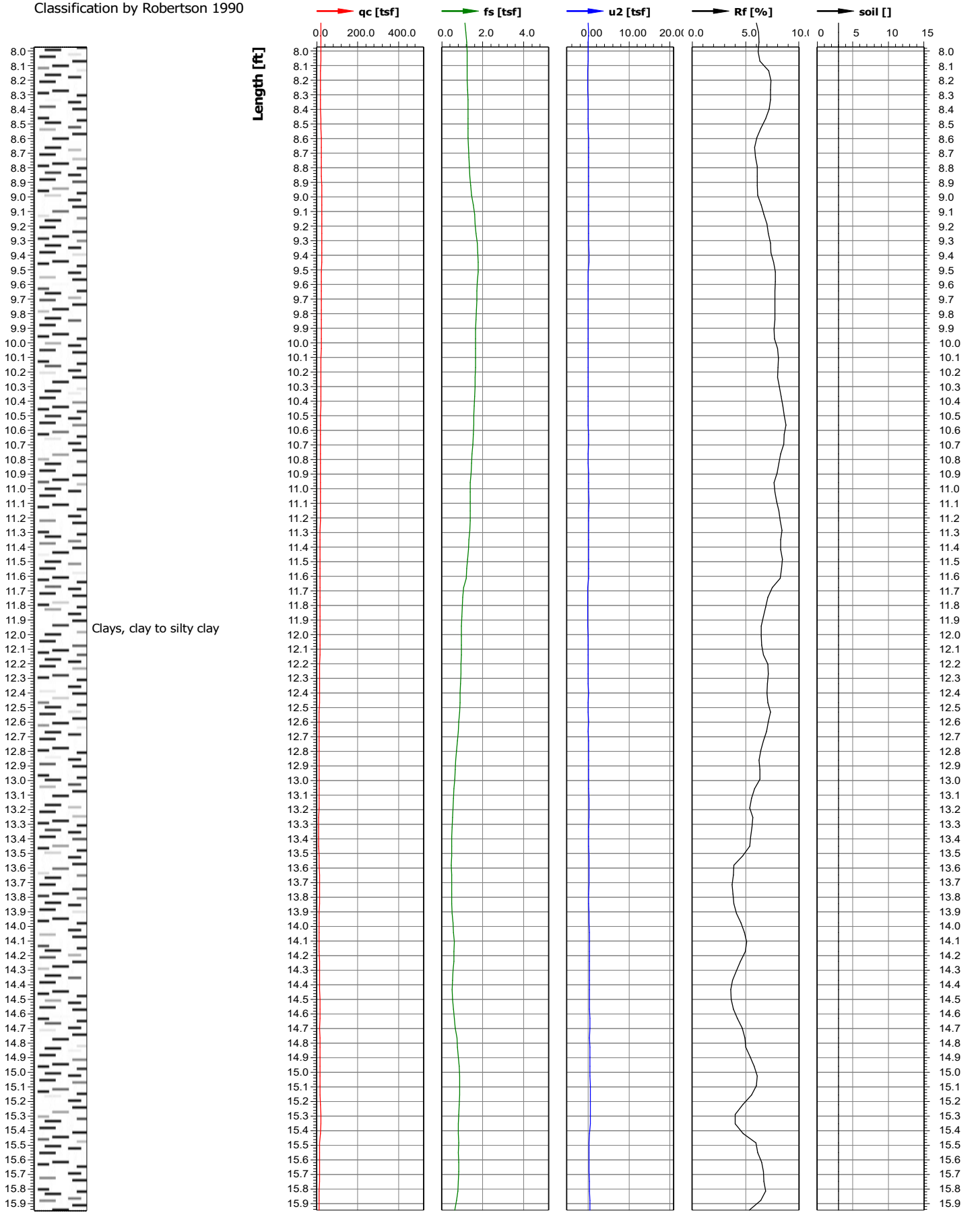
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



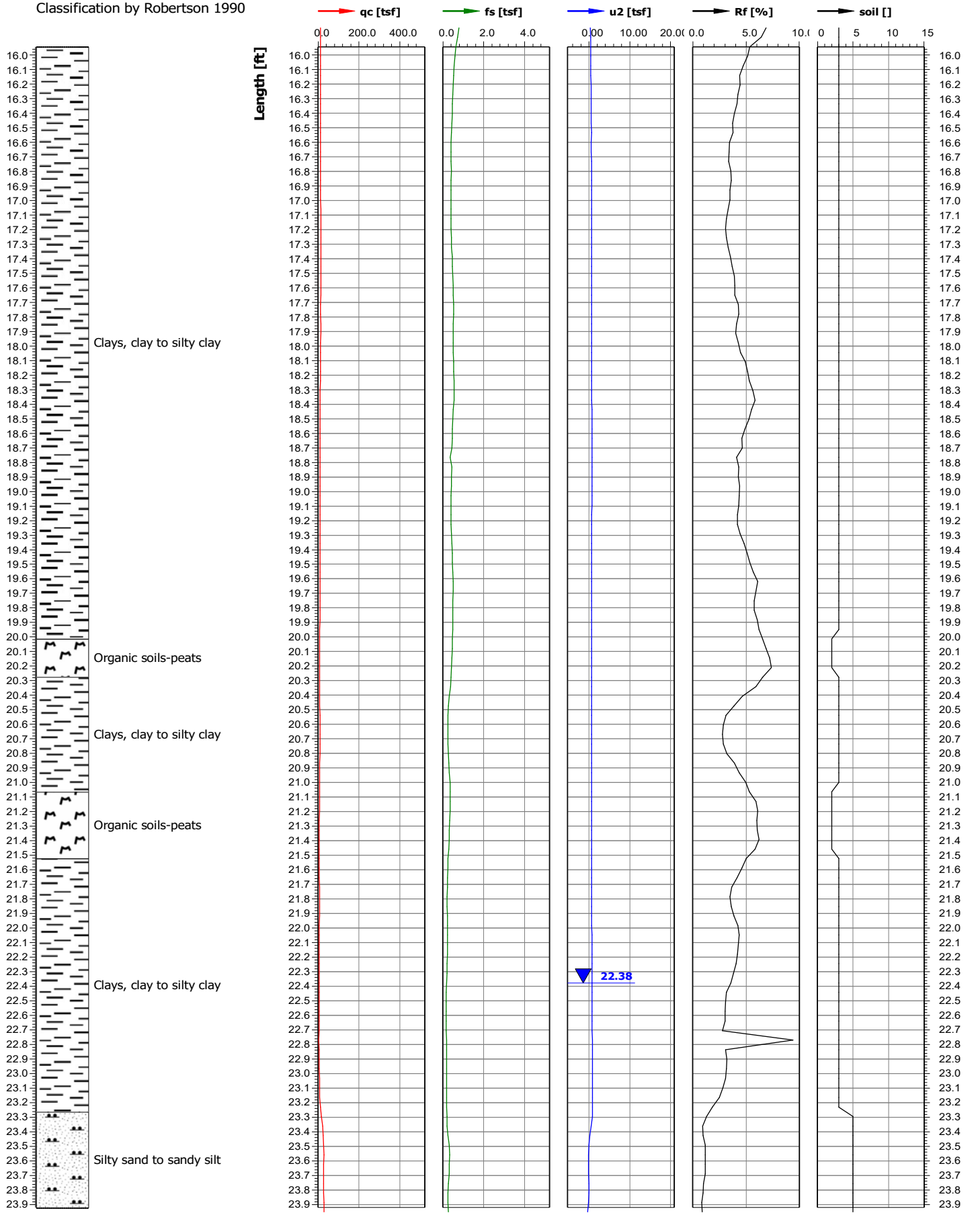
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



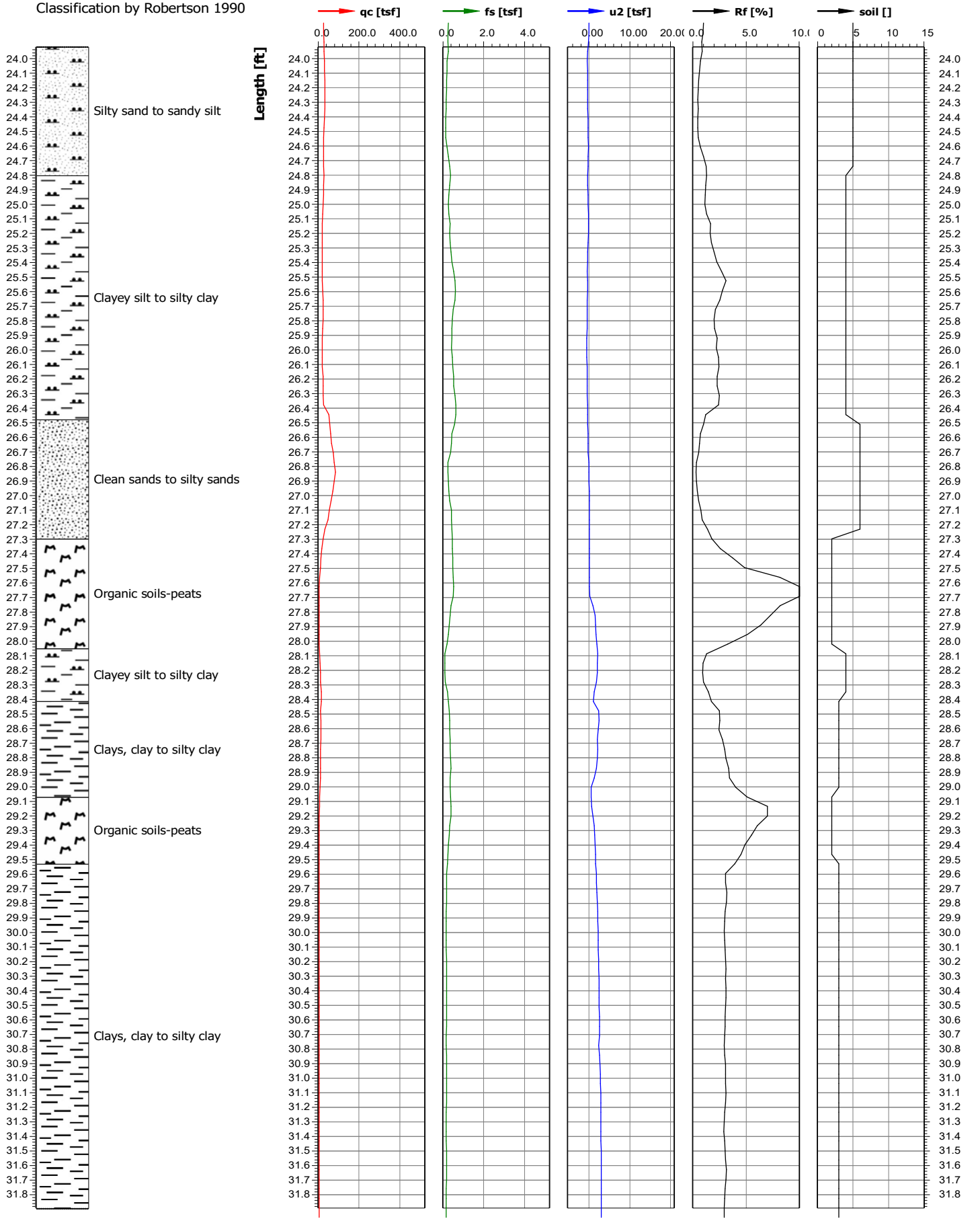
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



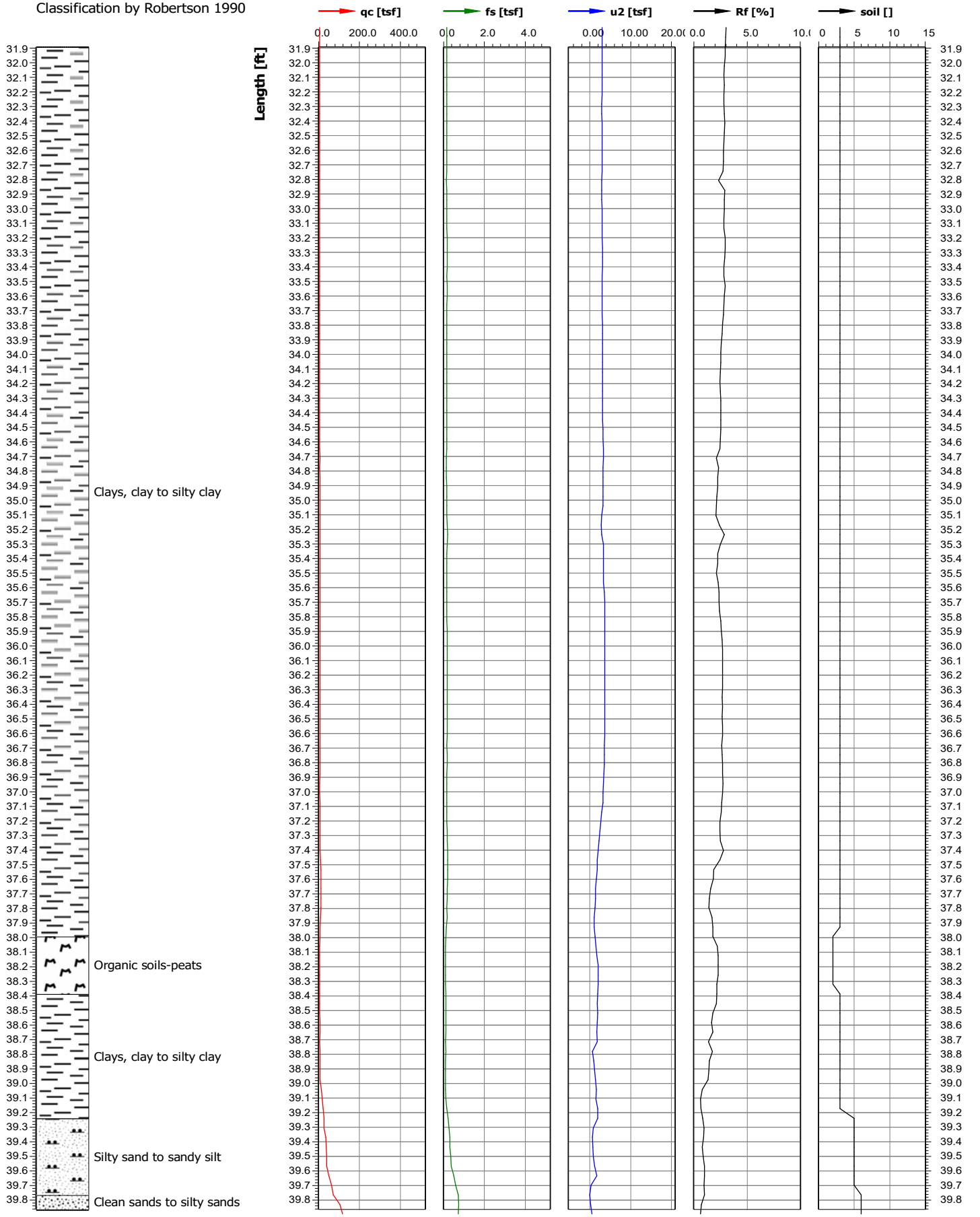
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



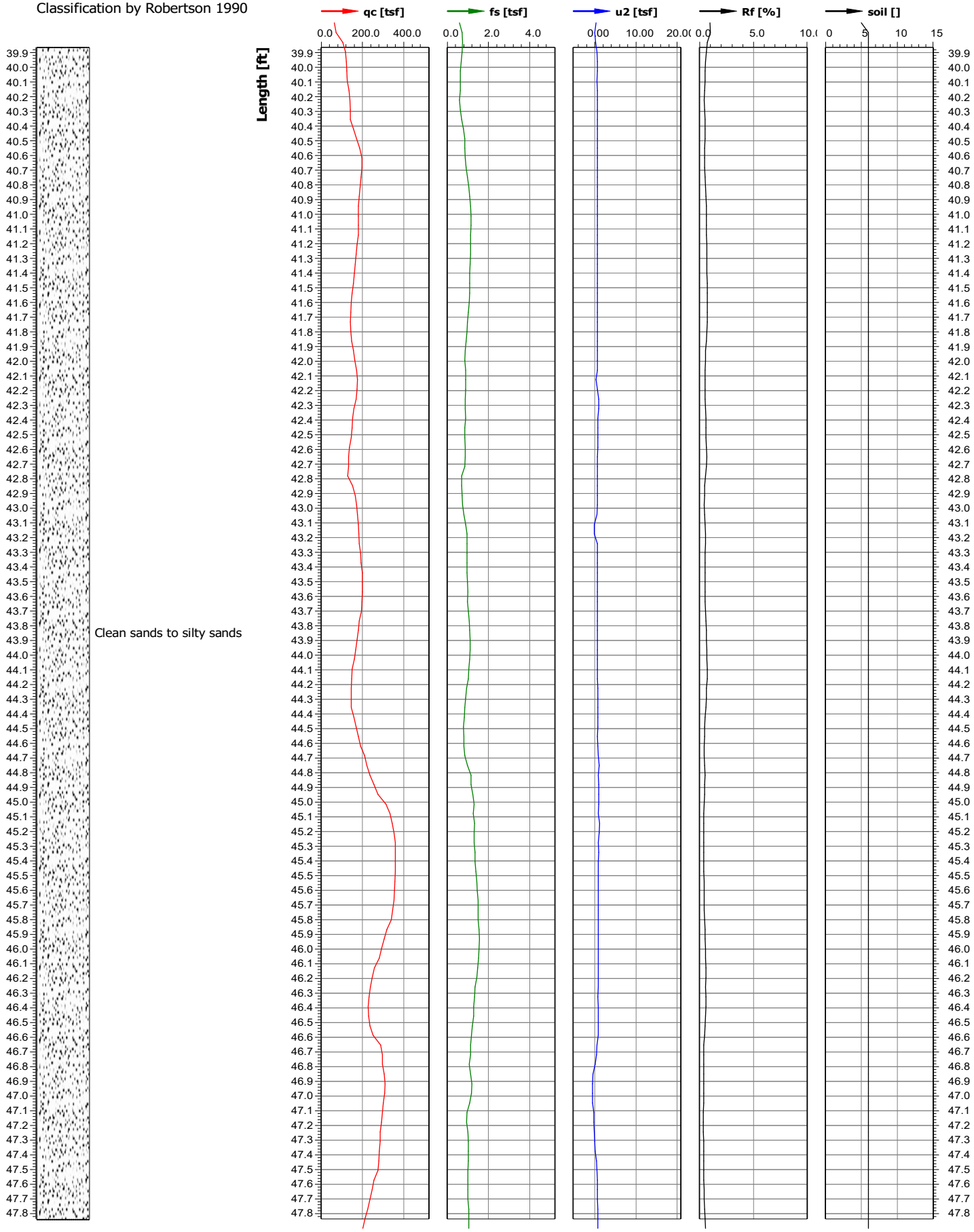
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



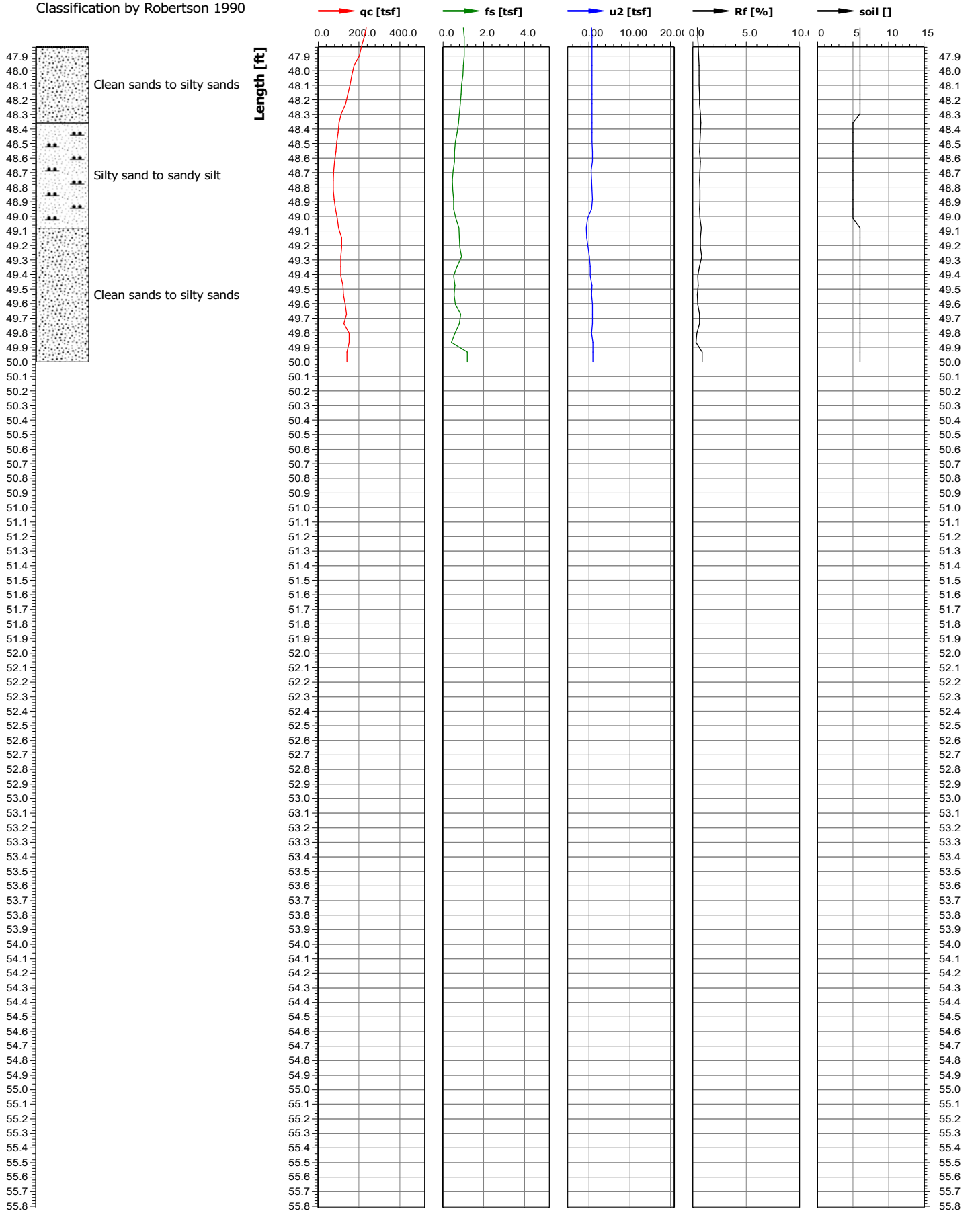
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		6/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



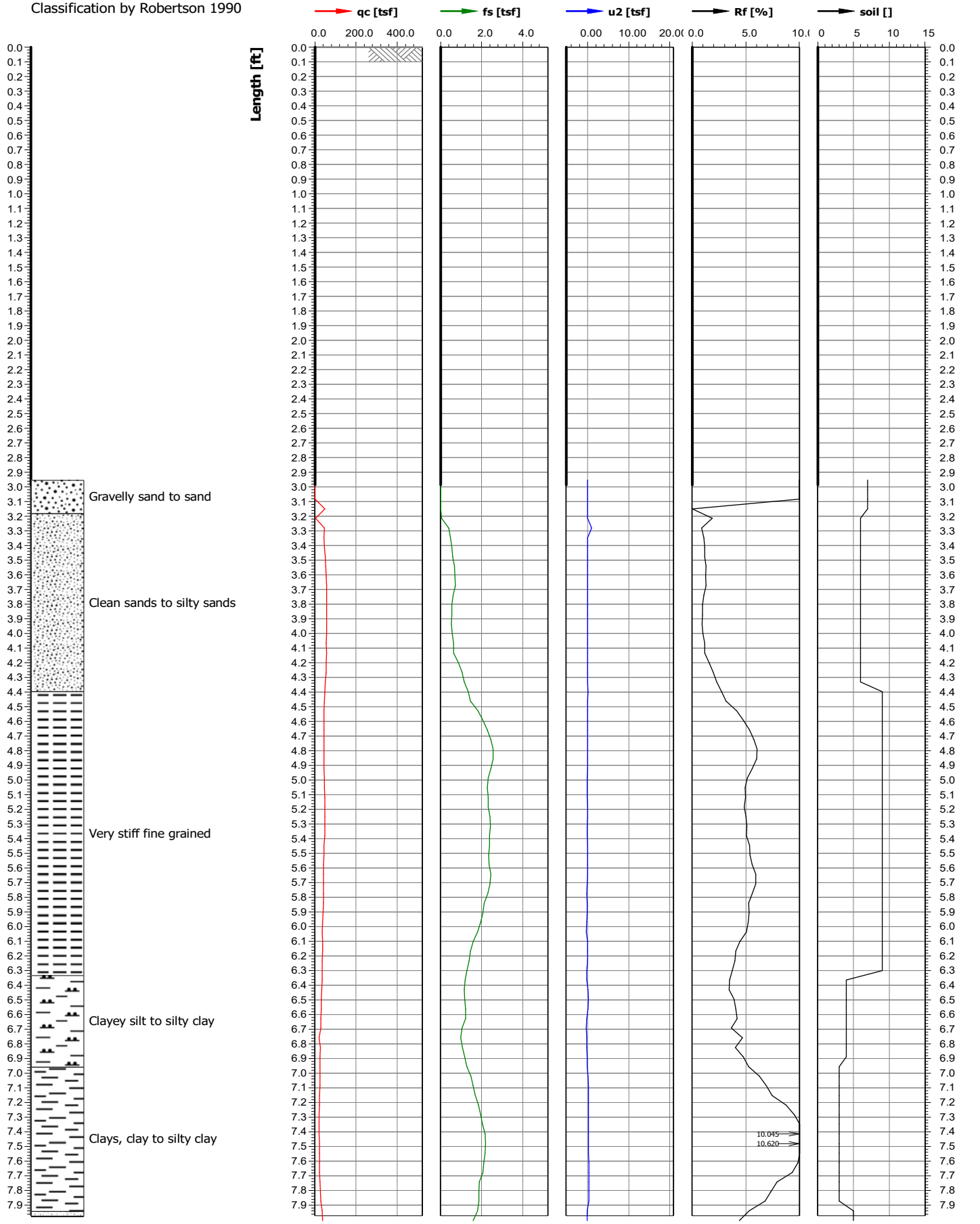
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		7/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



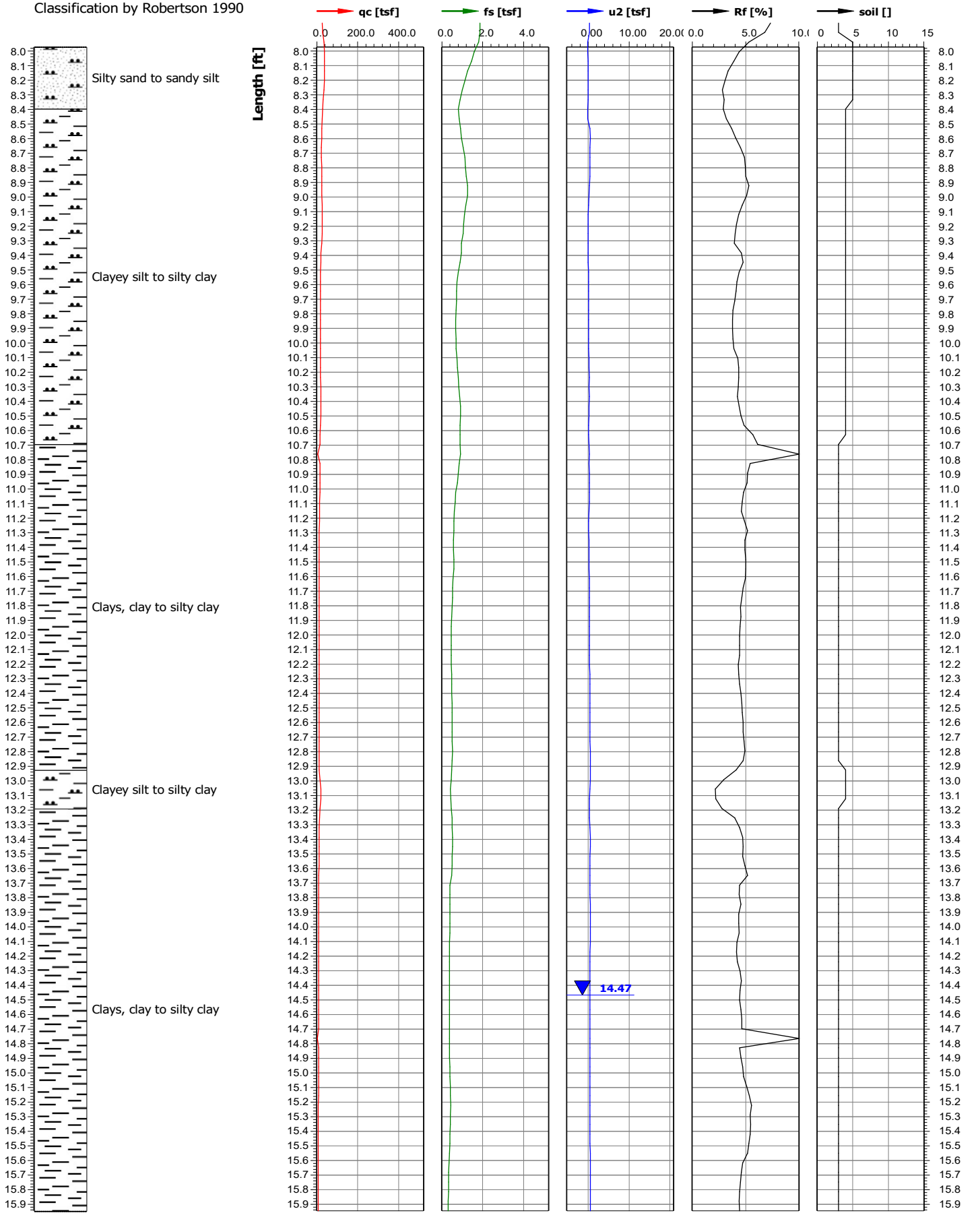
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



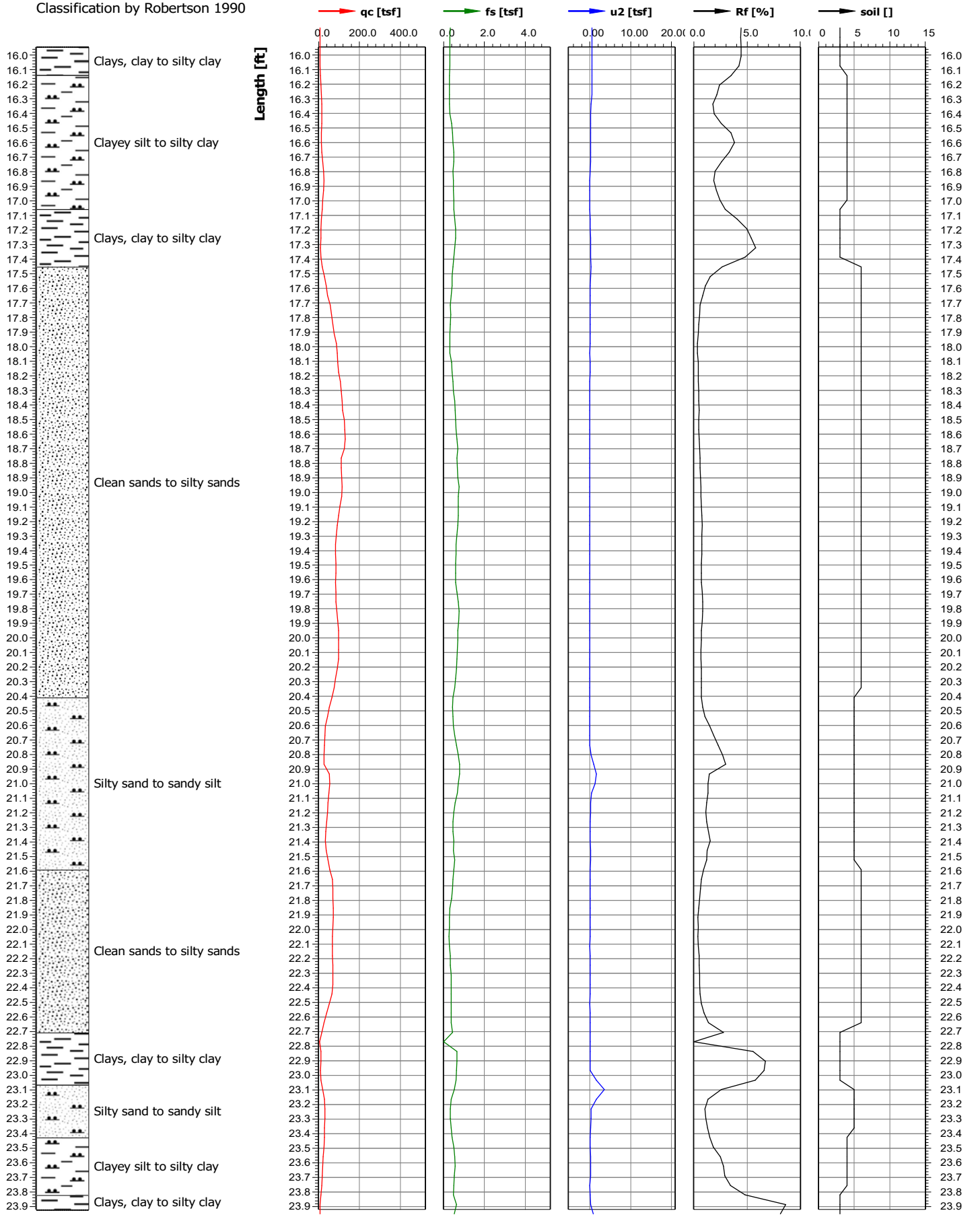
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



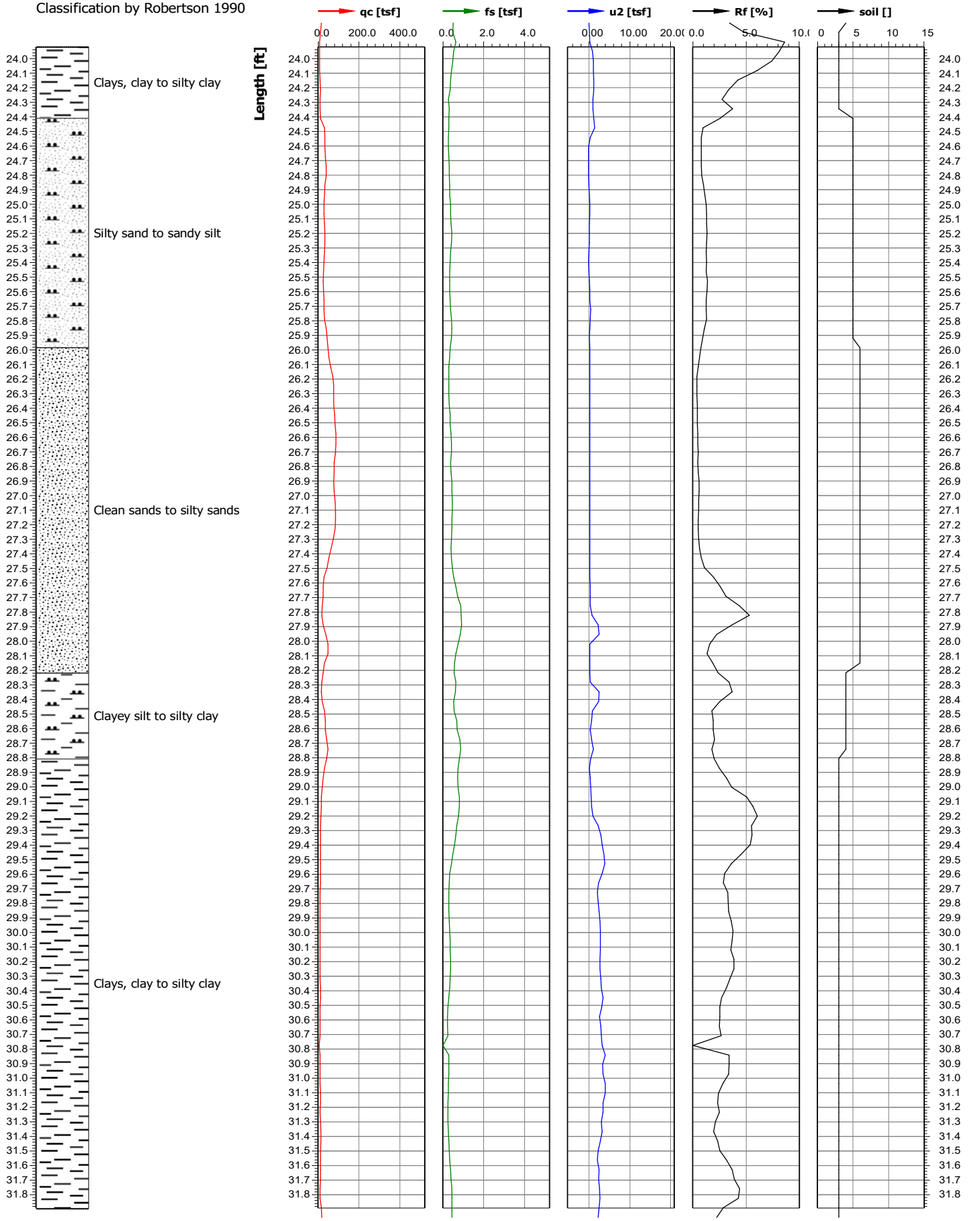
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



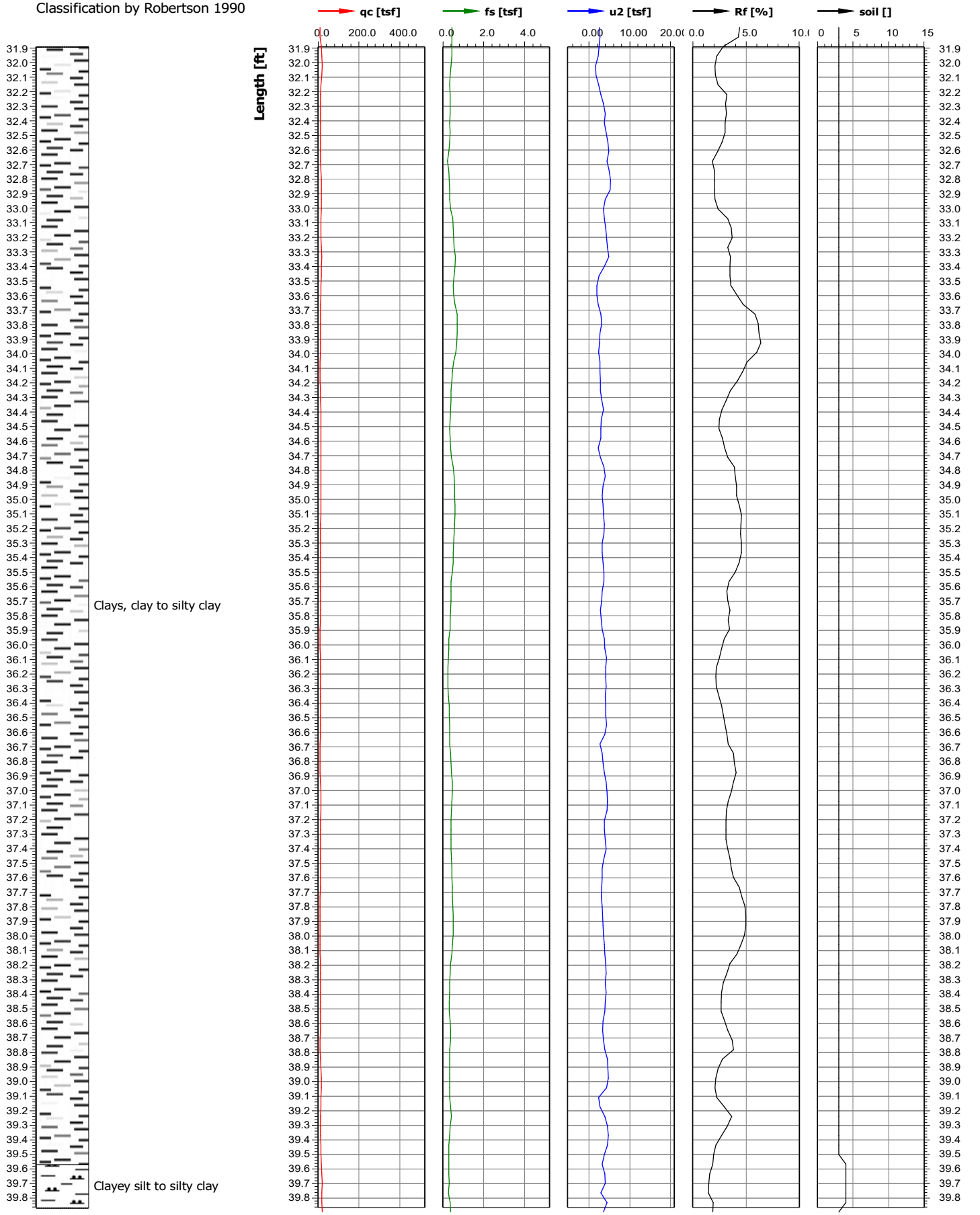
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



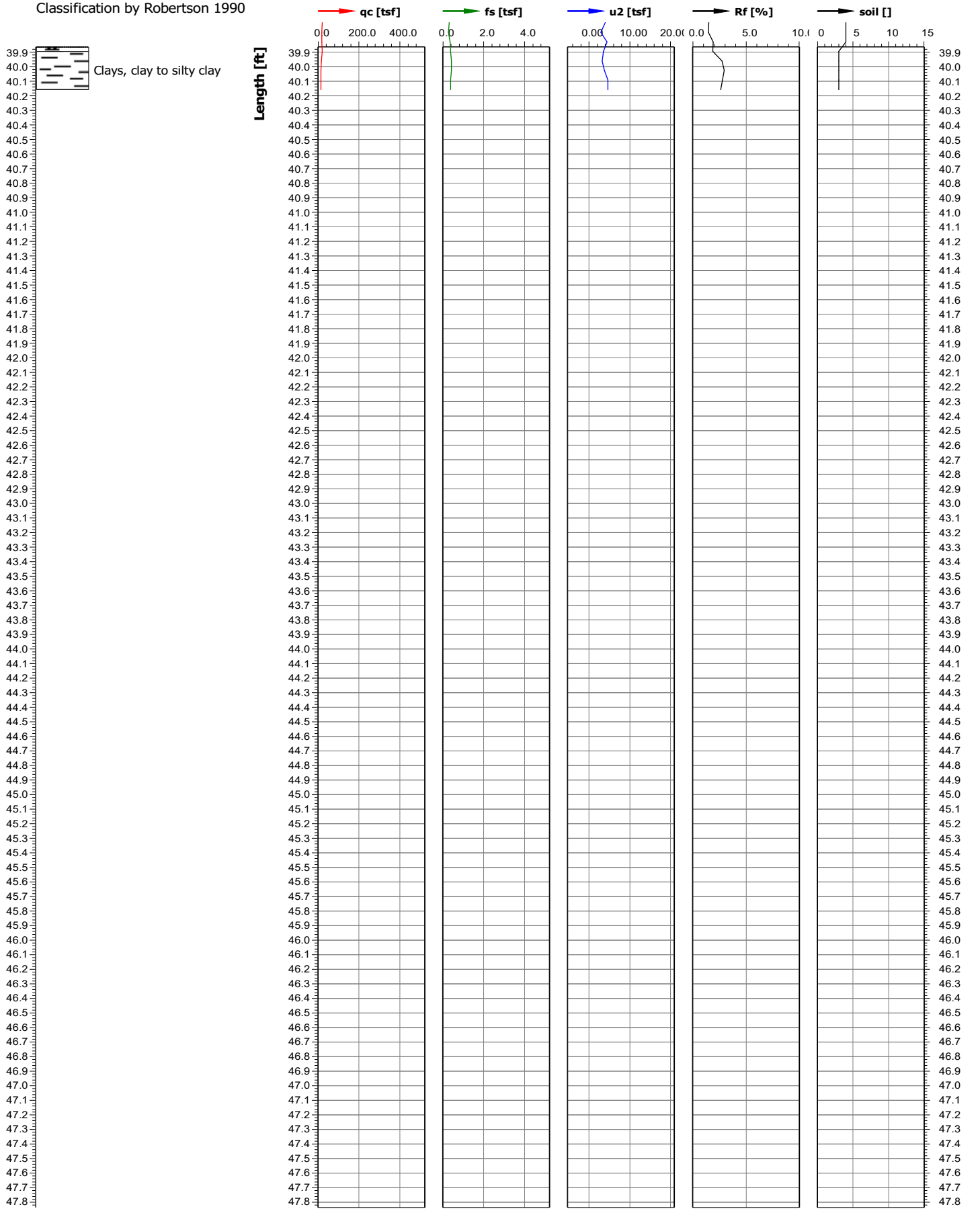
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



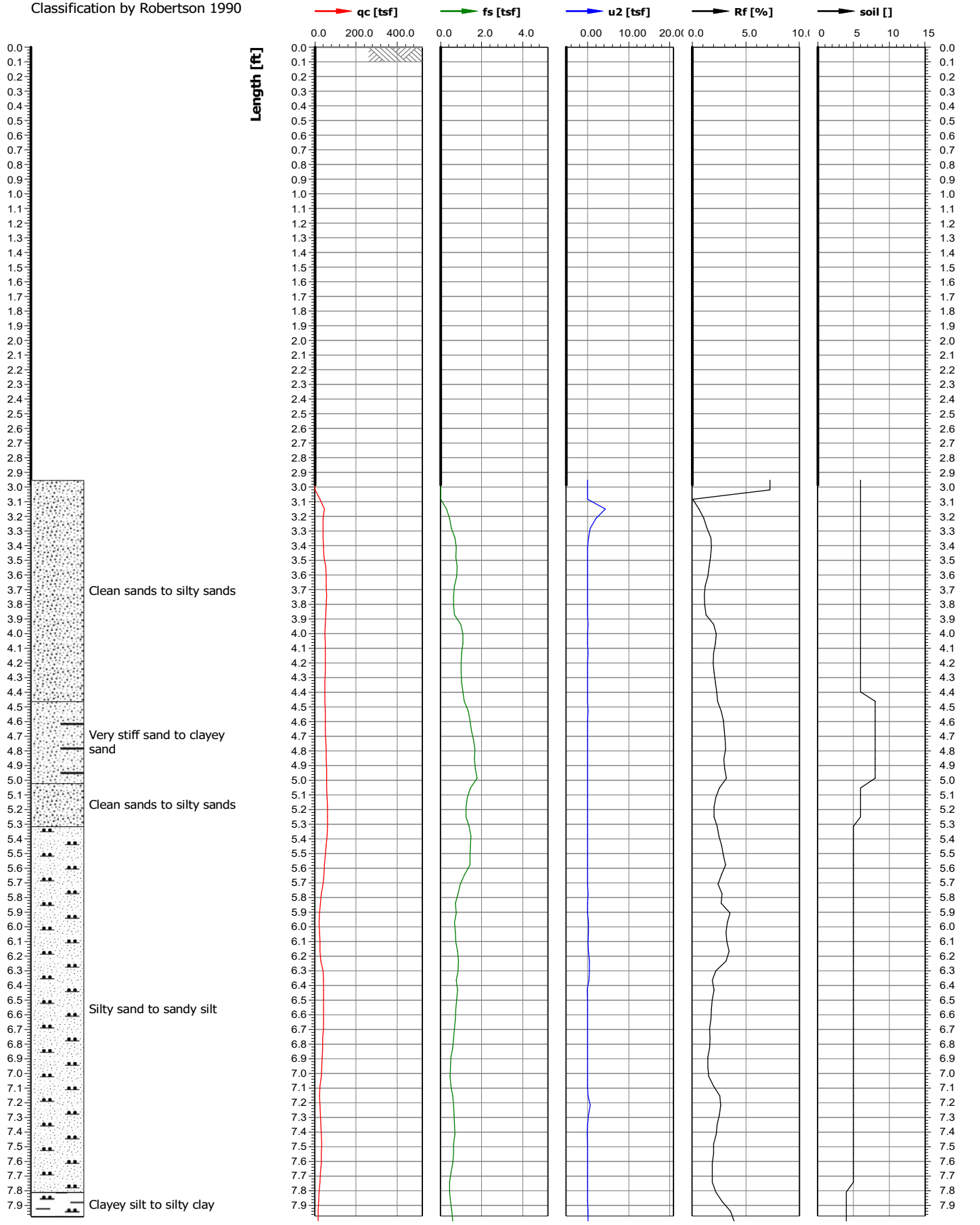
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		6/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



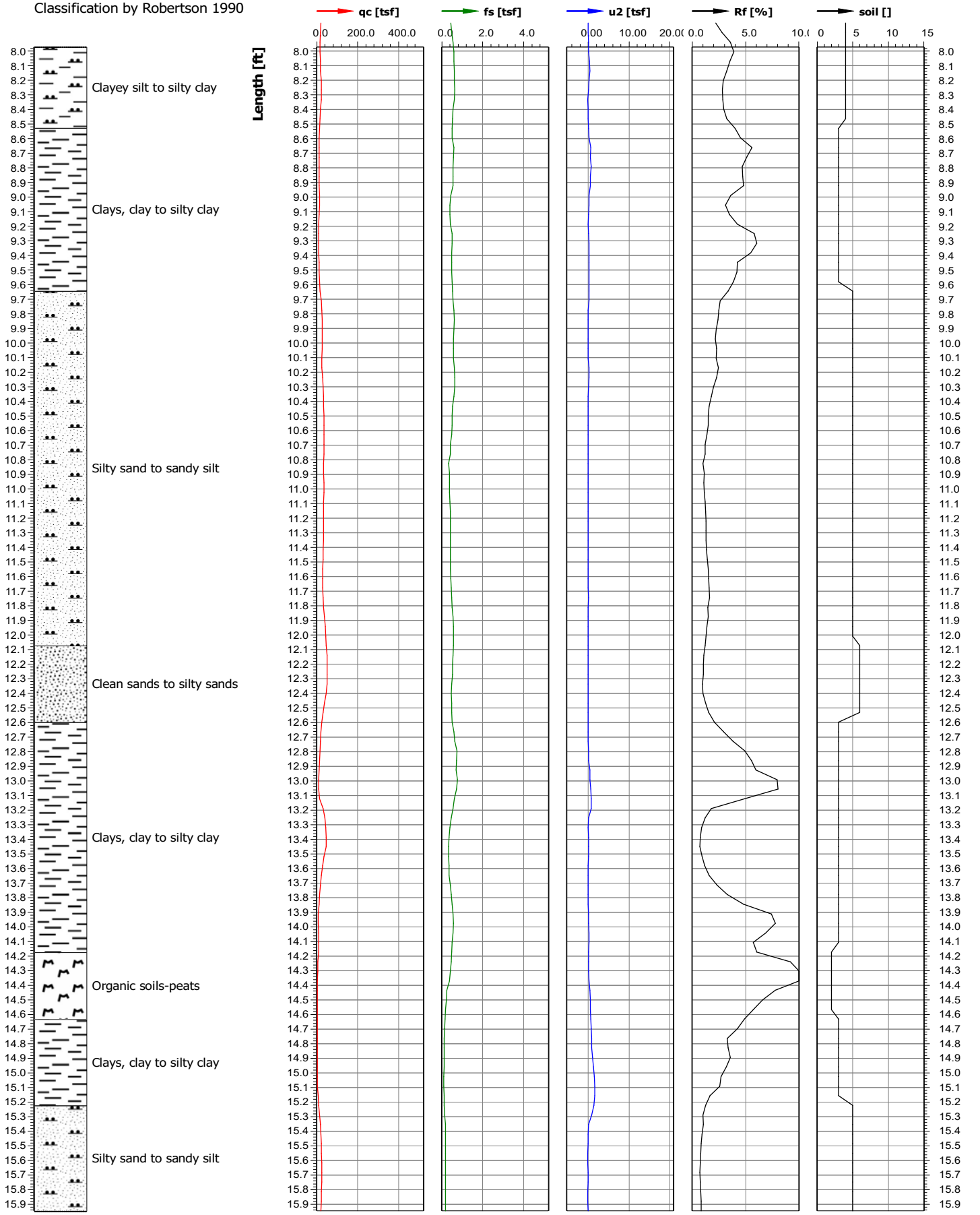
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



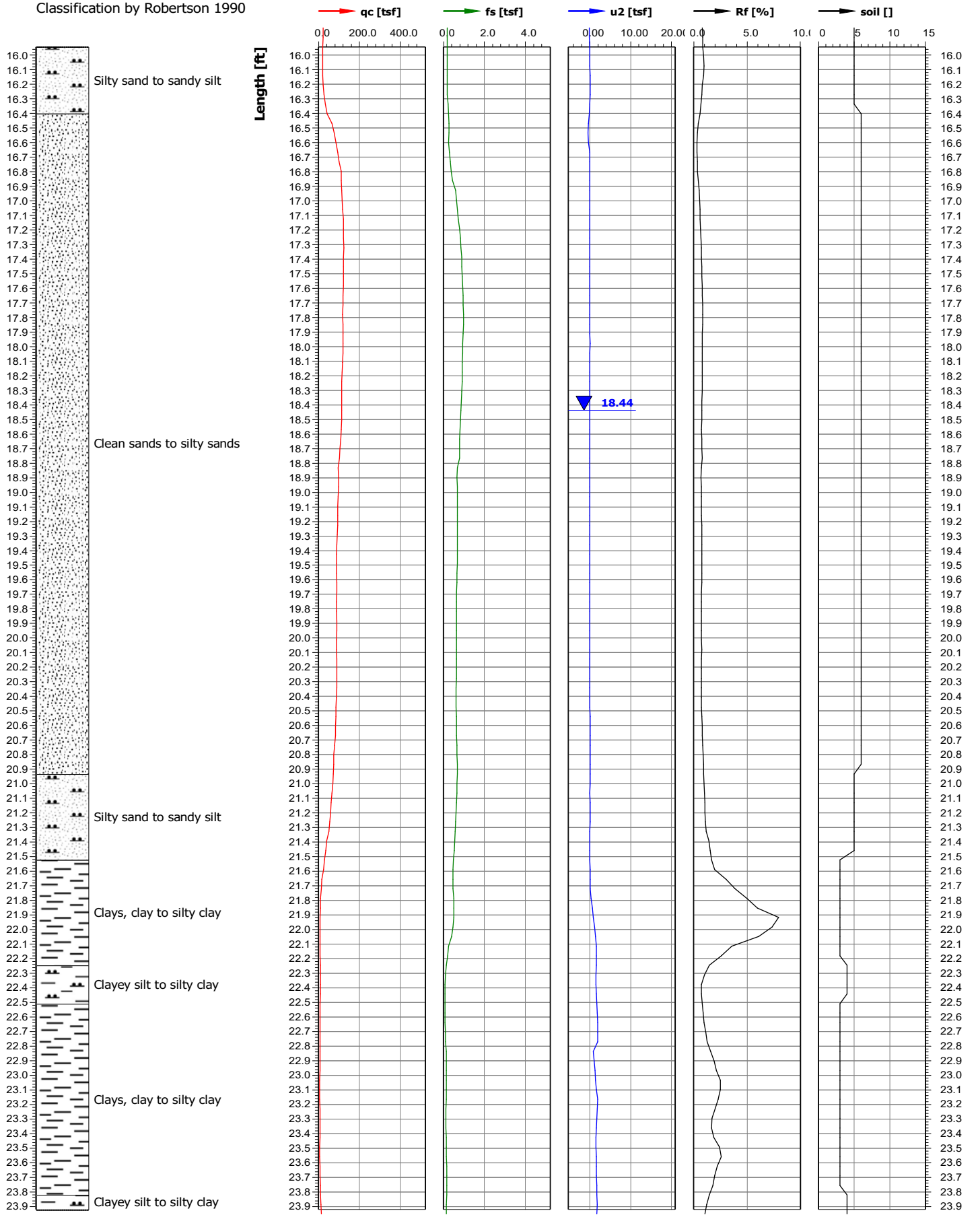
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



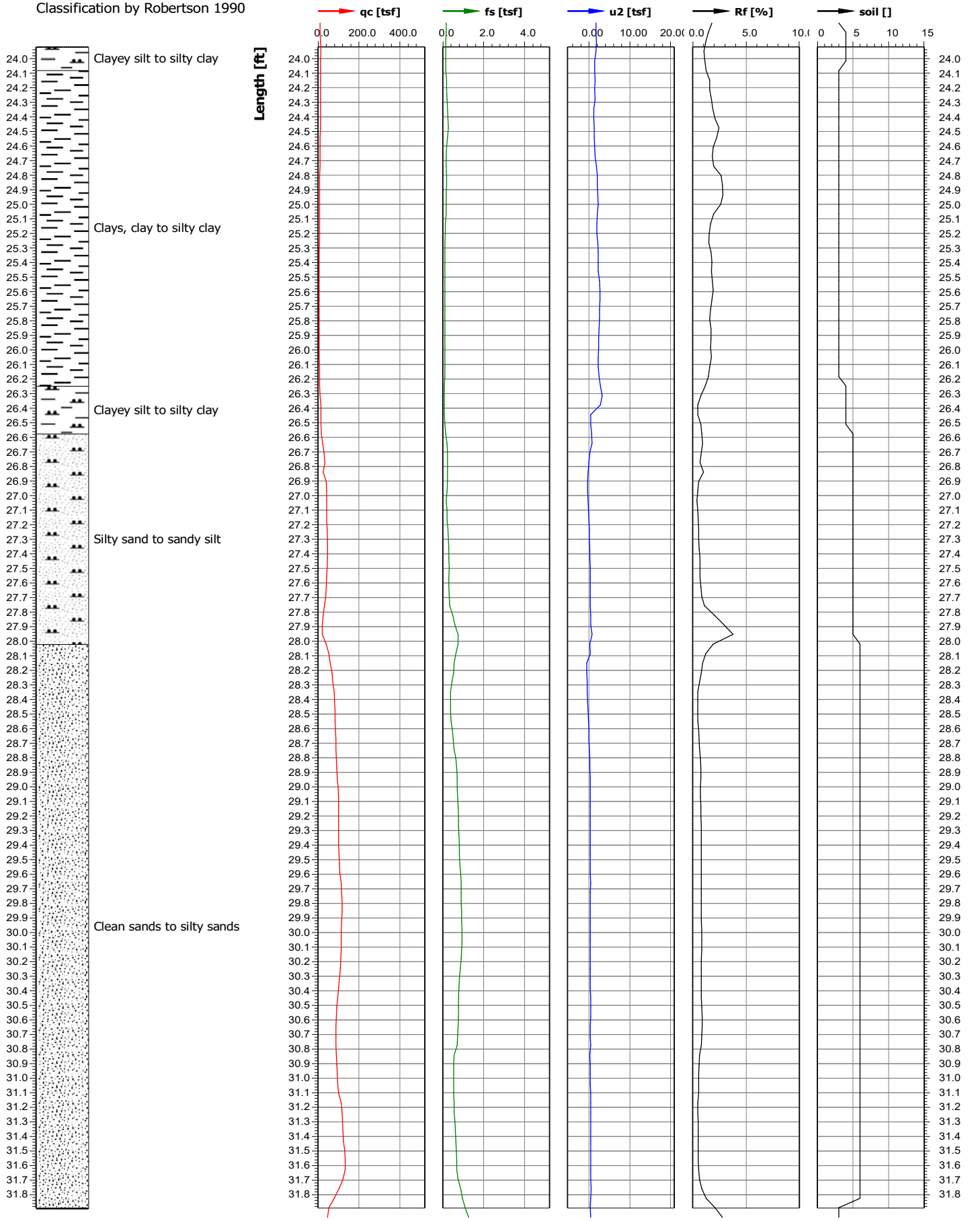
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



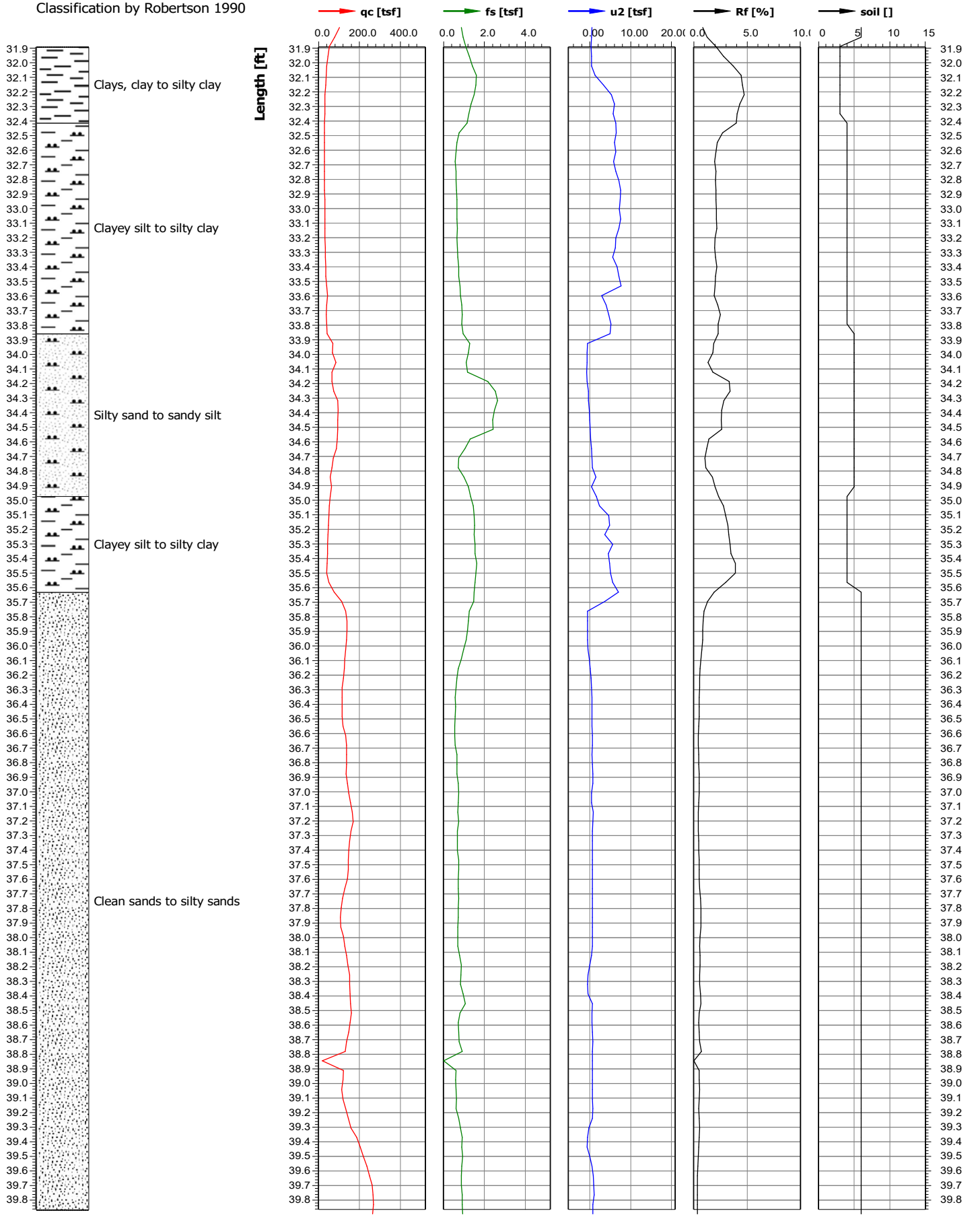
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



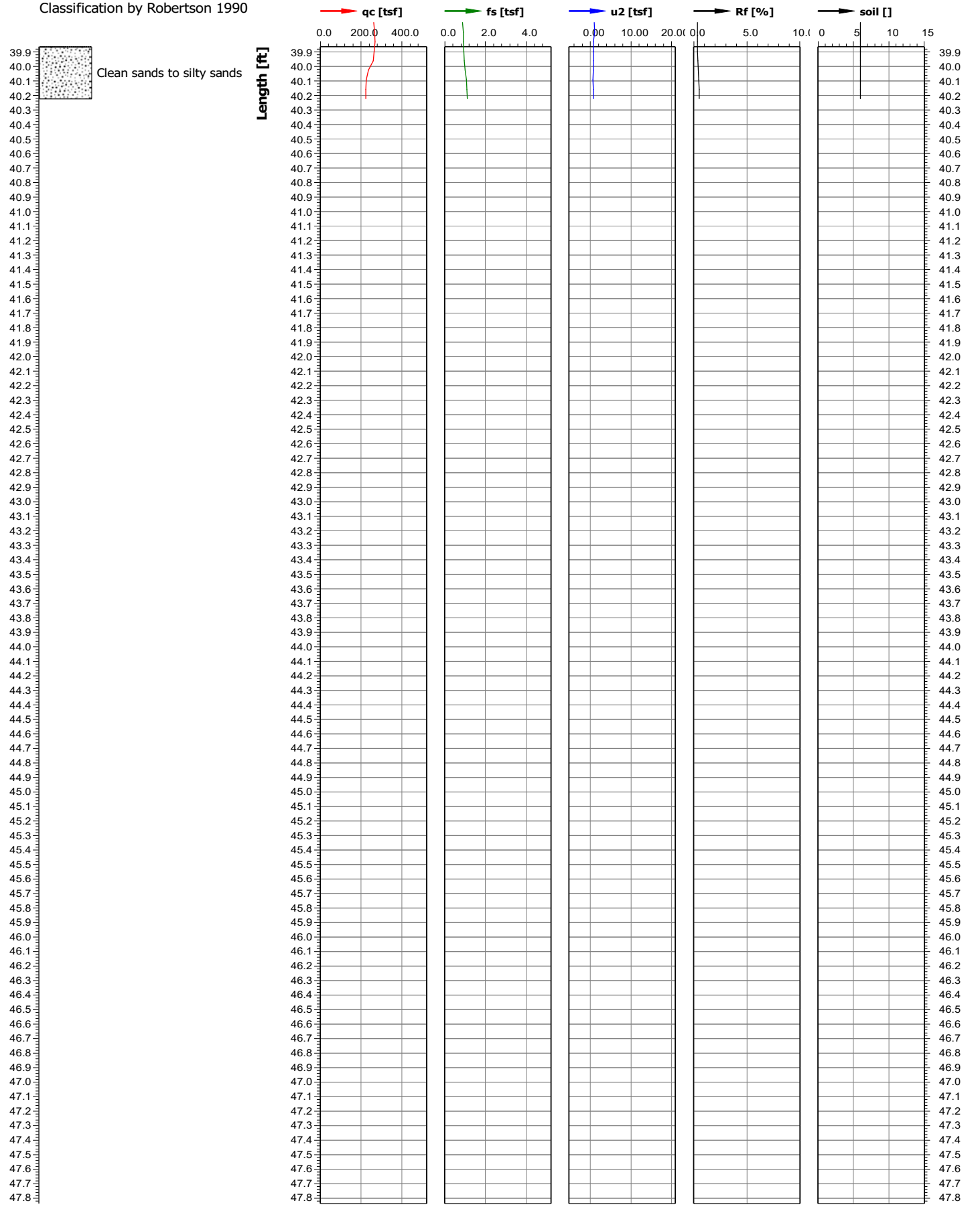
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		6/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



DRILLING LOG

DIVISION: Northwestern		INSTALLATION	Sheet 1 of 1
1. PROJECT: Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site		10. COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 613629.88 E: 1748769.83	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: KN-FY21-BH01	3. DRILLING AGENCY: NWO Drill Crew	11. DATE BORING: STARTED Dec 09 2021	COMPLETED Dec 09 2021
4. NAME OF DRILLER: Chris Miner		12. HAMMER TYPE	EFFICIENCY (%)
5. EQUIPMENT		13. SIZE AND TYPE OF BIT: 4.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING: 0	14. ELEVATION SURFACE: 1668.0'
			15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 4.5'			16. TOTAL NUMBER CORE BOXES
8. DEPTH DRILLED INTO ROCK			17. SIGNATURE AND TITLE OF INSPECTOR: Tyler Anderson, Geologist
9. TOTAL DEPTH OF BORING: 4.5'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
		2				POORLY GRADED SAND (SP) fine to medium, subrounded; brown, wet, loose, trace silt			
		2	4				87	D-1	
1663.5	4.50	2							
						Borehole finished at 4.5			

1663

DRILLING LOG

DIVISION: Northwestern		INSTALLATION	Sheet 1 of 1
1. PROJECT: Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site		10. COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 613517.45 E: 1748833.94	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: KN-FY21-BH03	3. DRILLING AGENCY: NWO Drill Crew	11. DATE BORING: STARTED Dec 09 2021	COMPLETED Dec 09 2021
4. NAME OF DRILLER: Chris Miner		12. HAMMER TYPE	EFFICIENCY (%)
5. EQUIPMENT		13. SIZE AND TYPE OF BIT: 4.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING: 0	14. ELEVATION SURFACE: 1674.0'
			15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 7.5'			16. TOTAL NUMBER CORE BOXES
8. DEPTH DRILLED INTO ROCK			17. SIGNATURE AND TITLE OF INSPECTOR: Tyler Anderson, Geologist
9. TOTAL DEPTH OF BORING: 7.5'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
1667.5	6.50	2	5			SANDY LEAN CLAY (CL) subrounded; grayish brown, moist, soft, little fine to medium sand, few silt	93	D-1	
1666.5	7.50	3 2				POORLY GRADED SAND (SP) subrounded; grayish brown, moist, soft, trace silt		D-2	
						Borehole finished at 7.5			

1669

DRILLING LOG

DIVISION: Northwestern		INSTALLATION	Sheet 1 of 1
1. PROJECT: Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site		10. COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 613327.94 E: 1748948.33	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: KN-FY21-BH04	3. DRILLING AGENCY: NWO Drill Crew	11. DATE BORING: STARTED Dec 09 2021	COMPLETED Dec 09 2021
4. NAME OF DRILLER: Chris Miner		12. HAMMER TYPE	EFFICIENCY (%)
5. EQUIPMENT		13. SIZE AND TYPE OF BIT: 4.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING: 0	14. ELEVATION SURFACE: 1663.0'
			15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 7.5'			16. TOTAL NUMBER CORE BOXES
8. DEPTH DRILLED INTO ROCK			17. SIGNATURE AND TITLE OF INSPECTOR: Tyler Anderson, Geologist
9. TOTAL DEPTH OF BORING: 7.5'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
		1				SILTY SAND (SM) fine to medium, subrounded; gray to black, moist, soft, little silt, possible organics		D-1	
1656.4	6.60	0	1			SANDY LEAN CLAY (CL-ML) black, moist, soft, possible organics	87	D-2	
		1							
1655.5	7.50					Borehole finished at 7.5			

1658

DRILLING LOG

DIVISION: Northwestern		INSTALLATION	Sheet 1 of 1
1. PROJECT: Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site		10. COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 613723.51 E: 1748904.62	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: KN-FY21-BH05	3. DRILLING AGENCY: NWO Drill Crew	11. DATE BORING	STARTED: Dec 09 2021 / COMPLETED: Dec 09 2021
4. NAME OF DRILLER: Chris Miner		12. HAMMER TYPE	EFFICIENCY (%)
5. EQUIPMENT		13. SIZE AND TYPE OF BIT: 4.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING: 0	14. ELEVATION SURFACE: 1664.0'
			15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 5.5'			16. TOTAL NUMBER CORE BOXES
8. DEPTH DRILLED INTO ROCK			17. SIGNATURE AND TITLE OF INSPECTOR: Tyler Anderson, Geologist
9. TOTAL DEPTH OF BORING: 5.5'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
		1	1			POORLY GRADED SAND (SM) fine to medium, subrounded; brown, moist, soft	73	D-1	
1659.4	4.60	0				LEAN CLAY (CL) gray, moist, soft, trace sand		D-2	1659
		1							
1658.5	5.50					Borehole finished at 5.5			

DRILLING LOG

DIVISION: Northwestern		INSTALLATION	Sheet 1 of 5
1. PROJECT: Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site		10. COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 613493.99 E: 1748592.12	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: KN-FY21-BH10	3. DRILLING AGENCY: NWO Drill Crew	11. DATE BORING	STARTED: Dec 08 2021 / COMPLETED: Dec 08 2021
4. NAME OF DRILLER: Chris Miner		12. HAMMER TYPE	EFFICIENCY (%)
5. EQUIPMENT		13. SIZE AND TYPE OF BIT: 4.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING: 0	14. ELEVATION SURFACE: 1688.0'
			15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 39.5'			16. TOTAL NUMBER CORE BOXES
8. DEPTH DRILLED INTO ROCK			17. SIGNATURE AND TITLE OF INSPECTOR: Tyler Anderson, Geologist
9. TOTAL DEPTH OF BORING: 39.5'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS

1683

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 2 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613493.99 E: 1748592.12	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
			0			LEAN CLAY (CL) brown to grayish brown, moist, little fine to medium sand, Iron staining, possibly Fat Clay (CH)	70	UD-1	
1678.0	10.00								

1678

1673

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 3 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613493.99 E: 1748592.12	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
			0			LEAN CLAY (CL) gray brownish gray, moist, trace fine sand, trace silt, possibly fat clay	70	UD-2	
1667.0	21.00								

1668

1663

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 4 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613493.99 E: 1748592.12	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS	
										1658
			0			SANDY LEAN CLAY (CL-ML) fine to medium, subrounded; gray, wet, organic material present, black specs lignite?	35	UD-3		1653
1652.0	36.00									

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 5 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613493.99 E: 1748592.12	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
		0				FAT CLAY (CH) gray, soft, trace fine sand, trace silt			
		0	3				93	D-1	
1648.5	39.50	3							
						Borehole finished at 39.5			

1648

1643

DRILLING LOG

DIVISION: Northwestern		INSTALLATION	Sheet 1 of 5
1. PROJECT: Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site		10. COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 613857.86 E: 1748671.97	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: KN-FY21-BH11	3. DRILLING AGENCY: NWO Drill Crew	11. DATE BORING: STARTED Dec 07 2021	COMPLETED Dec 07 2021
4. NAME OF DRILLER: Chris Miner		12. HAMMER TYPE	EFFICIENCY (%)
5. EQUIPMENT		13. SIZE AND TYPE OF BIT: 4.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING: 0	14. ELEVATION SURFACE: 1688.0'
			15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 46.5'			16. TOTAL NUMBER CORE BOXES
8. DEPTH DRILLED INTO ROCK			17. SIGNATURE AND TITLE OF INSPECTOR: Tyler Anderson, Geologist
9. TOTAL DEPTH OF BORING: 46.5'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
						LEAN CLAY (CL) brown to grayish brown, few fine sand, possible iron staining			

1683

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 2 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613857.86 E: 1748671.97	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
			0			LEAN CLAY (CL) brown to grayish brown, few fine sand, possible iron staining	95	UD-1	
1679.0	9.00								
						LEAN CLAY (CL) brown to gray, moist, fine to medium sand lenses in bottom of shelby mixed with clay	85	UD-2	
			0						
1672.0	16.00								

1678

1673

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 3 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613857.86 E: 1748671.97	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
1669.0	19.00		0			POORLY GRADED SAND (SP) subrounded; yellowish brown, moist	200	UD-3	

1668

1663

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION		Sheet 4 of 5
PROJECT Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	COORDINATE SYSTEM NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL NAVD88
	LOCATION COORDINATES N: 613857.86 E: 1748671.97	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS

1658

1653

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 5 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613857.86 E: 1748671.97	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
									1648
									1643
		0				FAT CLAY (CH) subrounded; gray, moist, soft, trace coarse sand, possible organics			
		4	10				133	D-1	
		6							
1641.5	46.50								
						Borehole finished at 46.5			

Knife River – Elbee Bend Bank Stabilization Project
GEOLOGICAL INVESTIGATION
Knife River Indian Villages, ND

FIELD REPORT

U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA, NEBRASKA 68102-4901

06 Jan 2022

1. PROJECT SCOPE

A soil investigation was completed on the right bank (cutbank) and left bank (pointbar) of Elbee Bend - Knife River in support of a bank stabilization project near Stanton, ND.

Cutbank erosion rates of 1.0 to 3.5 feet per year (Sexton, 2012) within the past several decades threaten an archaeological site, a highway, and above-ground power lines within the Knife River Indian Villages Historical Sites (**Figure 1**). The National Park Service has requested that USACE design and construct a revetment to stabilize the cutbank of Elbee Bend. A subsurface geotechnical investigation was undertaken to collect relevant information on soil characteristics and potential borrow material from the left bank.

2. GEOTECHNICAL FIELD INVESTIGATION

Fieldwork for the soil investigation (**Figure 2**) was conducted from 01 December 2021 through 09 December 2021. Work consisted of pushing twelve (12) cone penetration tests (CPTs) and drilling six (6) auger borings.

CPT boring locations were selected by the Geotechnical Engineer to gain insight on specific areas within the project boundary and designated KN-FY21-CPT01 to KN-FY21-CPT12. Auger borings were then acquired that target specific intervals within certain CPTs and designated as KN-FY21-BHxx based on which CPT boring the auger twinned. CPT and auger boring locations are plotted on a map, **Figure 2**.

Fifteen (15) samples of disturbed soil were collected utilizing either a shelbe tube or a 2-foot split spoon sampler advanced within a hollow stem auger. Borings ranged from 4.5 to 78.6 feet below ground surface.

Table 1.

Boring Designation	Latitude[1]	Longitude[1]	Elevation (top of soil surface)[2]	Total Depth (feet below grade[3] surface)
KN-FY21-CPT01	47.3459	-101.3864	1668	30.4
KN-FY21-CPT02	47.3453	-101.3862	1674	36.9
KN-FY21-CPT03	47.3455	-101.3861	1674	30.8
KN-FY21-CPT04	47.3450	-101.3856	1663	31.1
KN-FY21-CPT05	47.3461	-101.3858	1664	30.6
KN-FY21-CPT06	47.3459	-101.3856	1677	40.1
KN-FY21-CPT07	47.3453	-101.3856	1678	30.2
KN-FY21-CPT08	47.3442	-101.3858	1684	78.6
KN-FY21-CPT09	47.3448	-101.3865	1693	40.1

KN-FY21-CPT10	47.3455	-101.3871	1688	50.0
KN-FY21-CPT11	47.3465	-101.3868	1688	40.1
KN-FY21-CPT12	47.3470	-101.3863	1684	40.2
KN-FY21-BH04	47.3450	-101.3856	1663	7.5
KN-FY21-BH05	47.3461	-101.3858	1664	5.5
KN-FY21-BH03	47.3455	-101.3861	1674	7.5
KN-FY21-BH01	47.3459	-101.3864	1668	4.5
KN-FY21-BH11	47.3465	-101.3868	1688	46.5
KN-FY21-BH10	47.3455	-101.3871	1688	39.5

[1]Latitude and longitude are as-drilled locations from a hand-held Garmin 62s GPS, accuracy +/-9 feet.
[2]Elevations extracted from USACE topography survey
[3]distance is measured from below grade. For surface samples it is the depth from the surface.

2.1 Utility Clearances/Soil Boring Locations

All of the soil boring locations were staked on a USACE Site Visit at locations provided by the USACE Soils Engineer. The utility clearances were obtained through the 811 - North Dakota.

2.2 Geotechnical Borings

Eighteen (18) geotechnical soil borings were pushed/drilled to obtain lithologic and groundwater information. Disturbed and undisturbed samples were described in the field, collected in sampling jars or buckets, or Shelby tubes and sent to a laboratory for potential analysis.

Borings were advanced to a depth of 4.5 to 78.6 feet below grade surface.

The location of the borings are presented in **Table 1**.

2.1.1 Drilling Methodology

Drilling was performed with a Geoprobe Model 3230DT track rig equipped with dual CPTu and HSA capability. The CPTu tool consists of a conical point having a 60° apex angle and 10 cm^2 base area. The CPT consisted of a 10-ton cone with a filter in the U2 location. The geoprobe drilling instructions specified that the 10-ton cone should be advanced to a depth of 3 feet below ground surface (bgs) to start the measurement.. CPT data was collected as the penetrometer tip was advanced through the soil at a constant rate of 20 mm/s. The force on the conical point (cone) required to penetrate the soil was measured by electrical methods at a minimum of 50 mm of penetration. Stress was calculated by dividing the measured force (total cone force) by the cone base area to obtain cone resistance (qc). Pore-water pressure induced during the advancement of the penetrometer tip using an electronic pressure transducer was measured by a piezocone that is advanced at a rate of 20 mm/s and readings taken at a minimum of every 50 mm of penetration. The CPT was conducted in accordance with ASTM 5778 -07, "Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils." CPT logs are included in **Attachment B**

The CPT data was reviewed by the getotechnical engineer who communicated which borings and intervals were twinned with HSA. The HSA tool consists of 4.25-inch-inside-diameter (ID) hollow-stem augers. A two-foot long split spoon was advanced to collect samples at designated depths. The borings had a diameter of approximately 8.5 inches. No drilling fluids, water, or other additives were used.

Standard penetration tests were performed in accordance with ASTM D 1586, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils." Representative samples of the subsurface material were taken from the selected split-spoon (2-in outer diameter/1.375 in inner diameter with plastic sample retainer without liners) intervals, placed in a pint jar, and sealed with at least three wraps of electrical tape. During SPT drives, average rod stickup, above ground to the hammer, is 7 feet. Year 2021 calibration for the automatic hammer mounted on the Geoprobe Model 3230DT track rig used to complete the borings averaged 91.3% @ 55 blows per minute energy transfer ratio.

2.1.2 Soil Sampling Methodology

Representative disturbed samples were collected from each boring. Samples were collected at all changes in material. Representative samples of the subsurface material were logged and then taken from the split spoon sampler. Samples were placed in a pint jar and sealed with three wraps of electrical tape. Shelby tube samples were collected. Sample information is recorded on the drilling logs included in **Attachment B.**

2.1.3 Lab Testing

Samples were visually identified and classified in the field. For each change in lithography, a representative sample was jarred, labeled, and sealed. Collected samples were sent to Terracon in Omaha, NE for testing. Lab testing results are included in the appendices if available.

2.1.5 Boring Abandonment

At the completion of drilling, the borings were abandoned by backfilling with drill cuttings and bentonite chips as needed.

2.1.6 CPT Data Analysis

The CPT data was processed using CPT-Pro software (Geosoft). Input parameters included: 1) surface density of 17 kN/m^3; 109 lb/ft^3, 0.25 foot (ft) minimum layer thickness, and soil classification of Robertson, 1990.

Of the available soil classifications, the Robertson, 1990 soil classification provided the best fit as correlated with the data collected with the HSA method. A comparison is provided in **Table 2**.

Table 2

BH / CPT	Auger BH Depth Interval (ft bgs)	Auger BH Soil Class. (USCS)	CPT Soil Class. (Robertson, 90)	CPT Soil Class. Lithology (Robertson, 90)	CPT Depth Interval (ft bgs)	CPT Soil Class/Lith. (Robertson, 90)
01	3 to 4.5	SP	6	Clean sands to silty sands		
03*	6 to 6.5	CL	6	Clean sands to silty sands		
03	6.5 to 7.5	SP	6	Clean sands to silty sands		
04	6.0 to 6.6	SM	6	Clean sands to silty sands		
04	6.6 to 7.5	CL-ML	4	Clayey silt to silty clay		
05**	4.0 to 4.6	SP	6	Clean sands to silty sands	5.8 to 6.2	5/ Silty sand to and silt
05**	4.6 to 5.0	CL	6	Clean sands to silty sands	6.2 to 7.0	4/ Clayey silt ot silty clay
10	8.0 to 10.0	CL	3	Clays, clay to silty clay		
10	19.0 to 21.0	CL	3/2	Clays, clay to silty clay/ Organic soils-peats		
10	34.0 to 36.0	CL-ML	3	Clays, clay to silty clay		
10	39.0 to 39.5	CH	3	Clay, clay to silty clay		
11	7.0 to 9.0	CL	3	Clay, clay to silty clay		
11	14.0 to 16.0	CL	3	Clay, clay to silty clay		
11	18.0 to 19.0	SP	6	Clean sands to silty sands		
11***	45.0 to 46.5	CH				

* The CPT didn't seem to pickup the clay seam (but neither did the other soil classification options).
**If the auger samples are shifted 1.5' deeper, the lithologies are a closer match
*** CPT bottom at 40.1 ft

3. SITE GEOLOGY

3.1 General geology

The Knife River is a tributary of the Missouri River with the Elbee Bend site on the Knife River located approximately 2 miles from the junction of the two rivers. In 1983, Reiten published a Quaternary geology report which included subsurface materials (lithologic) information from 35 drill holes and 8 cores with aerial imaging and radiocarbon dating. The report established the basic geologic framework including terrace interpretation and designation which has been digitized and explained in Graham (2015). Recent (past few decades) increases in erosion rates of Archeology sites, situated on river bluffs, are linked to Knife River erosion and channel migration patterns (Sturdevant, 2009; Sexton, 2011). Many of the sites include charcoal and organic material radiocarbon dated to a few thousand years old (Reiten, 1983). The recent changes in channel migration rates and patterns are postulated to be related to river base-level modifications caused by dam/reservoir development on the Missouri River and associated fluvial-backwater development (Ellis, 2006; USACE 2018).

The geologic history of this area includes repeated advances and retreats of the Pleistocene North American Ice Sheet and Missouri River valley development. Prior to Pleistocene North American continental-scale glacial advances, the Missouri River course transported water/sediment to the northeast and Hudson Bay. The North American glacial advances (ice sheet centered over eastern Canada) changed continental-scale river drainage basins and guided the Missouri River course to the south and Gulf of Mexico. The Missouri River currently skirts the edge of the landscape molded by the the glacial advance and retreats. The Knife River, as a tributary to the Missouri River, currently joins the Missouri River on the eastern side of the Missouri River valley which means that the Knife River flows through and over underlying Missouri River alluvium. It likely occupies the abandoned channel of a recent Missori River course.

Geologic maps (Graham, 2015 – Hybels Map) show several units at the surface that are designated as Oahe and Coleharbor Formations. The Oahe Formation includes Holocene-age fluvial (river)- Qo7 <shown on the map>, eolian (wind) – Qo6 <not shown on the map>, and loess (wind) – Q05 <not differentiated on the map, but commonly forms a mantle on glacial sediment> deposits. The Coleharbor Formation includes Pleistocene to Holocene-age glacial deposits that include till (moraine) – Qc2, outwash-Oc3 <not differentiated on the map>, and lacustrine - Qc4 sediment. These units and interpretations are illustrated on lidar DEM data (**Figure 2**).

The Knife River Valley and Missouri River Valley are significant features in the area of interest. The sediment/soils that fill the Knife and Missouri valleys are composed of gravel, sand, silt and clay in channel belts, channel-fills, and overbank floodplains and are undifferentiated as Unit Qo7 on the most current geological map (Graham, 2015). The river valleys have cut-into and eroded the pre-existing glacial sediment which is now located on the flanks of the valleys. The glacial sediment is interpreted to have originated as till (basal glacial sediment that is typified as unsorted material with gravel, sand, silt, and clay mixtures), glacio-lacustrine (short-lived lakes at the margins of glacial ablation/melt zones that fill with fine-grained material), glacial-outwash (alluvial deposits), and eolian/loess (wind-deposits of silt and fine sand downwind of glacial sediment sources). Note: Missouri River Alluvium refers to very recent channel-belts/sediment deposited by migration of the Missouri River whereas MoRiv Chan Belt refers to an older Missouri River channel-belt which the Knife River has eroded into. The sediment/soils of these units would be very similar. Also, the Knife River Chan Belt Terrace marks a Knife River channel belt that is higher in elevation (approximately 10 feet) but sedimentologically very similar to the

modern Knife River deposits. It preserves a time when the Knife River base level was at a different level either because the Knife River base level was at a higher elevation or the entire area was at a lower elevation due to glacial-loading, i.e., subsequent crustal rebound due to glacial isostatic rebound after ice sheet retreat.

3.2 Site Geology

The area of interest is the Elbee Bend, of the Knife River. Aerial image and lidar DEM data analysis shows the Knife River to be a single-thread, meandering channel. The river channel transports water and sediment to the junction with the Missouri River through Quaternary sediment including fluvial (river), glacial, and lacustrine/glacial-lacustrine sediment. Several of the Knife meander bends have increased channel migration (meander) rates in the past few decades with the Elbee bend being the focus of this study.

A previous quaternary geology study (cira 1983) sampled the subsurface material (Reiten, 1983). In the Elbee bend cutbank, the river is actively eroding fine-grained material including clay, silt, and fine sand (Drill core DH-07 and Core C-7, C-6; Reiten, 1983). DH-07 sampled sediment described as a pebble loam which is a mixture of gravel, sand, silt, and clay. The unsorted nature as well as the range of particle sizes suggests a glacial till or glacial lacustrine origin as possible.. The base of the Knife River bankfull erosion appears to occur at a depth of 37 feet below ground surface along the Elbee Bend cutbank (bgs; DH-07) at the interpreted interface between glacio-lacustrine and glacial moraine/till sediment. The surface sediment silt is interpreted to be loess (wind-blown silt common in formerly glaciated landscapes) with the underlying sediment interpreted to be glacial-lacustrine (interbedded silt, fine sand, and clay deposited as suspension sediment in a standing body of water) or terrace alluvial/fluvial deposits of the Knife River.

This study provides substantially more subsurface information. Key findings include: 1) subsurface material/lithologic lateral continuity (or lack of), 2) correlation of geologic units, 3) subsurface material engineering characteristics. The CPT borings CPT-01 to CPT-07 were acquired on the Knife River left bank which is the modern Knife River point bar/ depositional bend. The CPT borings CPT-08 to CPT-12 were acquired on the Knife River right bank which is the modern Knife River cutbank.

Two (2) cross-sections were constructed to display the CPT and drilling data (**Figure 3 and Figure 4**). Two (2) geological cross-sections were constructed to illustrate the west to east, cross-valley (**Figure 5**) and south to north, valley-edge (**Figure 6**) subsurface materials and correlations. The valley-edge cross-section was oriented with south to the left as envisioned as if standing across the Knife River on the point bar (south/ left bank) perspective. The cross-valley cross section (**Figure 5**) illustrates the juxtaposition and continuity of sediment/soil of the west/ right bank of the Knife River to the sediment/soil of the relatively coarse-grained/sandy deposits of the Knife River alluvium overlying the Missouri River (MoRiv) deposits. The MoRiv deposits can be further separated into a lower, coarser-grained alluvium and an upper, finer-grained/heterolithic alluvium. The upper MoRiv alluvium is interpreted to represent the abandoned channel of the Missour River which the Knife River is currently occupying and filling. CPT-02 was advanced to refusal at 36.9 feet bgs which is shown as a candidate for the boundary between the unconsolidated alluvium and the underlying bedrock. Outcrop observations indicate relative age of different units (**Figure 7**). If a unit of material can be observed to thin onto or lap onto another unit, it is technically on top of the other unit and therefore must be younger (law of superposition – the layer on the bottom is the oldest). The oldest unit, observable in the cutbank outcrop (sampled by CPT 09) which is onlapped by other units at the surface contains the archaeological artifacts and might be interpreted as glacial lacustrine with the laminated (thin interbeds) of clay, silt, and fine sand to a depth of approximately 30 feet. To the north, outcrop observations show two (2) successively onlapping younger units marked by yellow arrows on **Figure 7**. At the surface the older of the two onlapping units is

interpreted as Knife River terrace alluvium (samped by CPT-10 and CPT-11) and the younger of the two onlapping units (sampled by CPT-12) is interpreted as Missouri River alluvium (additional geomorphic evidence from surface aerial image and lidar DEM data). The Knife River terrace alluvium is interpreted to extend to a depth of just approximately 10 feet. At depths greater than about 10 feet, this unit interpreted to be a continuation of the glacial lacustrine meaning that the onlapping unit is not very deep. The youngest observed (in the cutbank outcrop – **Figure 7**) onlapping unit is interpreted to be Missouri River alluvium which is composed of approximately 20 foot-thick fining upward sequences with sand at the base and interbedded silt, clay, and fine sand at the top. To the south of the oldest unit (sampled by CPT-09), another onlapping unit (sampled by CPT-08) as observed in cutbank outcrop and aerial image/lidar DEM is interpreted to be Missiour River alluvium.

See **Attachment B** for drill and CPT logs.

3.3 Groundwater

Groundwater was encountered, and all of the samples were described as moist to wet. No collapse of boreholes was noted. Groundwater levels were calculated based on an equation: water table depth (d_{water}; NCHRP Synthesis 368: Cone Penetration Testing, 2007, p 25: Geostratigraphy Profiling). Groundwater levels shown in **Table 3**.

$\mathbf{d_{water} = d_{cone} - h_w}$ where

d_{cone} = depth of piezocone

h_w = water head (heigh of water above the cone)

$\mathbf{h_w = \mu_0/\sigma_w}$ where:

μ_0 = equilibrium pore pressure

σ_w = unit weight of water (64.2 lb/ft^3)

Table 3.

Boring	Final Dissipation (psf) <μ_0>	Depth of Test (ft)	Water Level above test (ft) <h_w>	Water Level bgs (ft)
KN-FY21-CPT01	1758	26.7	28.2	? (didn't dissipate)
KN-FY21-CPT02	2501	36.9	40.1	? (didn't dissipate)
KN-FY21-CPT03	1558	30.8	25.0	5.9
KN-FY21-CPT04	1712	31.1	27.4	3.7
KN-FY21-CPT05	1658	30.6	26.6	4.0
KN-FY21-CPT06	1677	40.1	26.9	13.3
KN-FY21-CPT07	1501	30.3	24.1	6.2
KN-FY21-CPT08	3516	78.6	56.3	22.2

KN-FY21-CPT09	4911	40.2	78.7	? didn't dissipate
KN-FY21-CPT10	1725	50.0	27.6	22.3
KN-FY21-CPT11	1606	40.2	25.7	14.5
KN-FY21-CPT12	1361	40.2	21.8	18.4

4. WORK PLAN DEVIATIONS/PROBLEMS ENCOUNTERED

The CPT borings were advanced as planned, but computer/software license complications precluded soil classification in the field. Basic tip resistance, sleeve friction, and pore pressure plots were digitally sent to the project geologist and engineer. All CPT borings (both right and left bank) were acquired. Cold (December) weather and snow delayed Auger boring sampling by two (2) days, but allowed the data to be processed and the project engineer to choose CPT borings and sample depths for twin auger borings.

Sampling: Jar samples were taken and noted on the drilling logs.

5. SEISMICITY

In reference to the American Society of Civil Engineers "Minimum Design Loads for Buildings and other Structures (ASCE 7-16)," the Department of Defense (DoD) "Unified Facilities Criteria (UFC) Seismic Design for Buildings (UFC 3-310-04) dated 1 May 2012, and the International Building Code (IBC) 2012, United States Air Force Academy has a 0.2-second spectral response acceleration (Ss) of 0.051 g and a 1.0-second spectral response acceleration (S1) of 0.022 g.

These accelerations are interpolated from 1:5,000,000 scale maps prepared by the U.S. Geological Survey (USGS), the Building Seismic Safety Council (BSSC), and the ASCE 7 Seismic Subcommittee for 0.2-second spectral response acceleration (5% critical damping), Site Class E, and 1.0-second spectral response acceleration (5% critical damping), Site Class E, respectively. These accelerations were confirmed by using the USGS Seismic Design Maps web-based tool available at https://hazards.atcouncil.org/ (ASCE7-16). The USGS web tool provides a link to the Applied Technology Council (ATC) website. A printout of the data is included as Attachment E.

ASCE 7 officially defines risk category as "A categorization of buildings and other structures for determination of flood, wind, snow, ice, and earthquake loads based on the risk associated with unacceptable performance". A risk category of II was used in this analysis and is defined as buildings and other structures except those listed in Risk Categories I, III, and IV (Table 1604.5: Risk Category of Buildings and Other Structures, ASCE7-16).

For all structures located within regions of the maps having Ss values greater than 0.051 g, or values of S1 greater than 0.022 g, the spectral response accelerations taken from these maps must be adjusted for site class effects using coefficients provided in the aforementioned guidance. Chapter 20 of ASCE 7-10, Site Classification, provides six site classes, Class A through Class F, which are defined on various geotechnical parameters (shear wave velocity, standard penetration resistance, or undrained shear strength). For this investigation, shear wave velocity and undrained shear strength were not determined. Therefore, the site classification is based on standard penetration resistance (i.e., SPT blow counts). For design purposes, the

reference site condition for this project is taken as site class D (Stiff Soil). This is based on the limited standard penetration resistance (ASTM D 1586) data (12 soil borings collected during this investigation).

Chapter 20 of ASCE 7-10 defines a site class E site as having an average standard penetration resistance ($\bar{N}$) of < 15 for the top 100 feet of the site profile. The ($\bar{N}$) value for the twelve (12) borings for the site is 8.5. The PGA was taken from calculations using the 2016 ASCE 7 with March 2013 errata. The adjusted maximum considered earthquake spectral response acceleration parameters (USGS values) using the site class E response coefficients (for $S_s \leq 0.051$ and $S_1 \leq 0.022$) are:

The short-period spectral acceleration ($S_{MS} = F_a S_S$) is (2.4 x 0.051) = 0.121

The 1-second period spectral acceleration ($S_{M1} = F_v S_1$) is (4.2 x 0.022) = 0.091

Table 3: Summary of Seismic Design Parameters

Site Location	N (blows/ft)	Site Class	PGA (g)	S_s (g)	S_1 (g)	F_a	F_v	S_{MS}	S_{M1}
Stanton, ND	8.5	E	0.023	0.051	0.022	2.4	4.2	0.121	0.091

Note: the ($\bar{N}$) value was obtained using an CPT-SPT correlation equation: $(q_t/p_a)/N_{60} = 8.5(1-I_c/4.6)$ (Robertson and Cabal, 2014). Where q_t = corrected cone resistance; p_a = atmospheric pressure; N_{60} = SPT N-value; I_c = Soil Behavior Type index.

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ATTACHMENT A: Figures

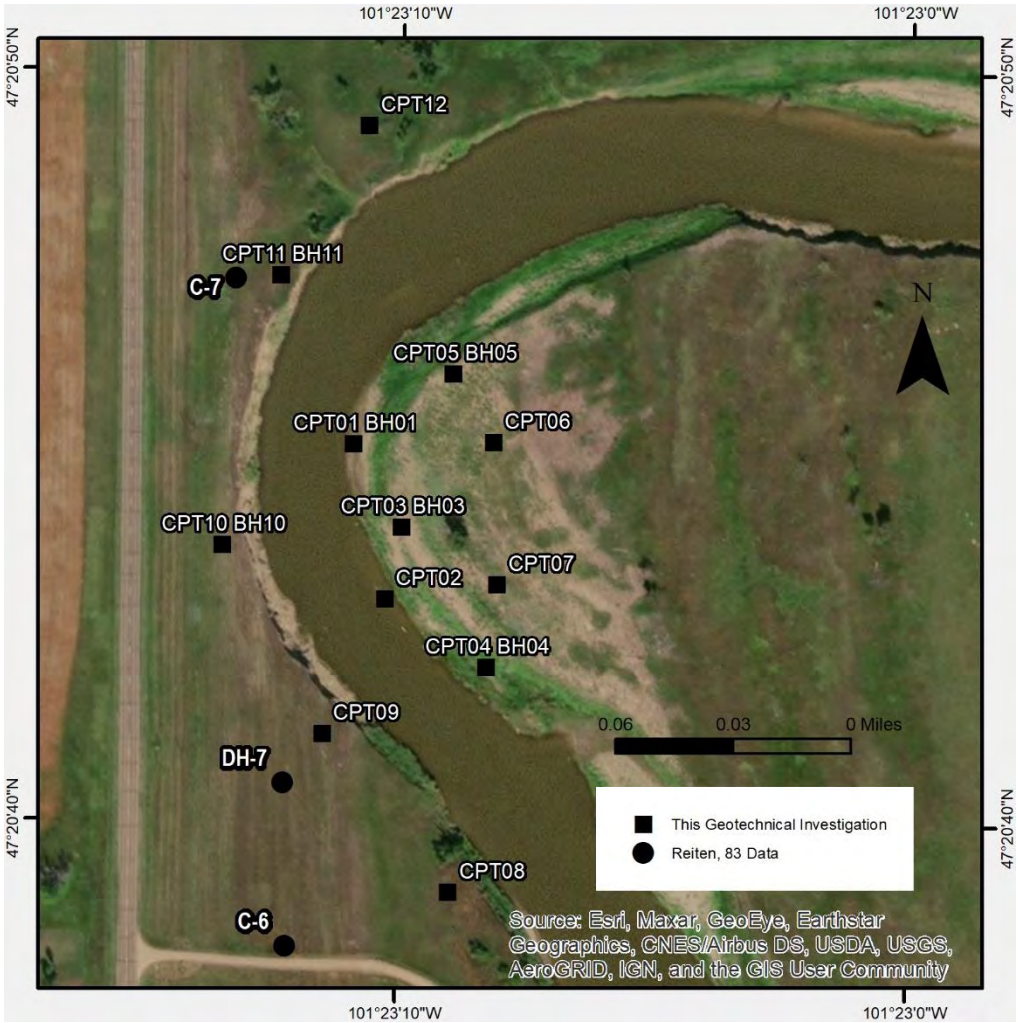


Figure 1. CPT and Borehole Location Map. Knife River flow is generally from north to south (top of image to bottom of image) and right bank (RB) is to the west whereas left bank (LB) is the the east.

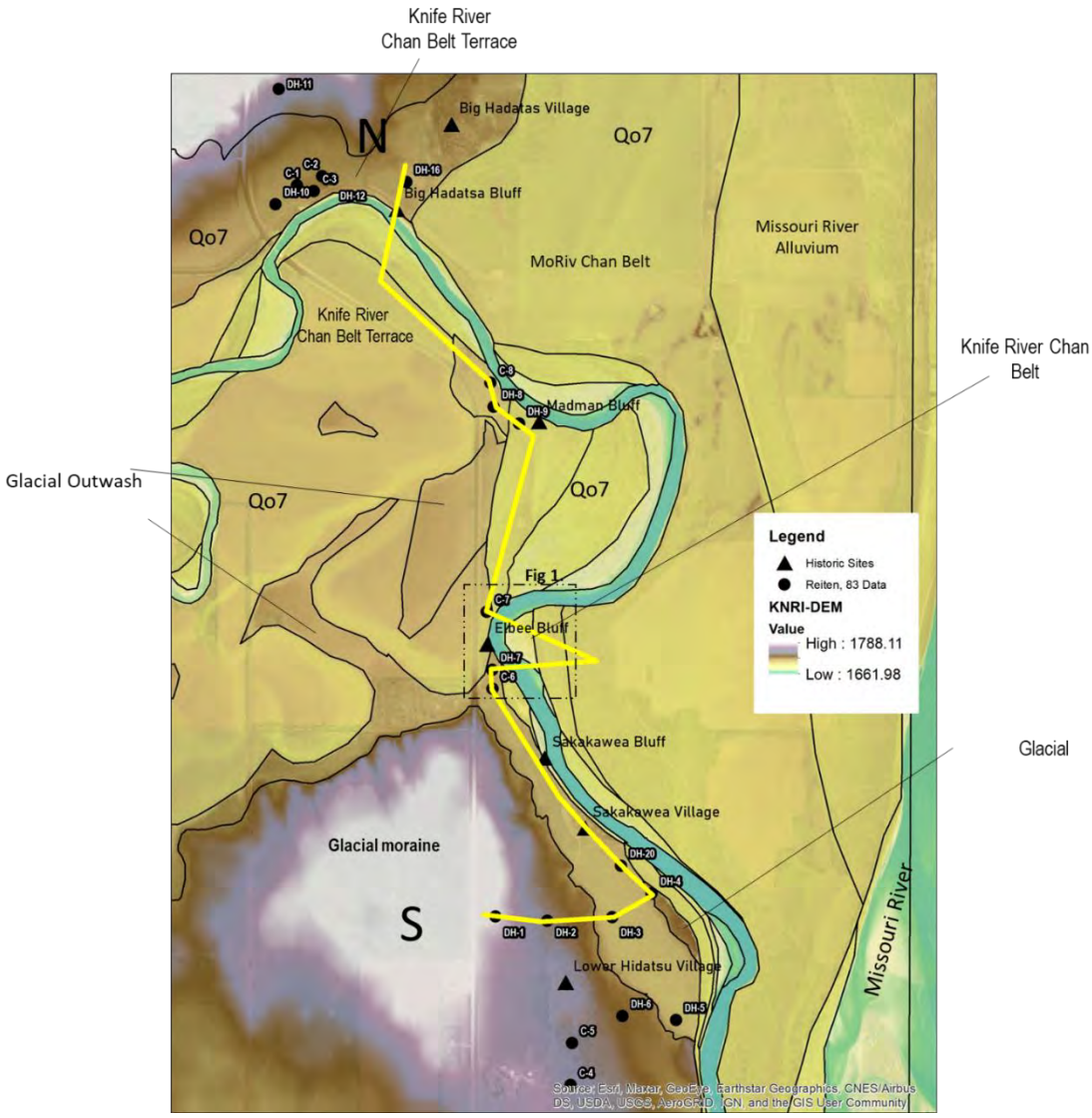


Figure 2. Lidar DEM data (from 2019 National Park Service/NPS survey) with geomorphic and lithologic units indicated. The Knife River Valley and Missouri River Valley are significant features in the area of interest. The sediment/soils that fill the Knife and Missouri valleys are composed of gravel, sand, silt and clay in channel belts, channel-fills, and overbank floodplains and are undifferentiated as Unit Qo7 on the most current Geological map (Graham, 2015). The river valleys have cut-into and eroded the pre-existing glacial sediment which is now located on the flanks of the valleys. The glacial sediment is interpreted to have originated as till (basal glacial sediment that is typified as unsorted material with gravel, sand, silt, and clay mixtures), glacio-lacustrine (short-lived lakes at the margins of glacial ablation/melt zones that fill with fine-grained material), and eolian/loess (wind-deposits of silt and fine sand downwind of glacial sediment sources). Note: Missouri River Alluvium refers to very recent channel-belts/sediment deposited by migration of the Missouri River whereas MoRiv Chan Belt refers to an older Missouri River channel-belt which the Knife River has eroded into. The sediment/soils of these units would be very similar. Also, the Knife River Chan Belt Terrace marks a Knife River channel belt that is higher in elevation (approximately 10 feet) but sedimentologically very similar to the modern Knife River deposits. It preserves a time when the Knife River base level was at a different level either because the Knife River base level was at a higher elevation or the entire area was at a lower elevation due to glacial-loading, i.e., subsequent crustal rebound due to glacial isostatic rebound after ice sheet retreat. Location of Figure 1 map shown with dashed box symbol.

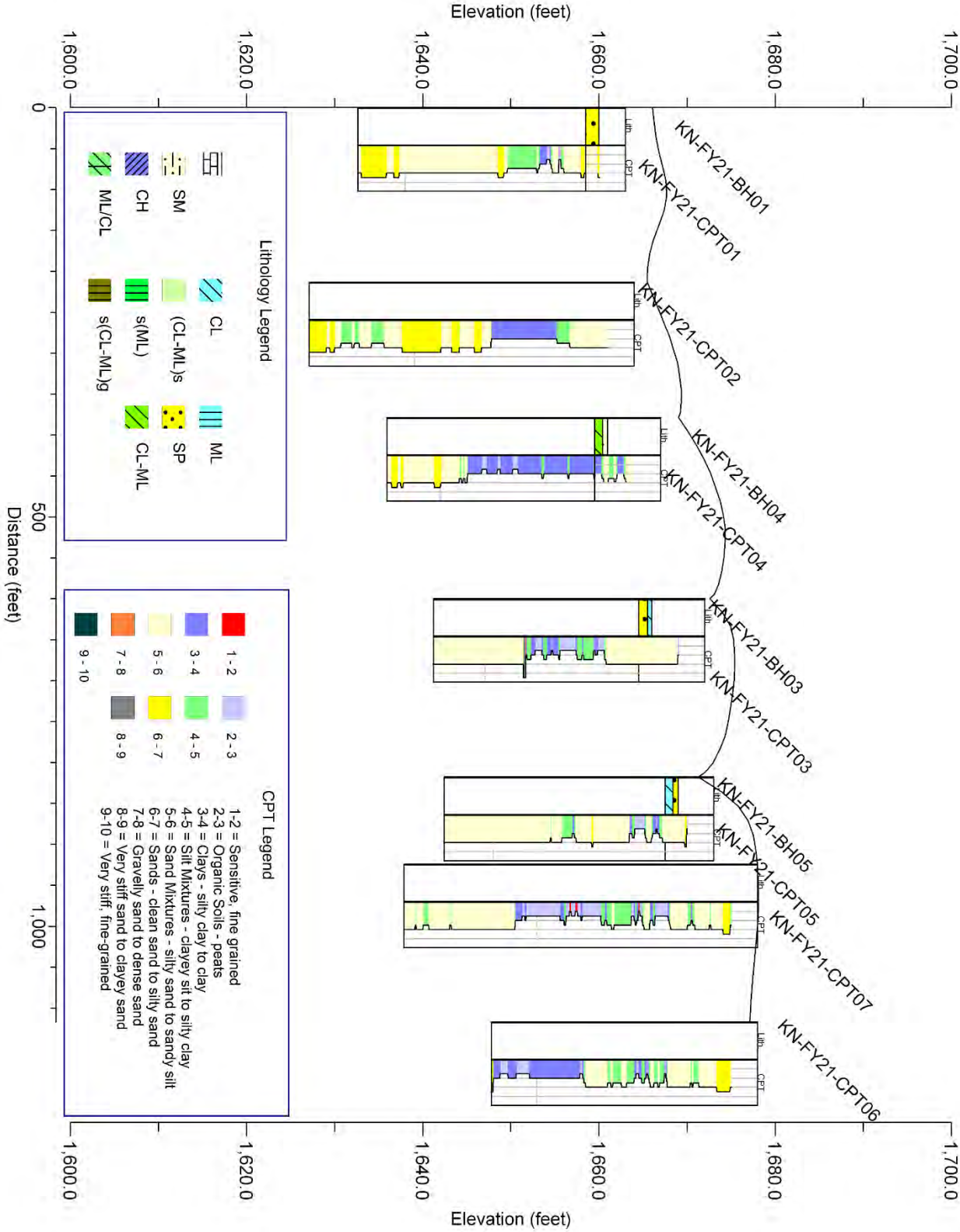


Figure 3. Knife River left bank CPT and BH cross section. Locations shown on Figure 1.

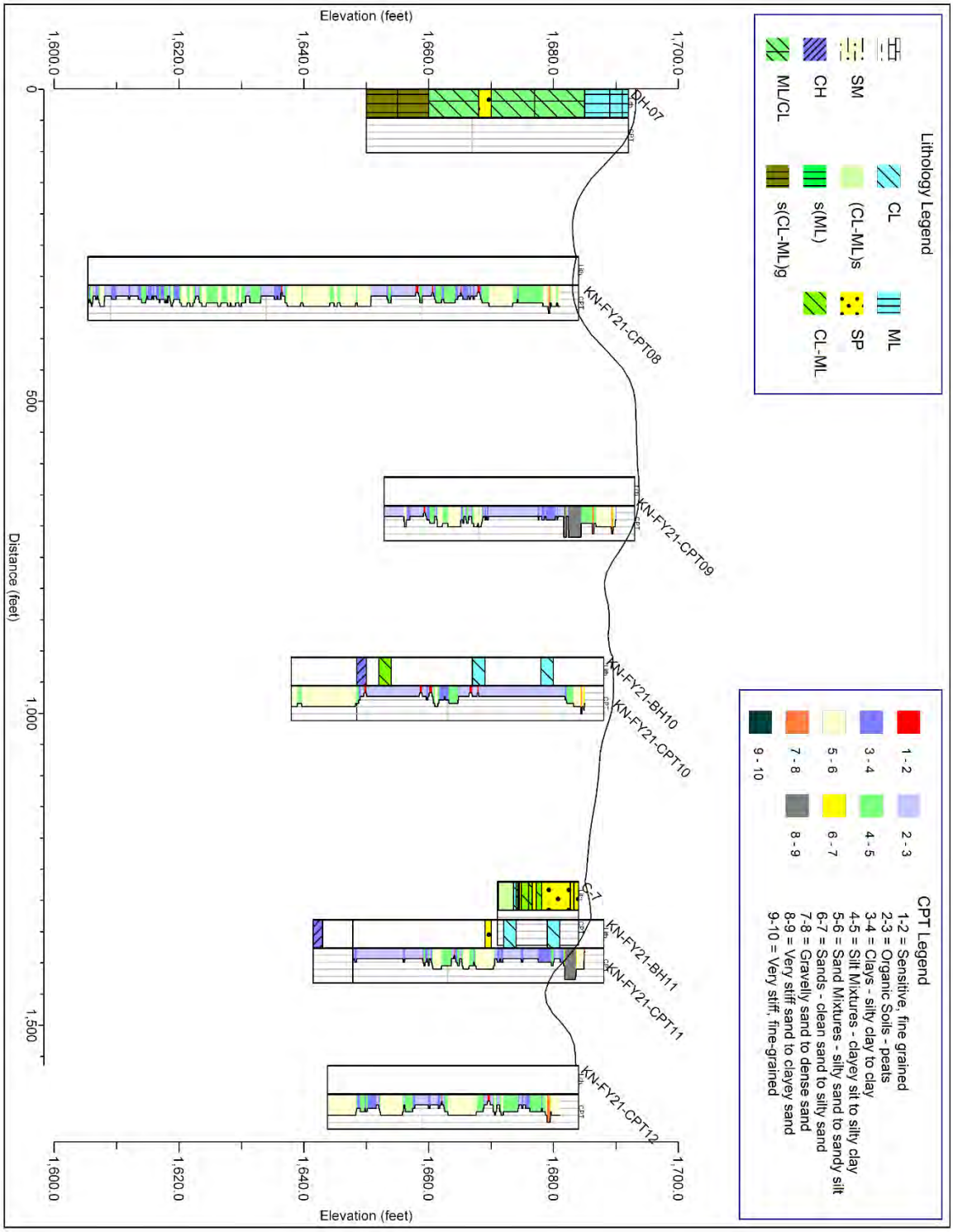


Figure 4. Knife River right bank CPT and BH cross section. Locations shown on Figure 1.

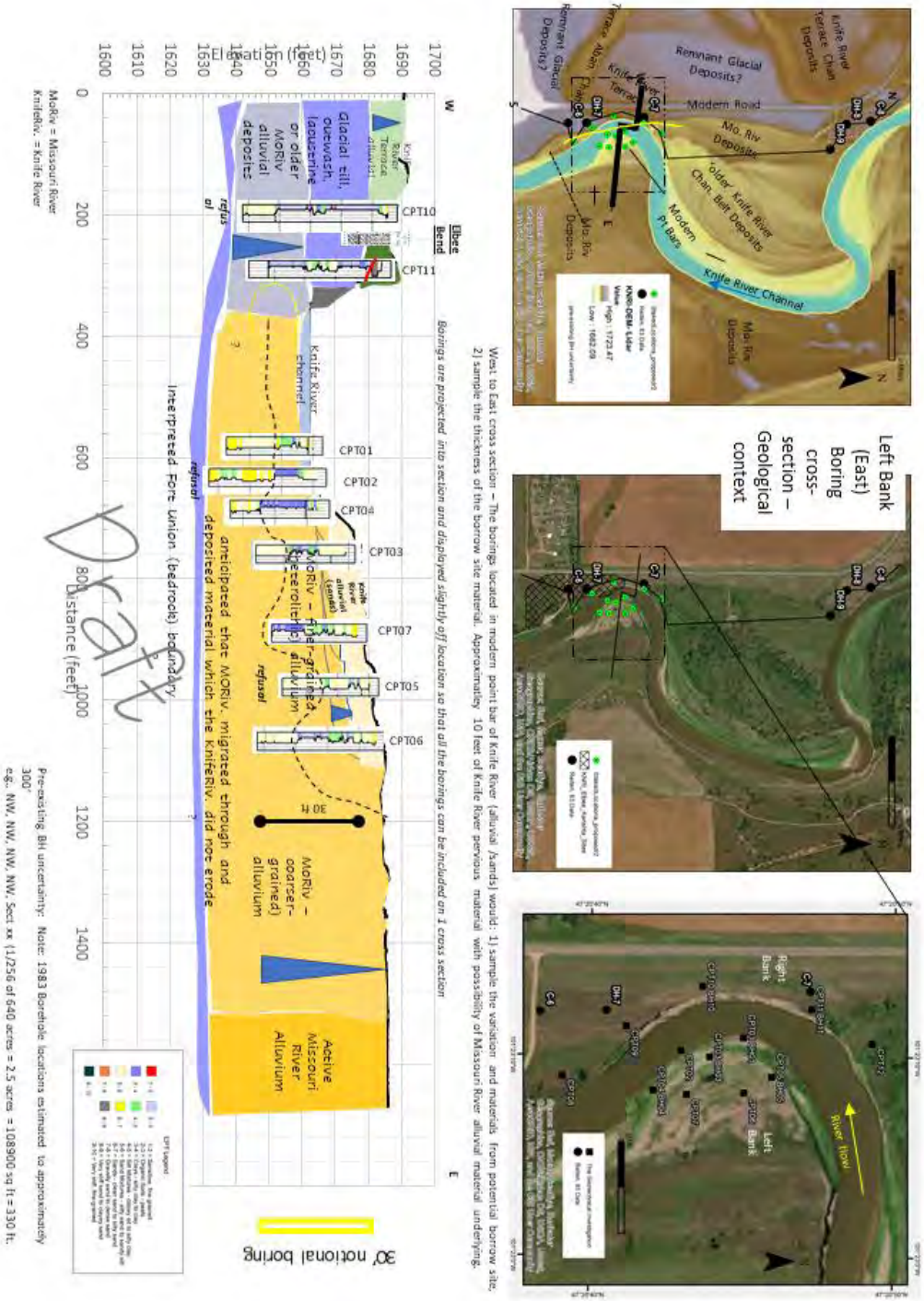


Figure 5. West to East Geological Cross Section with correlations and interpretation. The soil investigation goal was to collect representative material that the revetment will tie into and rest upon.The collected CPT data provides a range of potential soil material. In general, the material appears to be Missouri River-dominated alluvium.

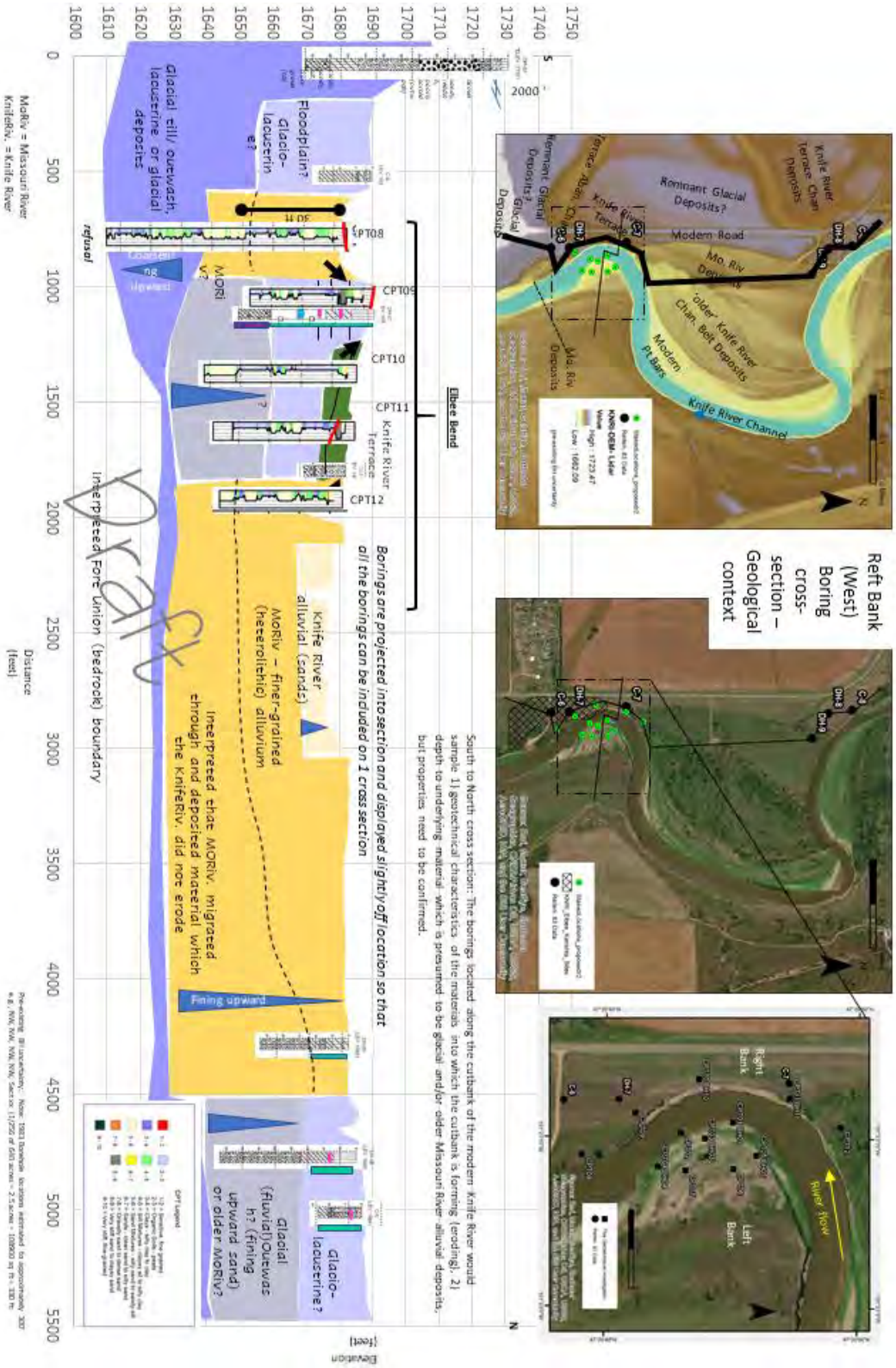


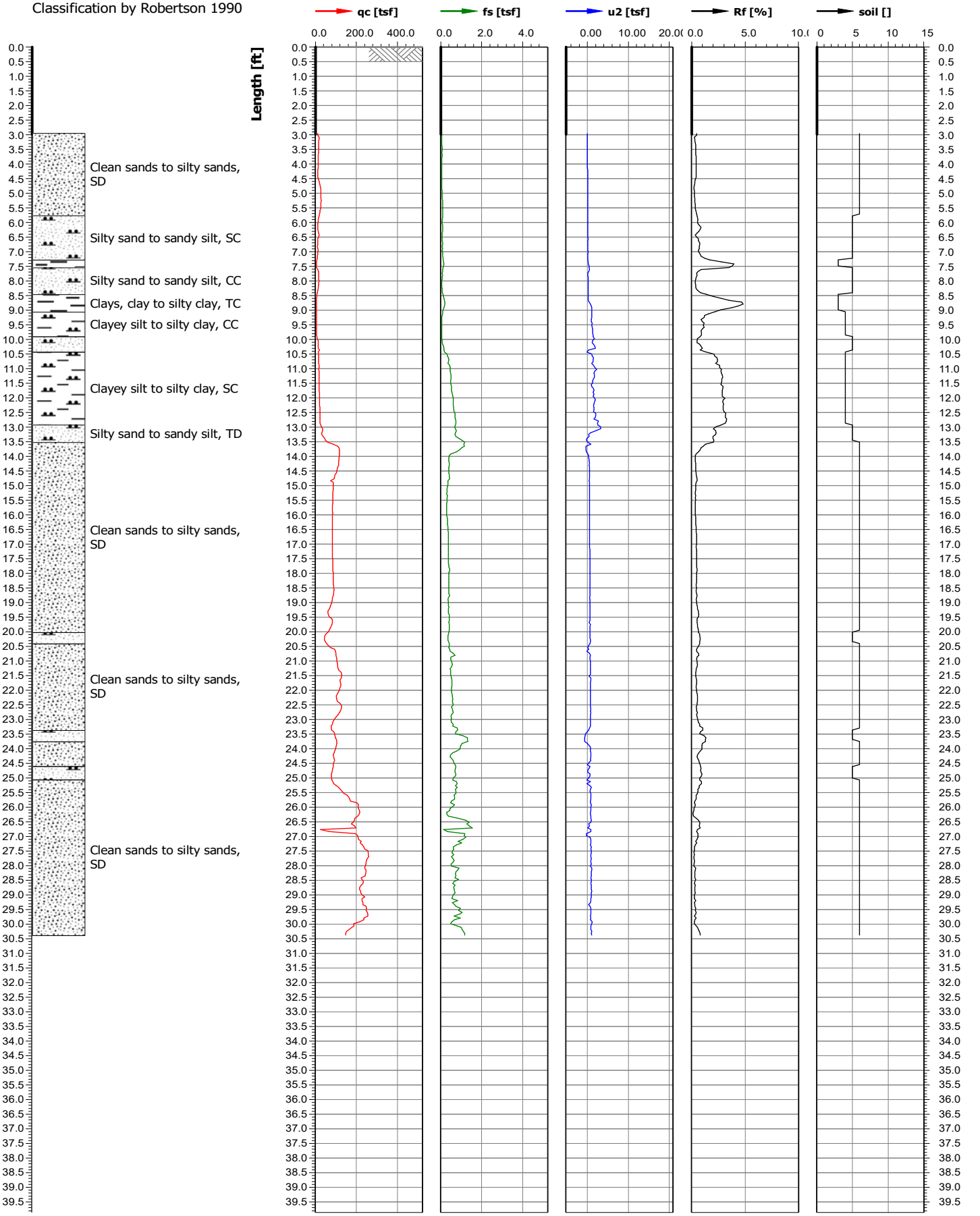
Figure 6. South to North Geological Cross Section with correlations and interpretation along Knife River Elbee Bend Cutbank and through Knife/Missouri Aluvium to bank of Madman Bluff. Cross section oriented as if the observer was standing on the left bank (east) point bar looking west.

Figure 7. Photomosaic image of Elbee Bend cutbank section with observable soil/sediment onlap relationships delineated. Yellow arrows indicate onlap of different units.

ATTACHMENT B: Drill Logs

Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT1	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/1	1:50	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



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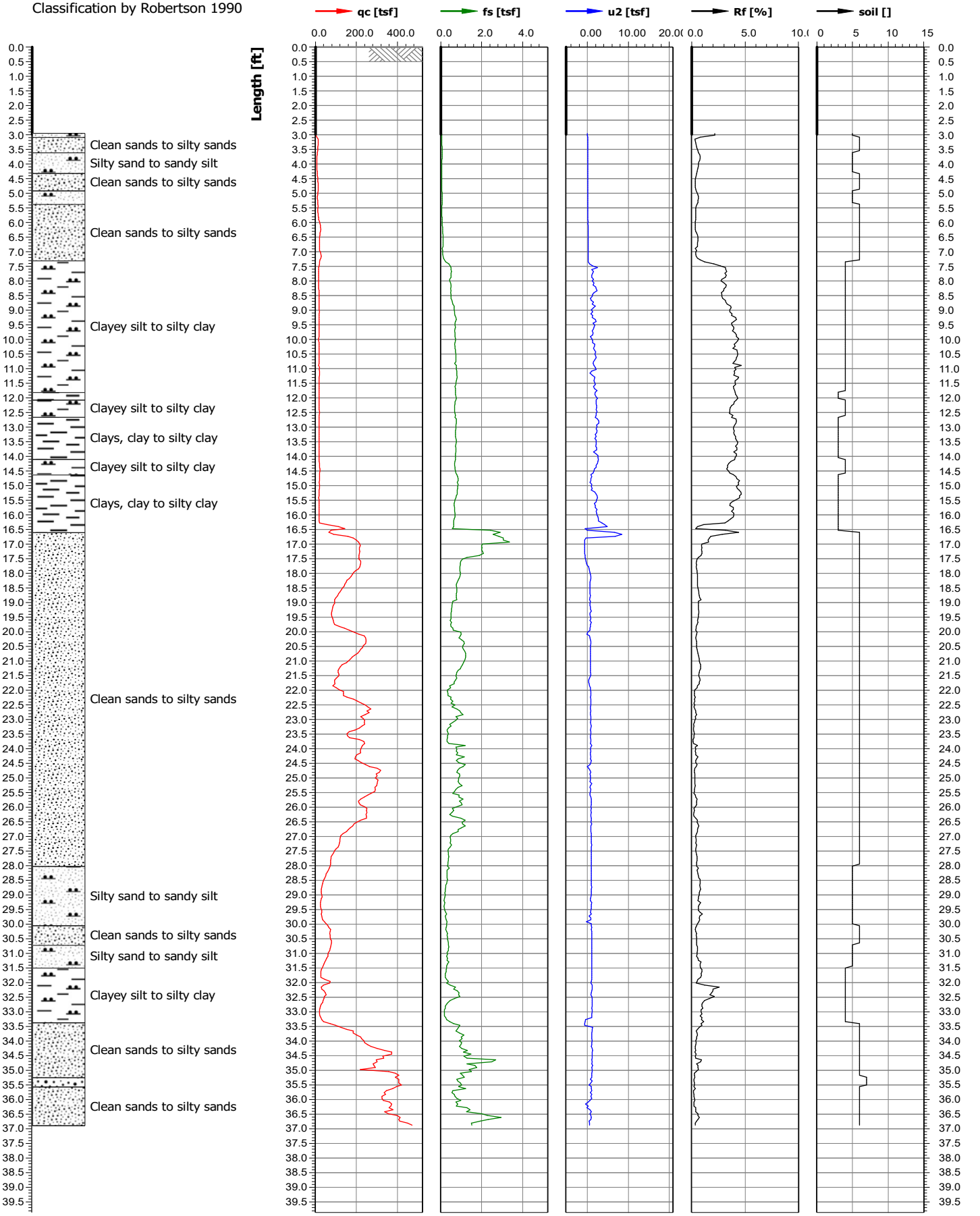
Project ID	**Client**	**Investigation start ...**	**Standard/Standar...**	**Nominal surface area of...**
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		**Page**	**Scale**	**Net surface area quotie...**
Knife River Elbee Bend Bank Stabilization		1/1	1:50	0.820/0.000
Remarks1		**Coordinate system used**		**U**
				u2

Classification by Robertson 1990



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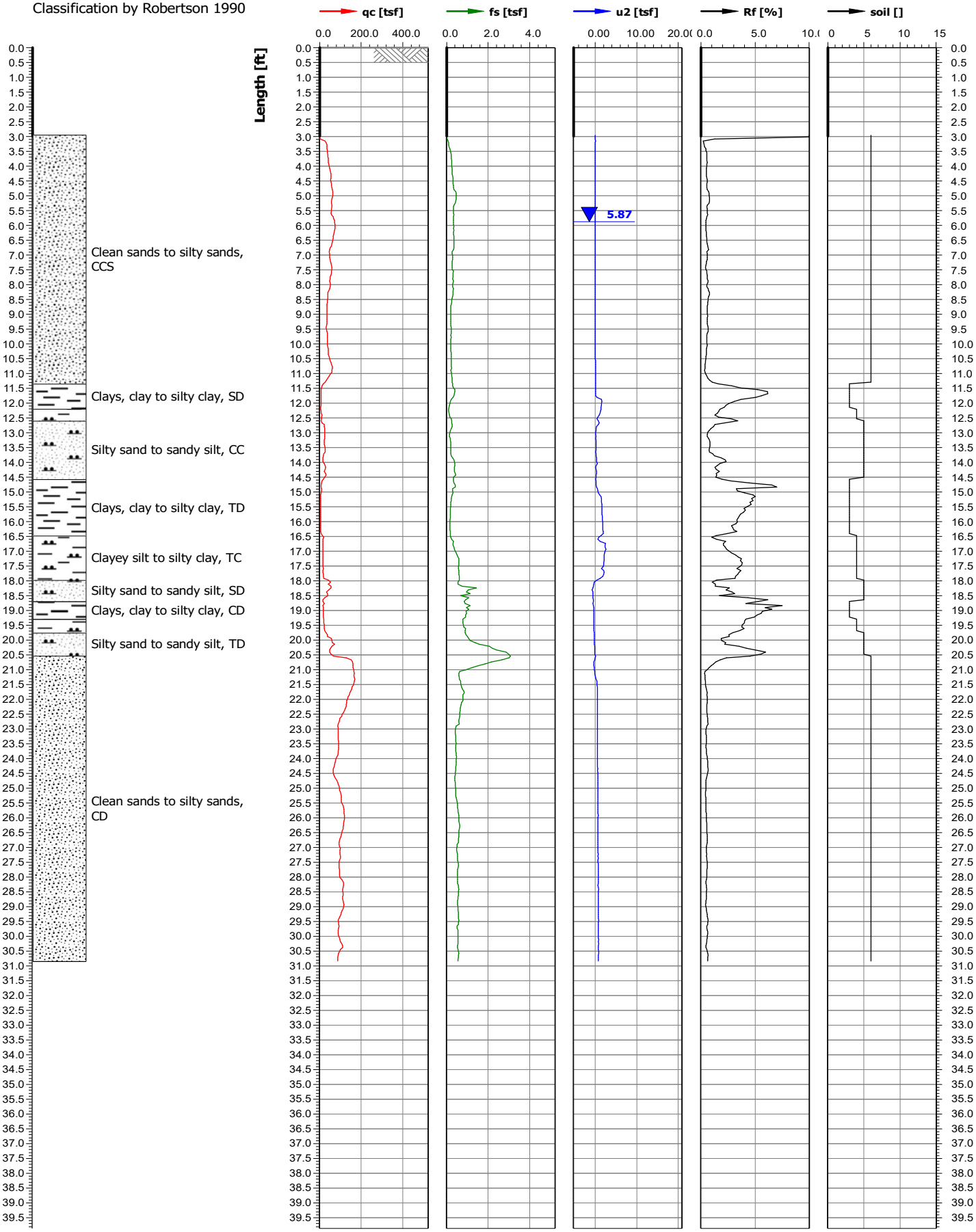
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/1	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



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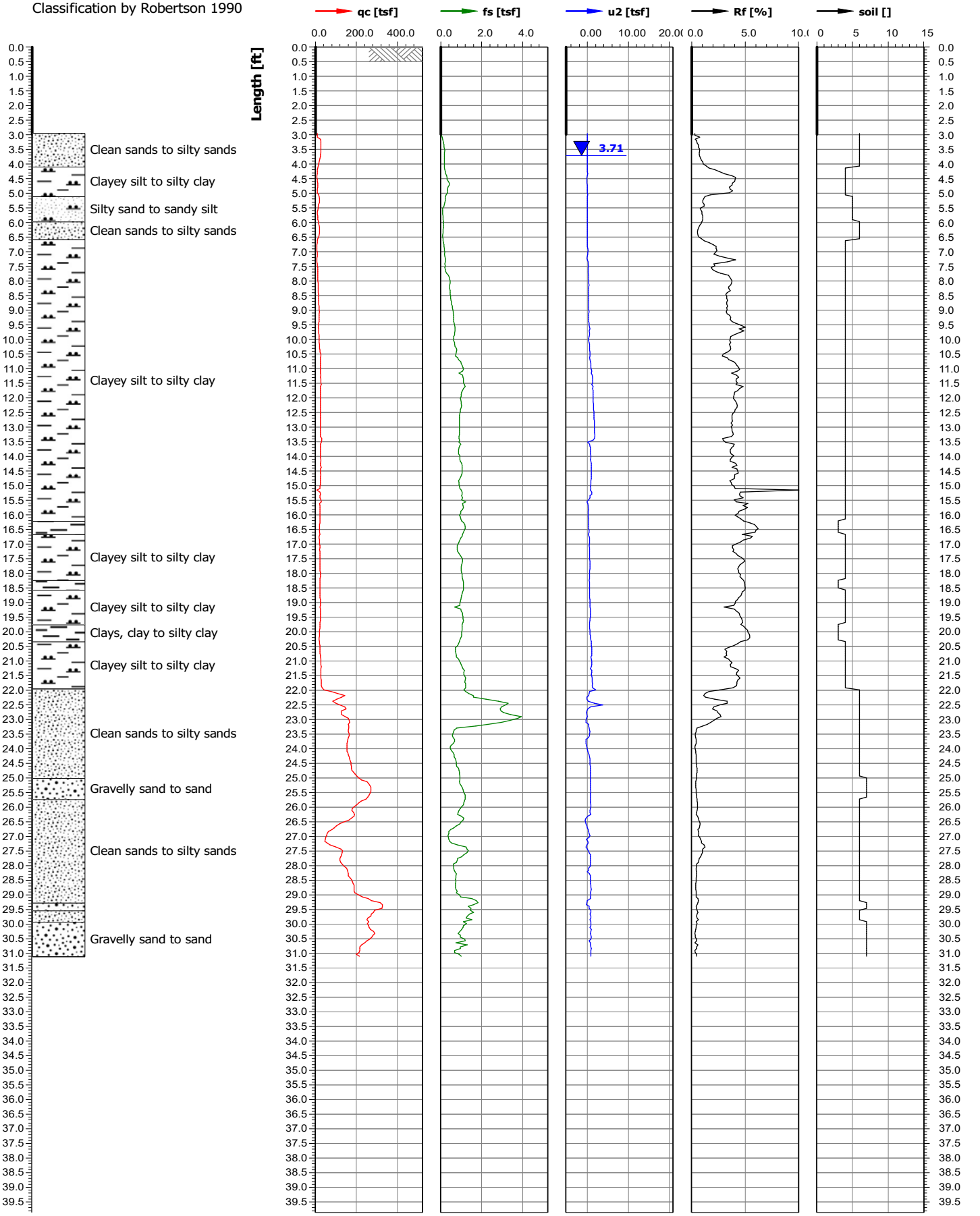
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/1	1:50	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



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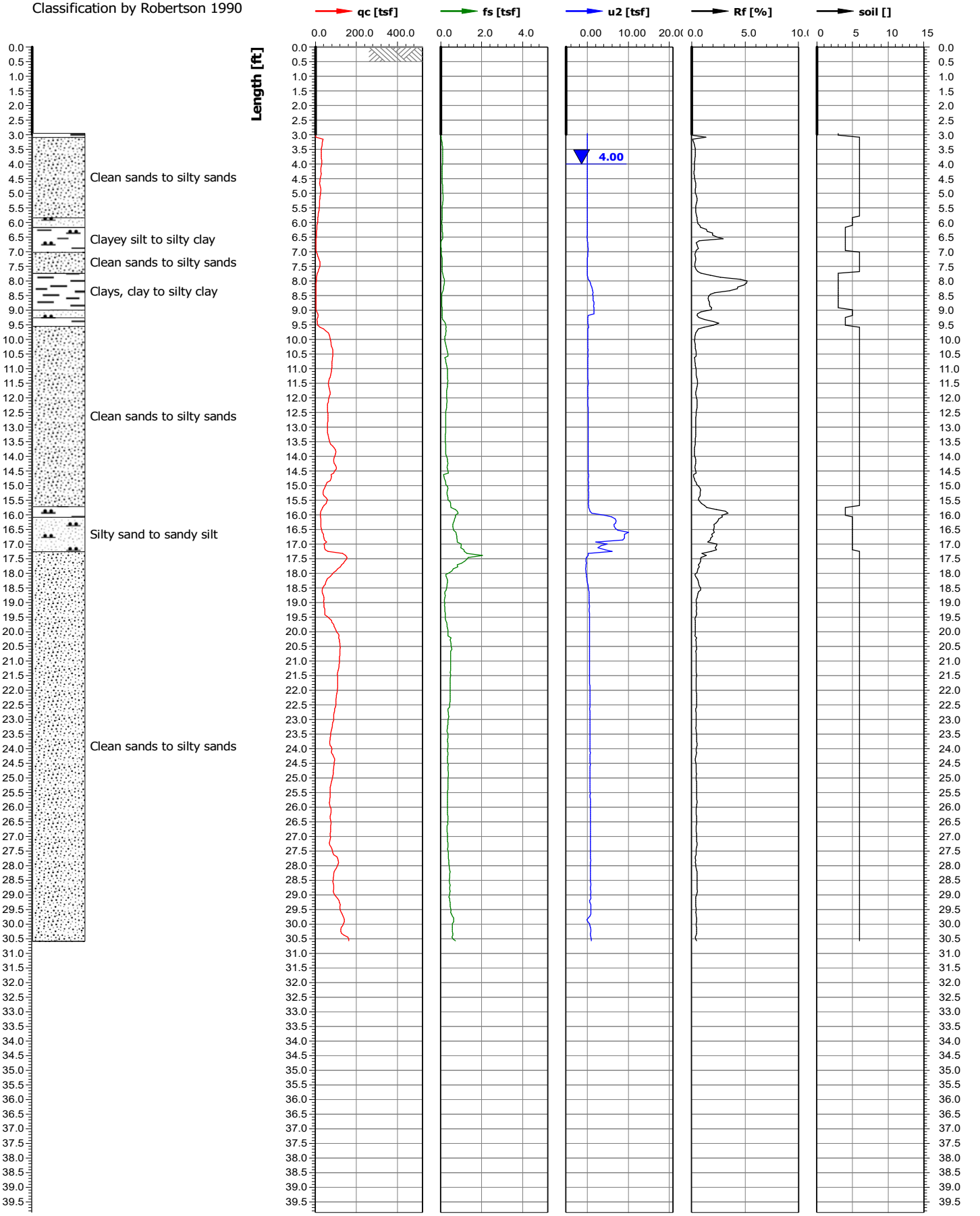
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/1	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
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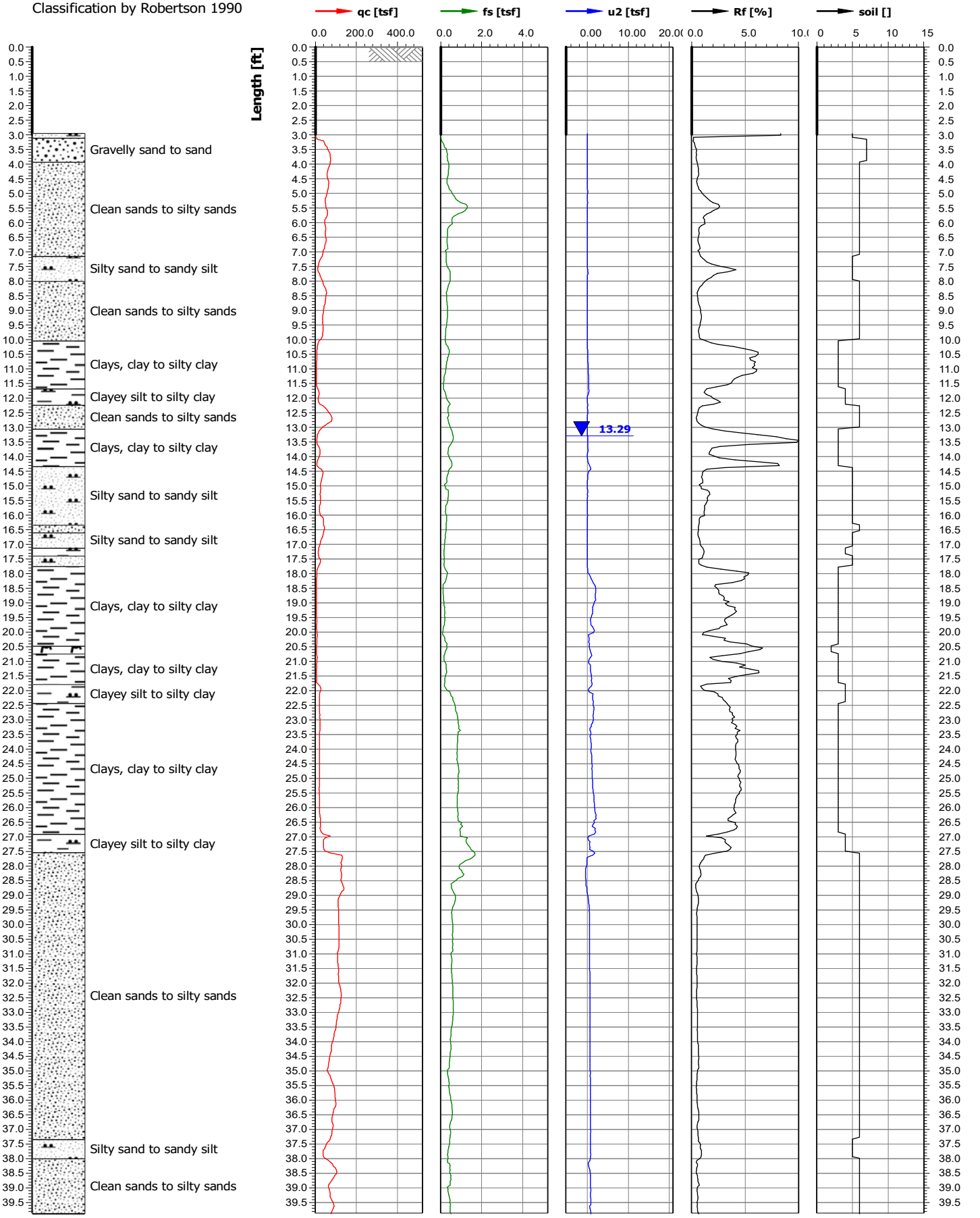
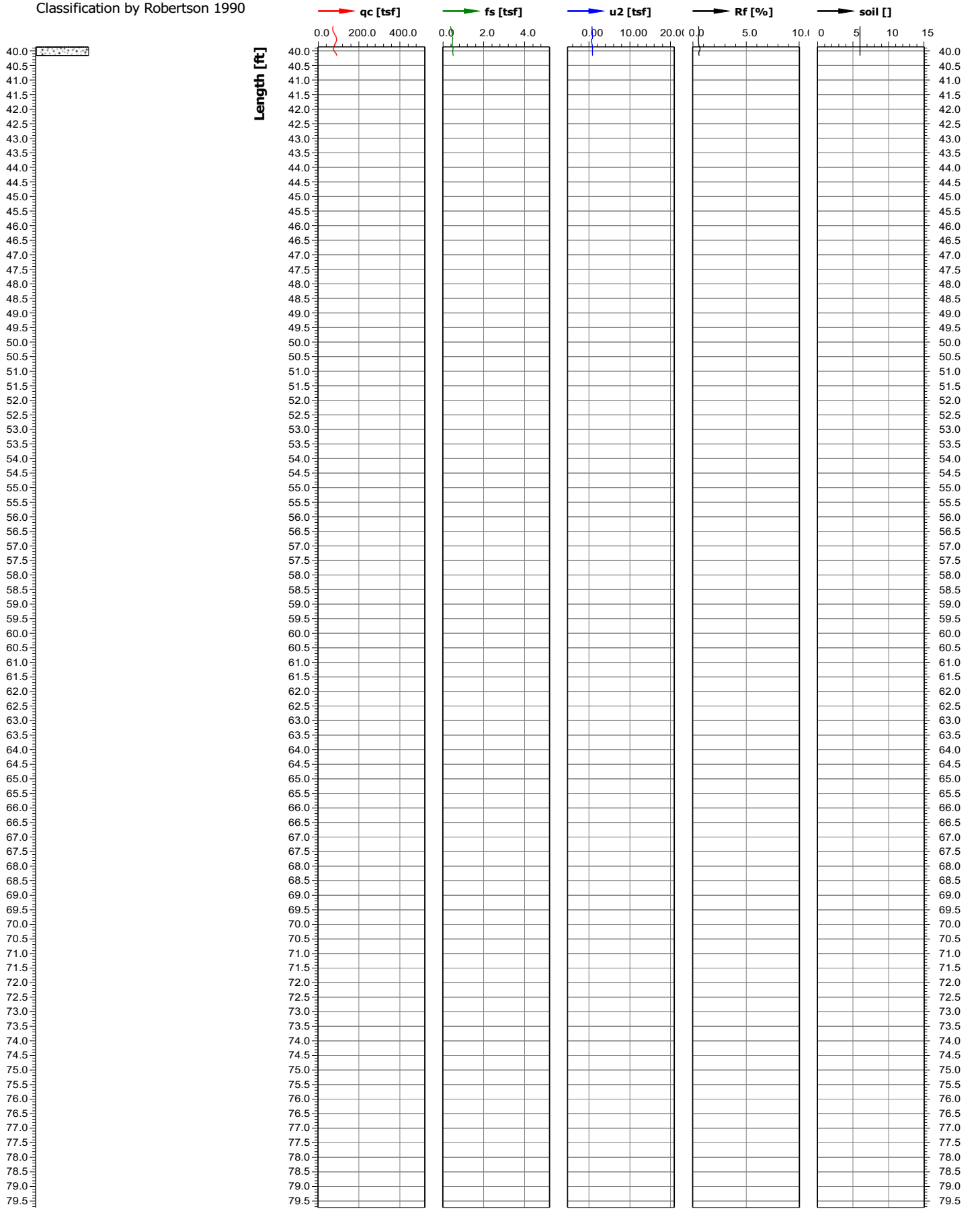
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



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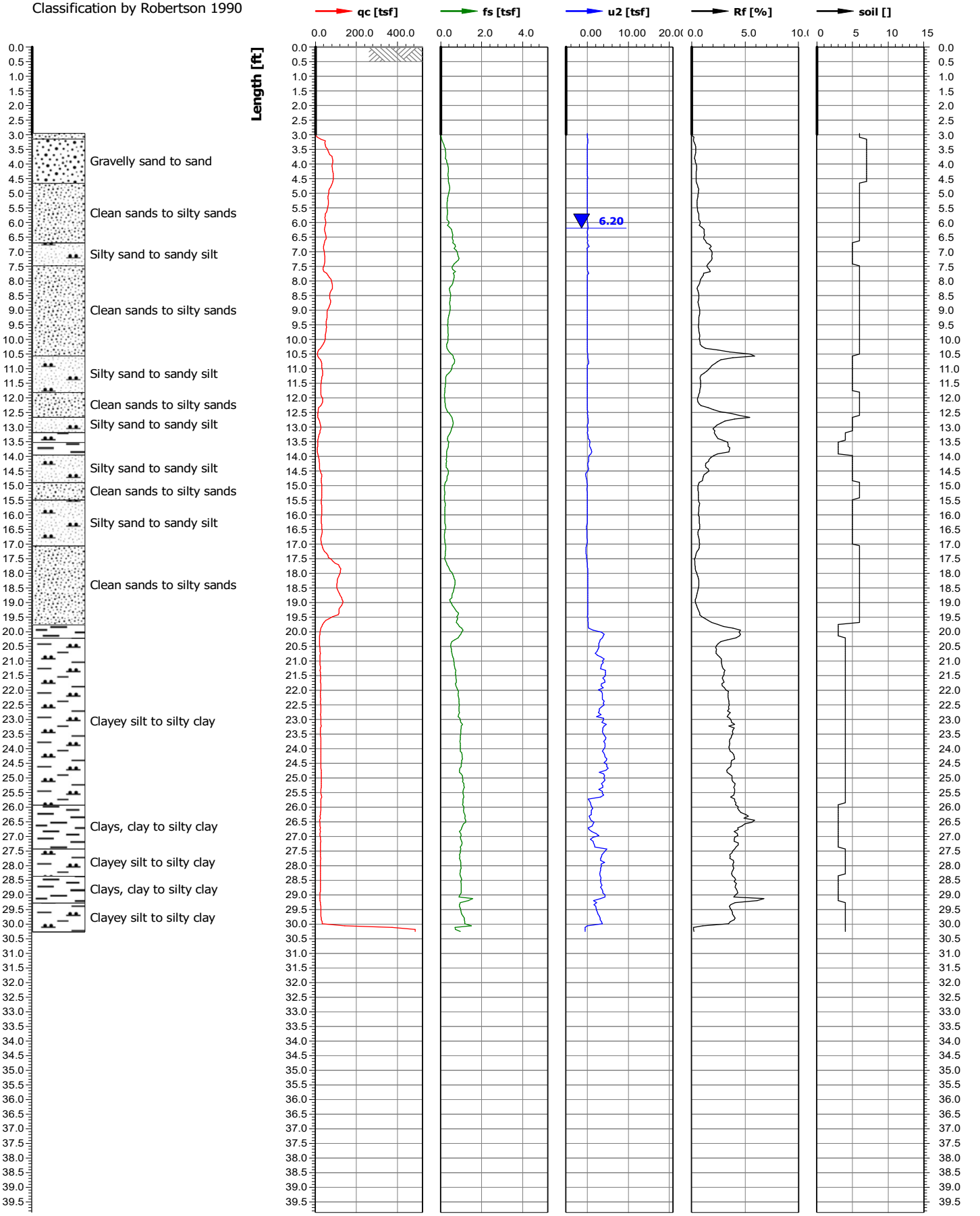
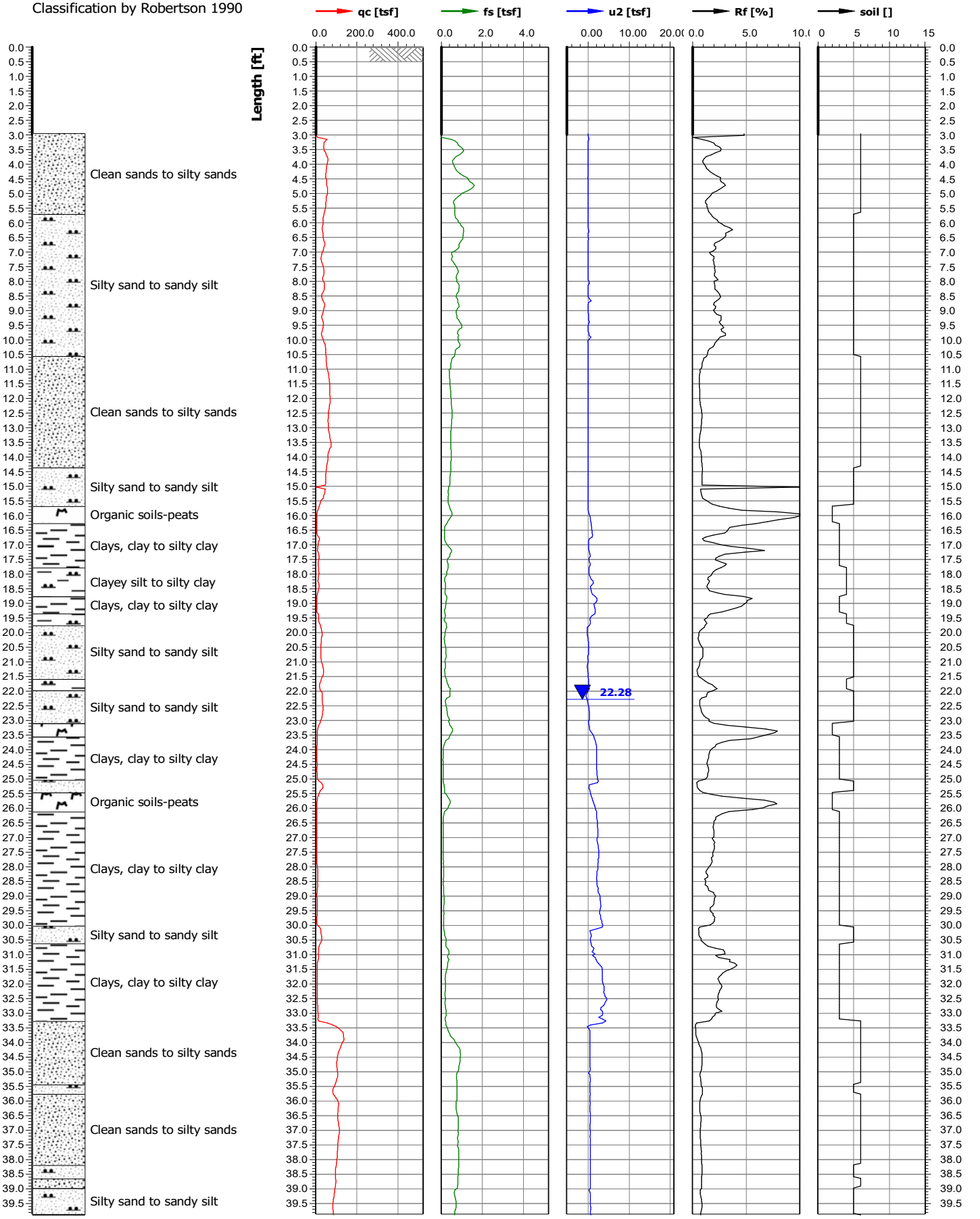
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT7	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/1	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



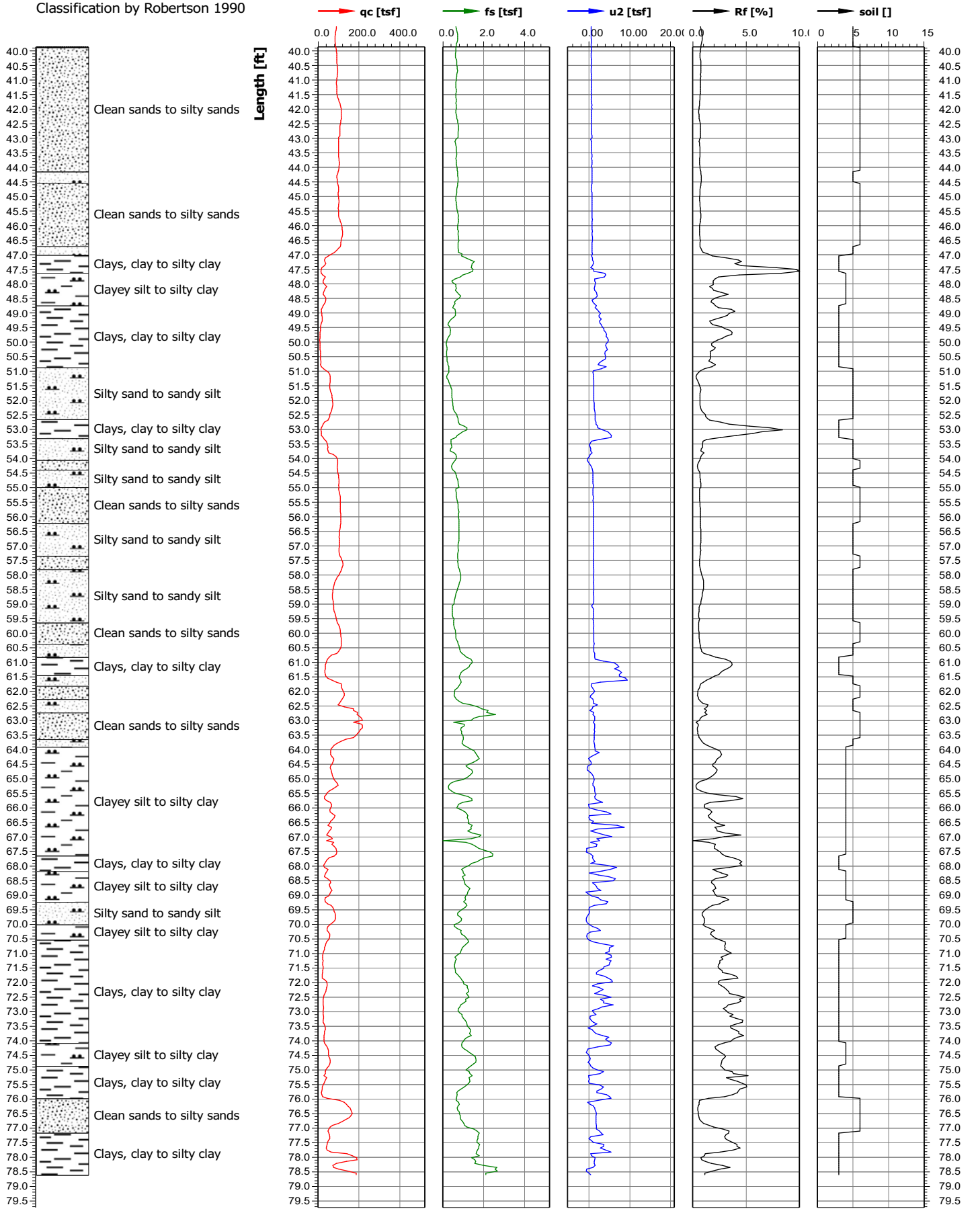
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
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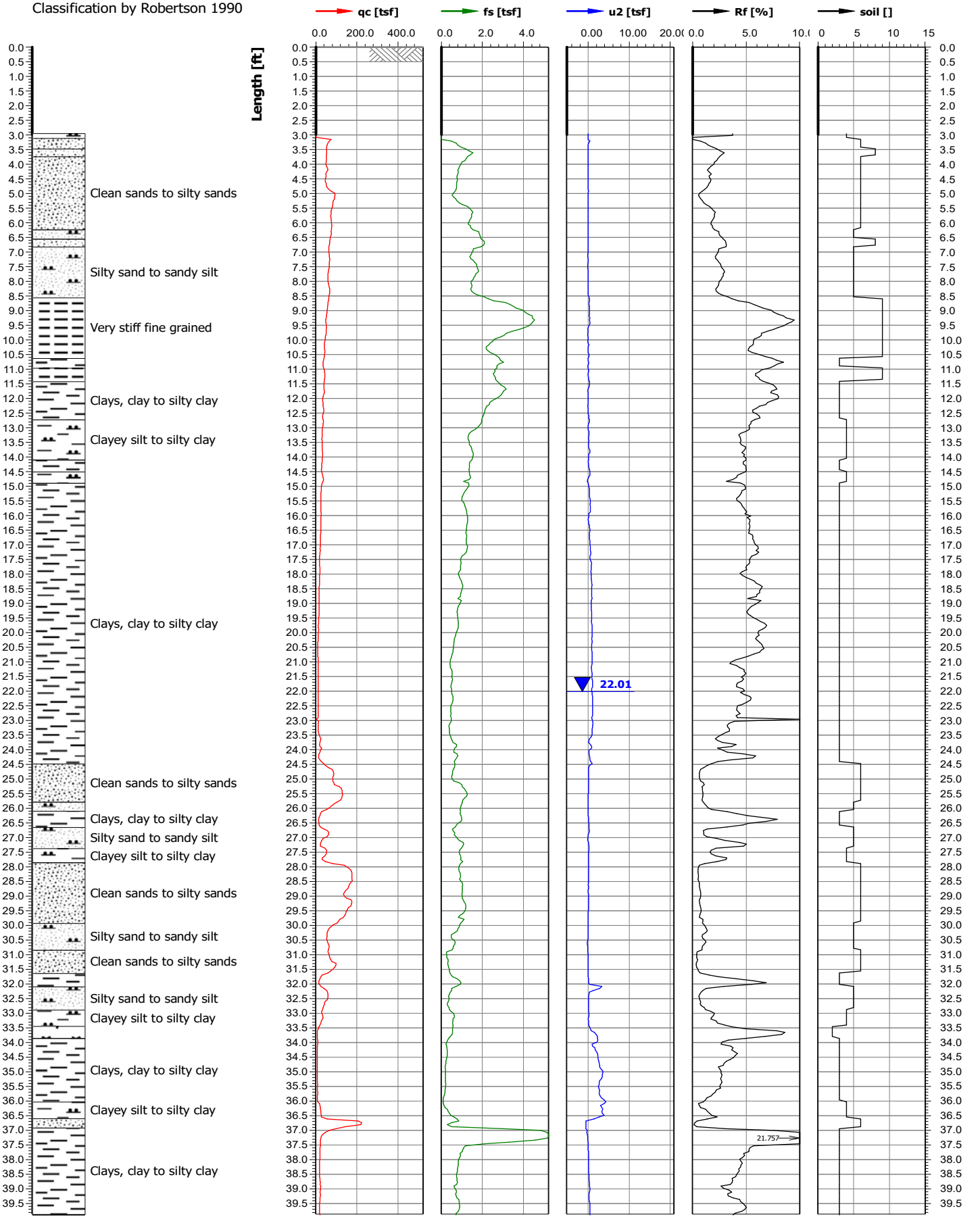
Project ID	**Client**	**Investigation start ...**	**Standard/Standar...**	**Nominal surface area of...**
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		**Page**	**Scale**	**Net surface area quotie...**
Knife River Elbee Bend Bank Stabilization		1/2	1:50	0.840/0.000
Remarks1		**Coordinate system used**		**U**
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
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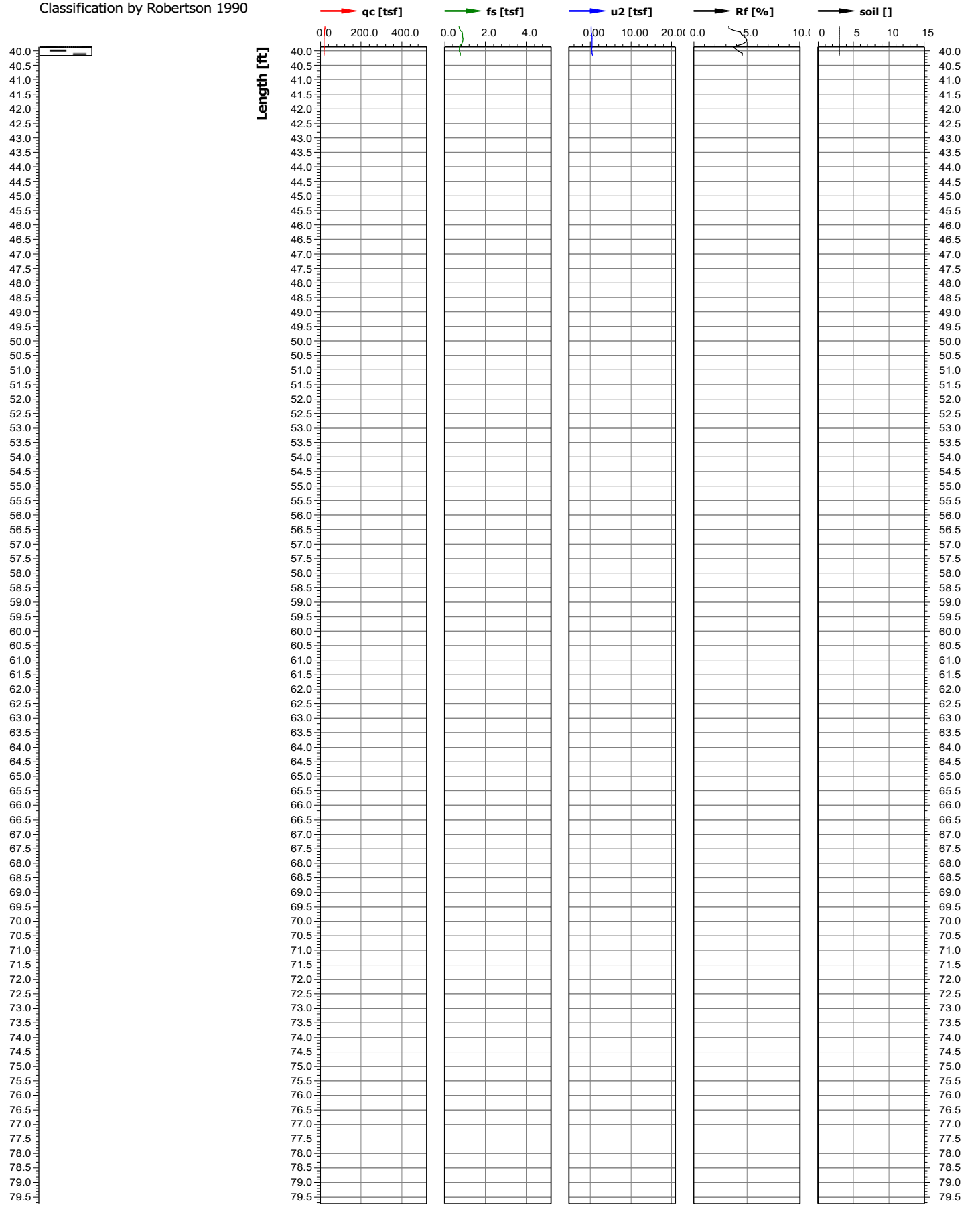
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
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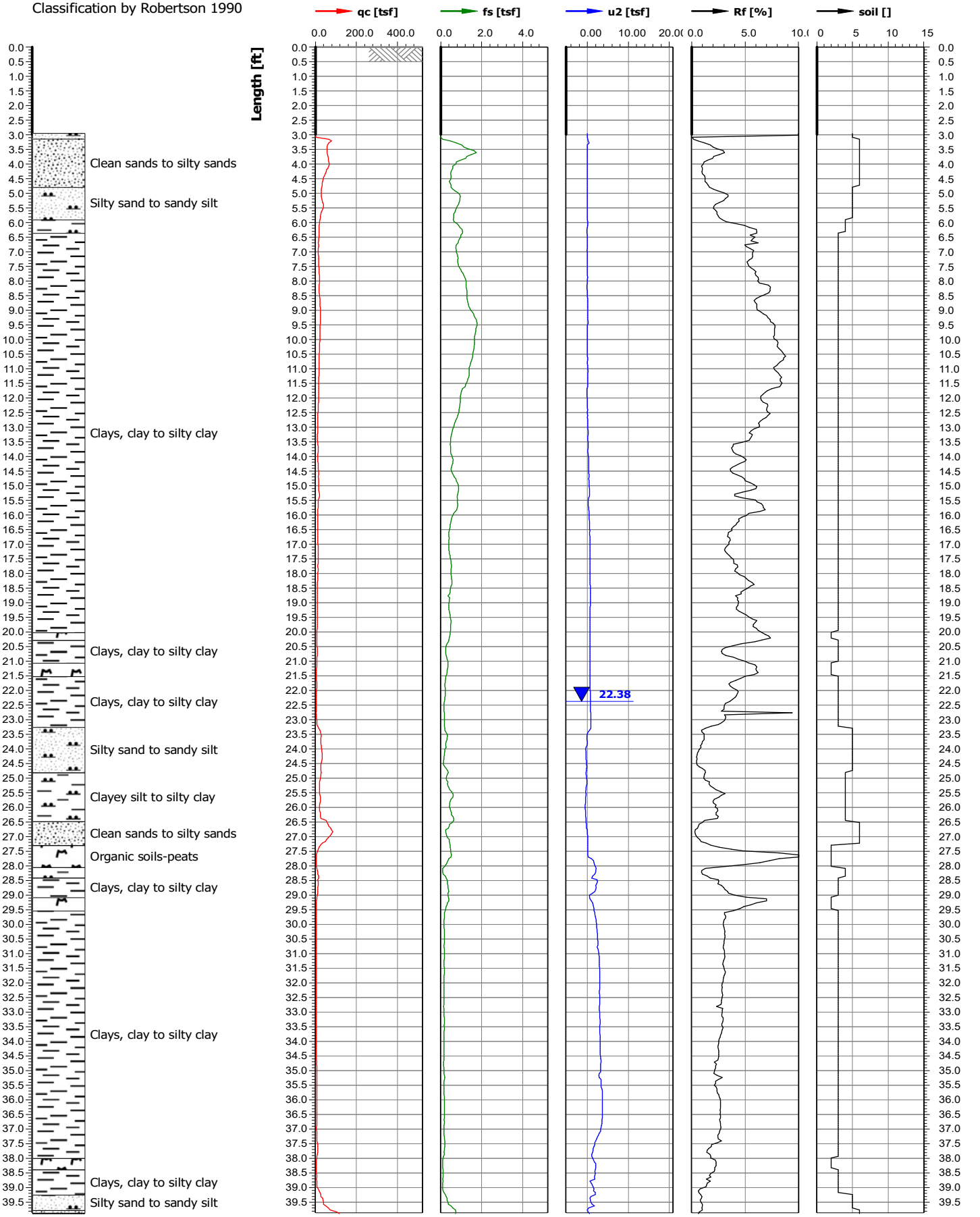
Project ID	**Client**	**Investigation start ...**	**Standard/Standar...**	**Nominal surface area of...**
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		**Page**	**Scale**	**Net surface area quotie...**
Knife River Elbee Bend Bank Stabilization		1/2	1:50	0.840/0.000
Remarks1		**Coordinate system used**		**U**
				u2

Classification by Robertson 1990



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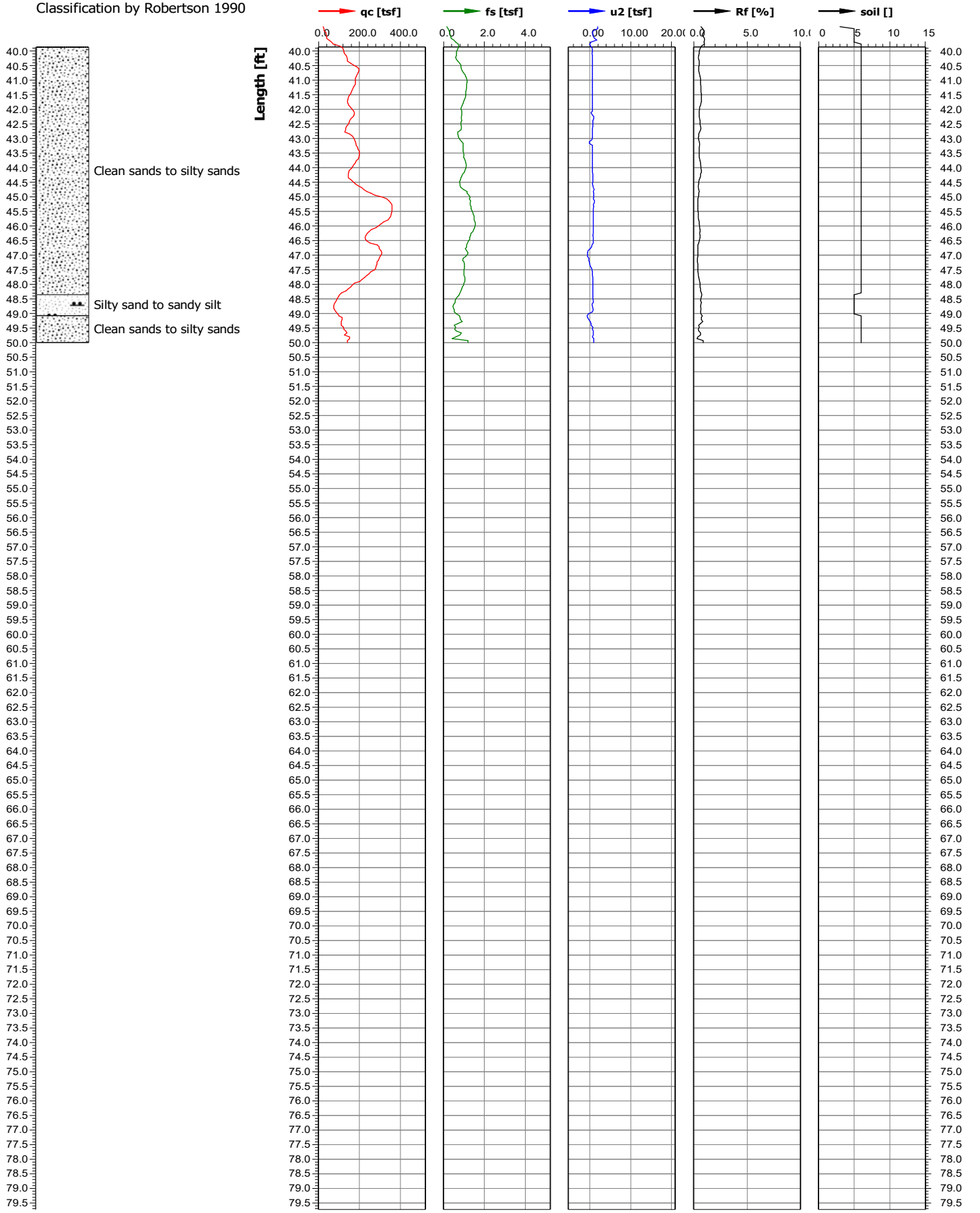
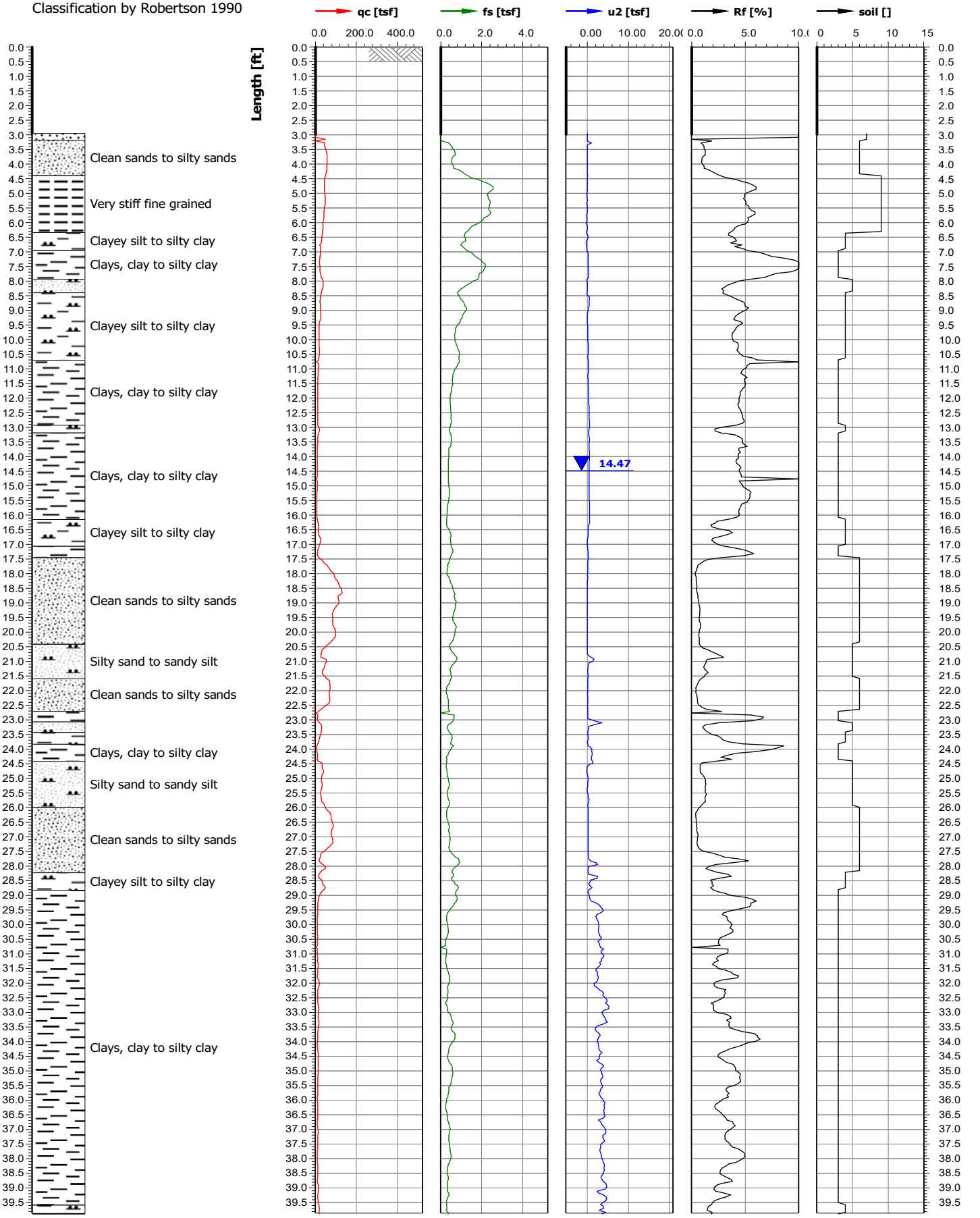
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	**Client**	**Investigation start ...**	**Standard/Standar...**	**Nominal surface area of...**
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		**Page**	**Scale**	**Net surface area quotie...**
Knife River Elbee Bend Bank Stabilization		1/2	1:50	0.840/0.000
Remarks1		**Coordinate system used**		**U**
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
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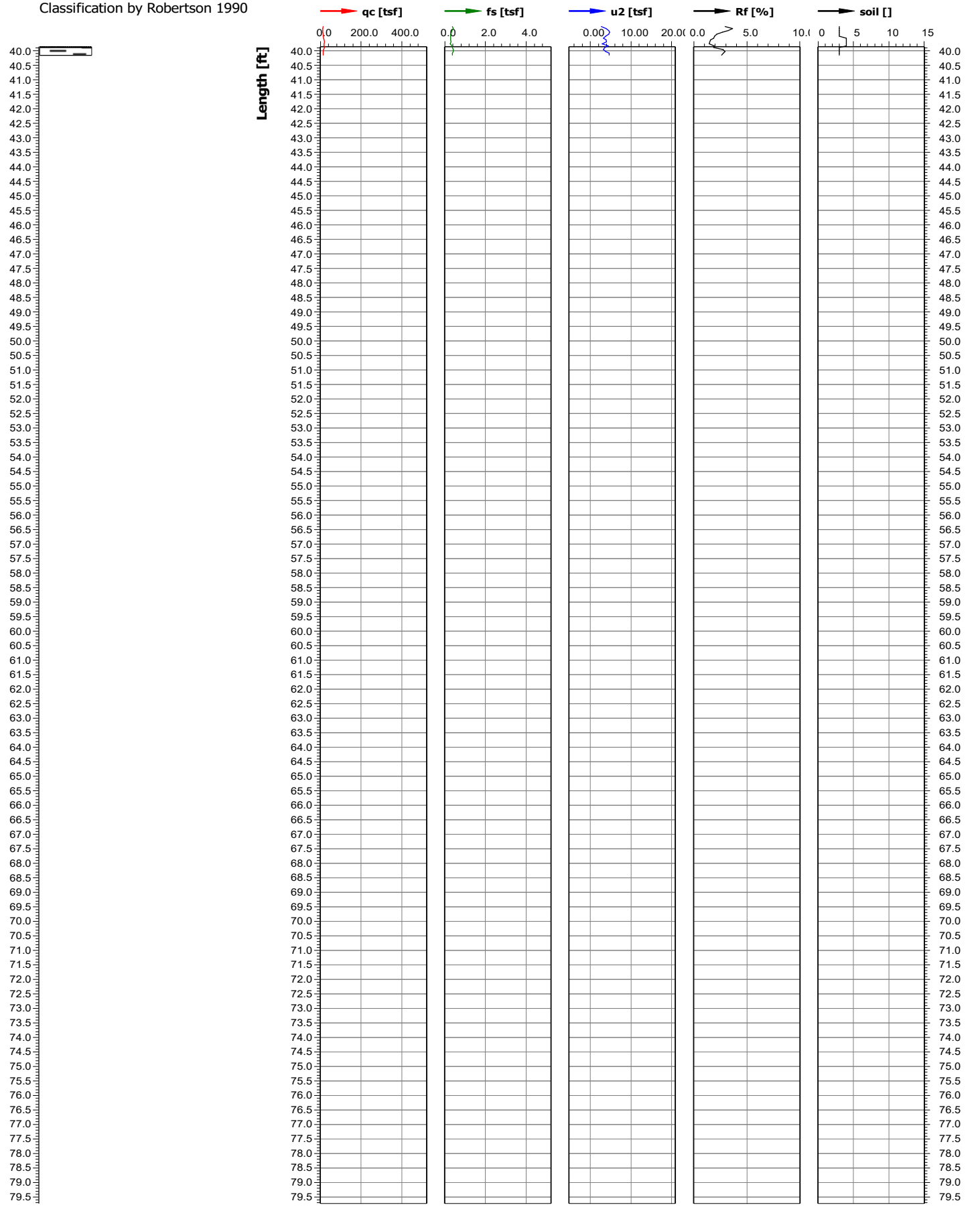
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
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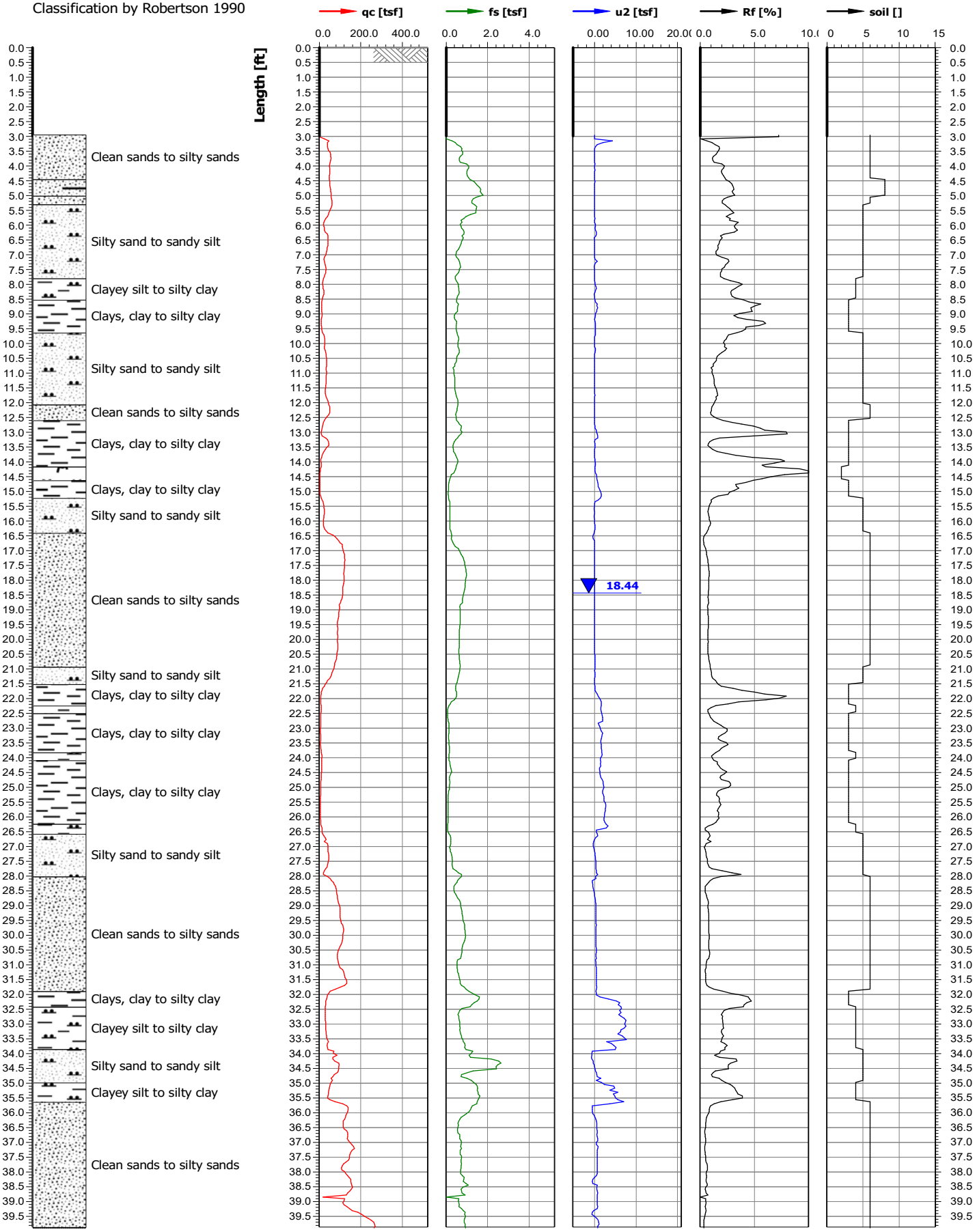
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
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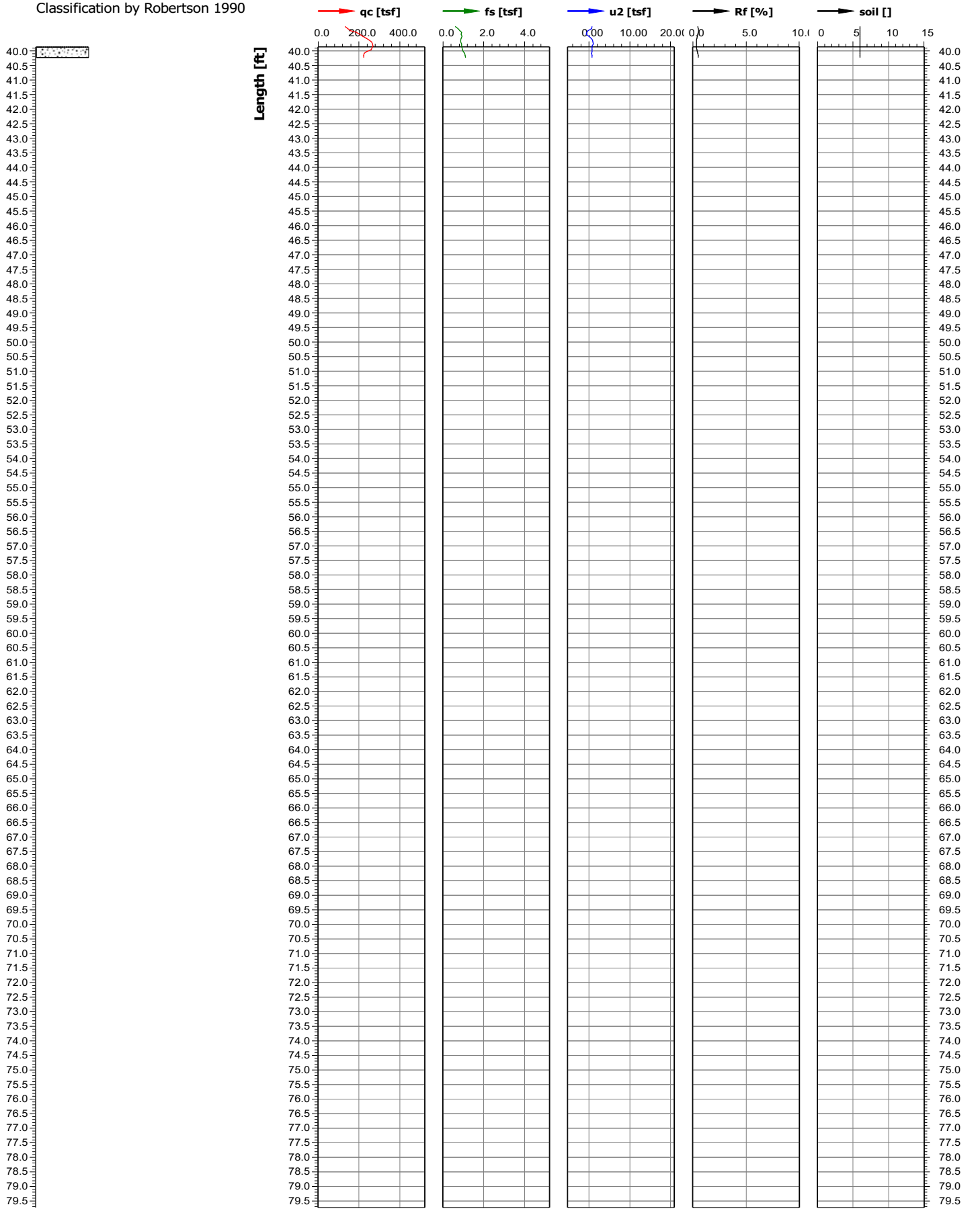
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/2	1:50	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
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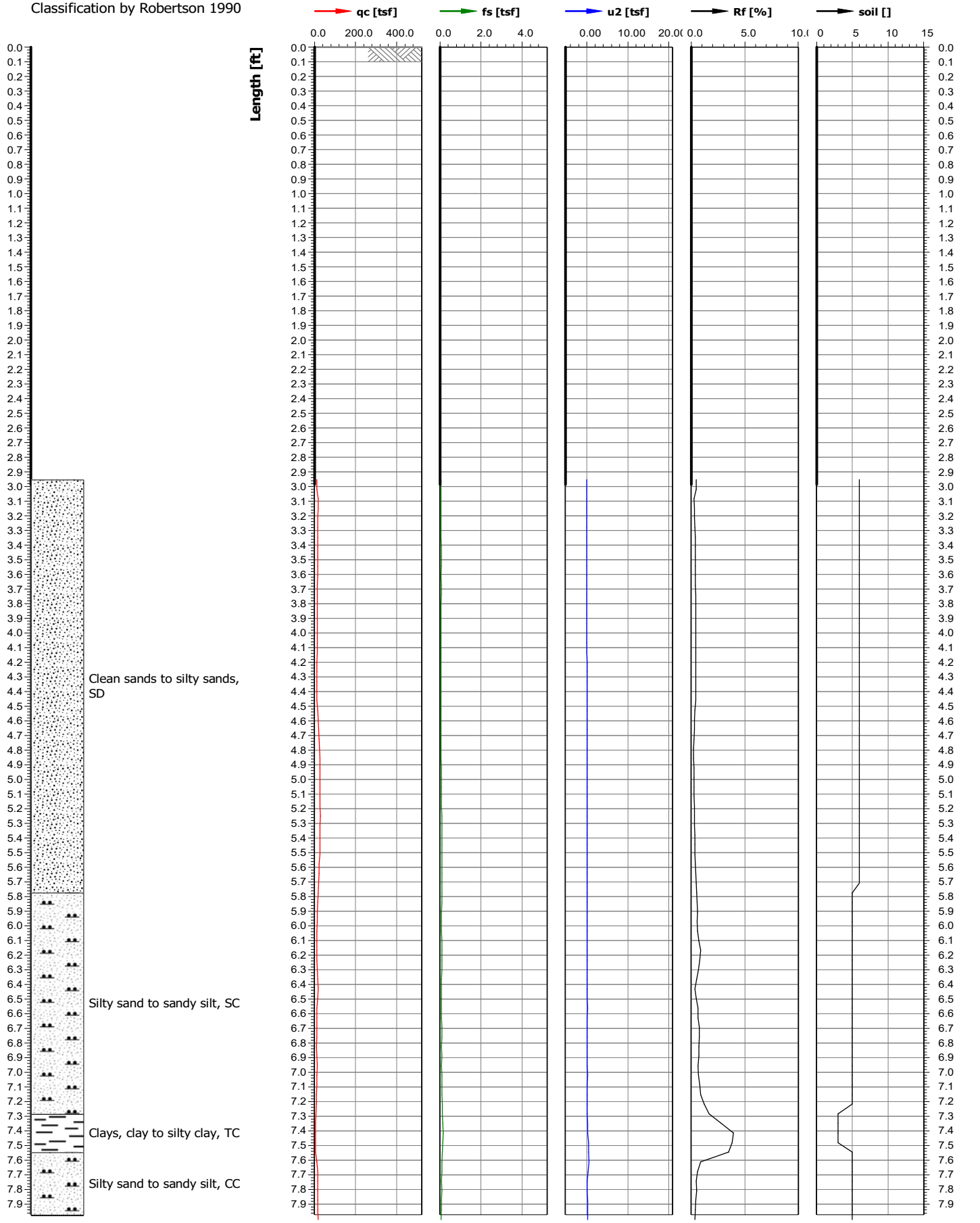
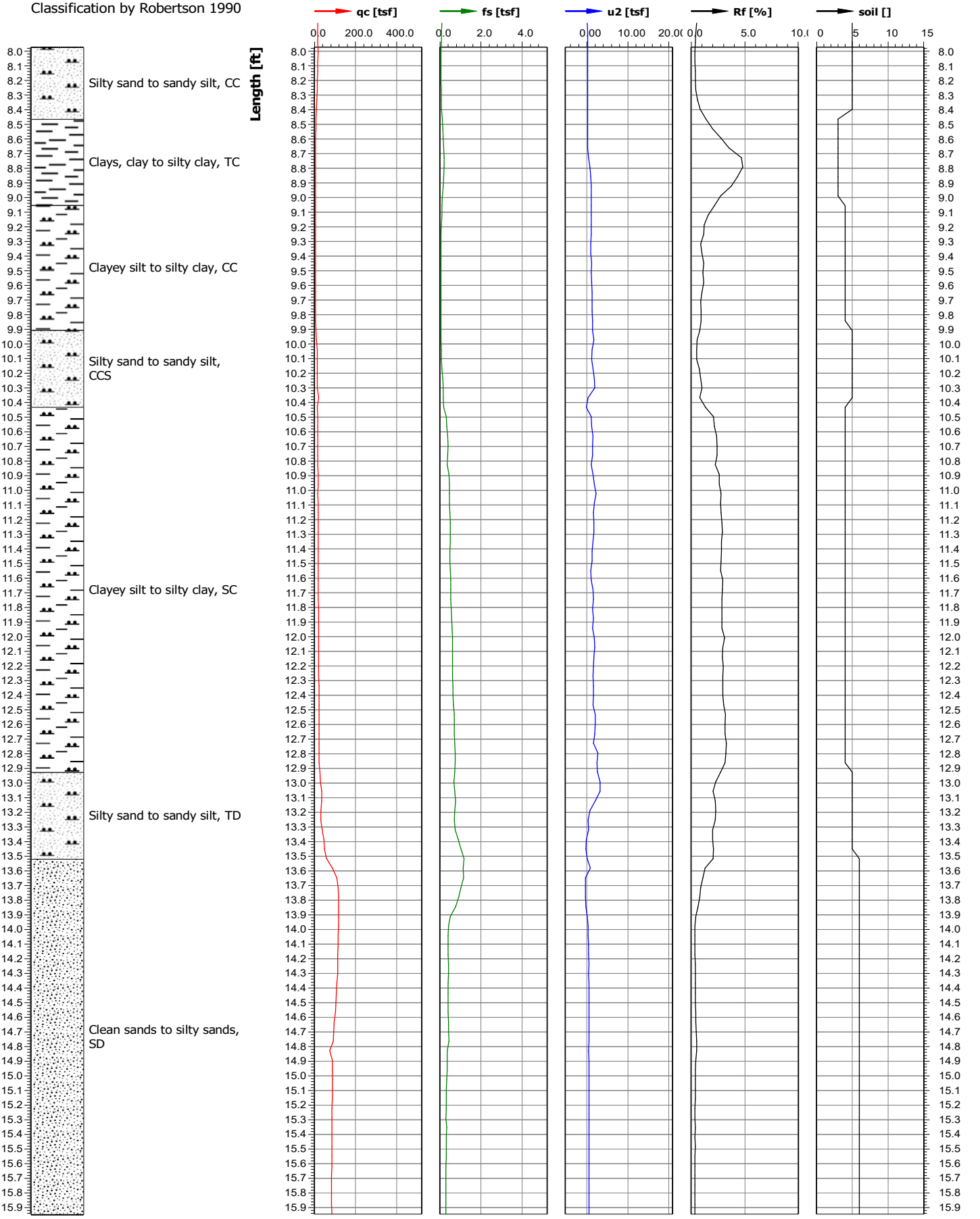
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



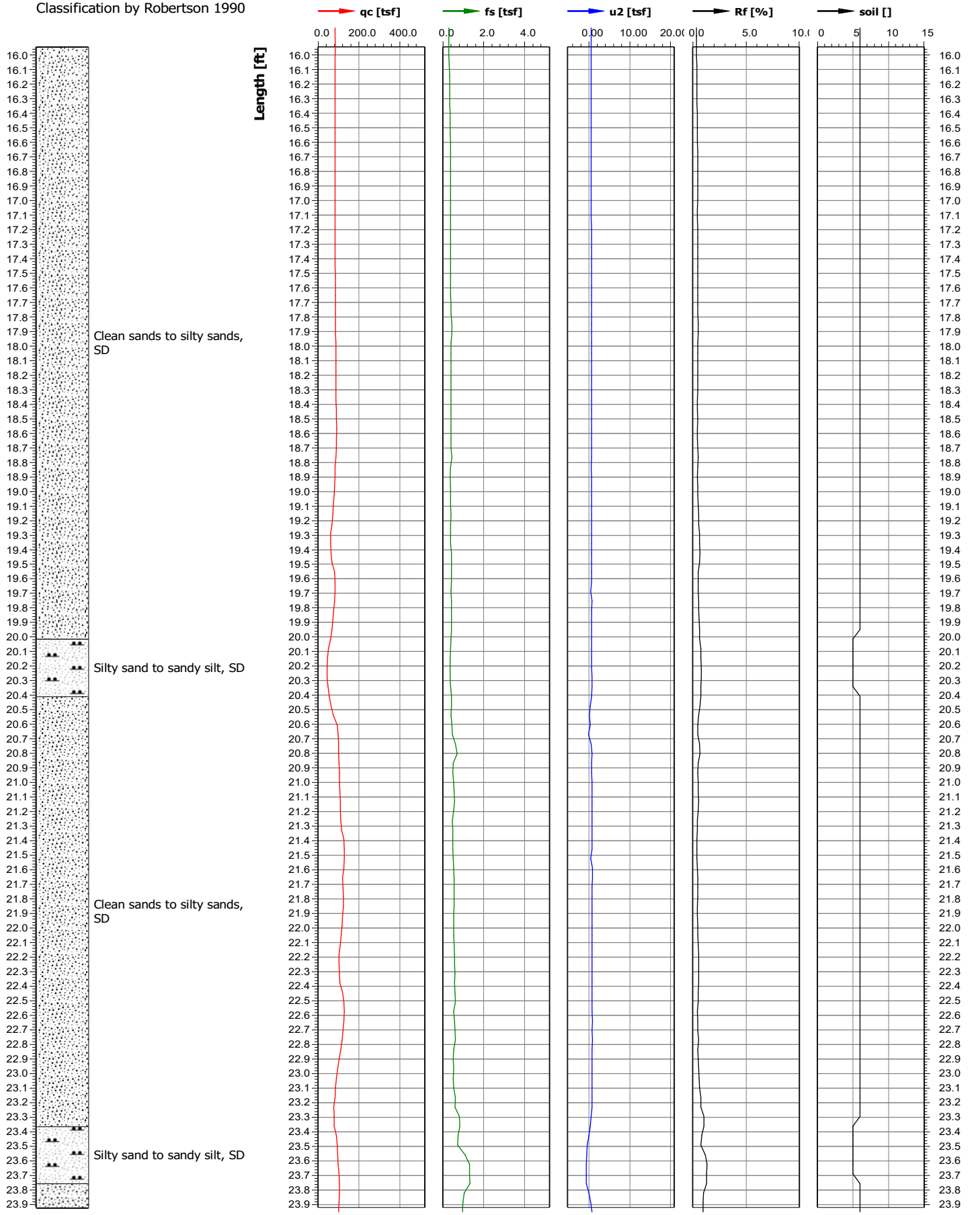
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT1	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



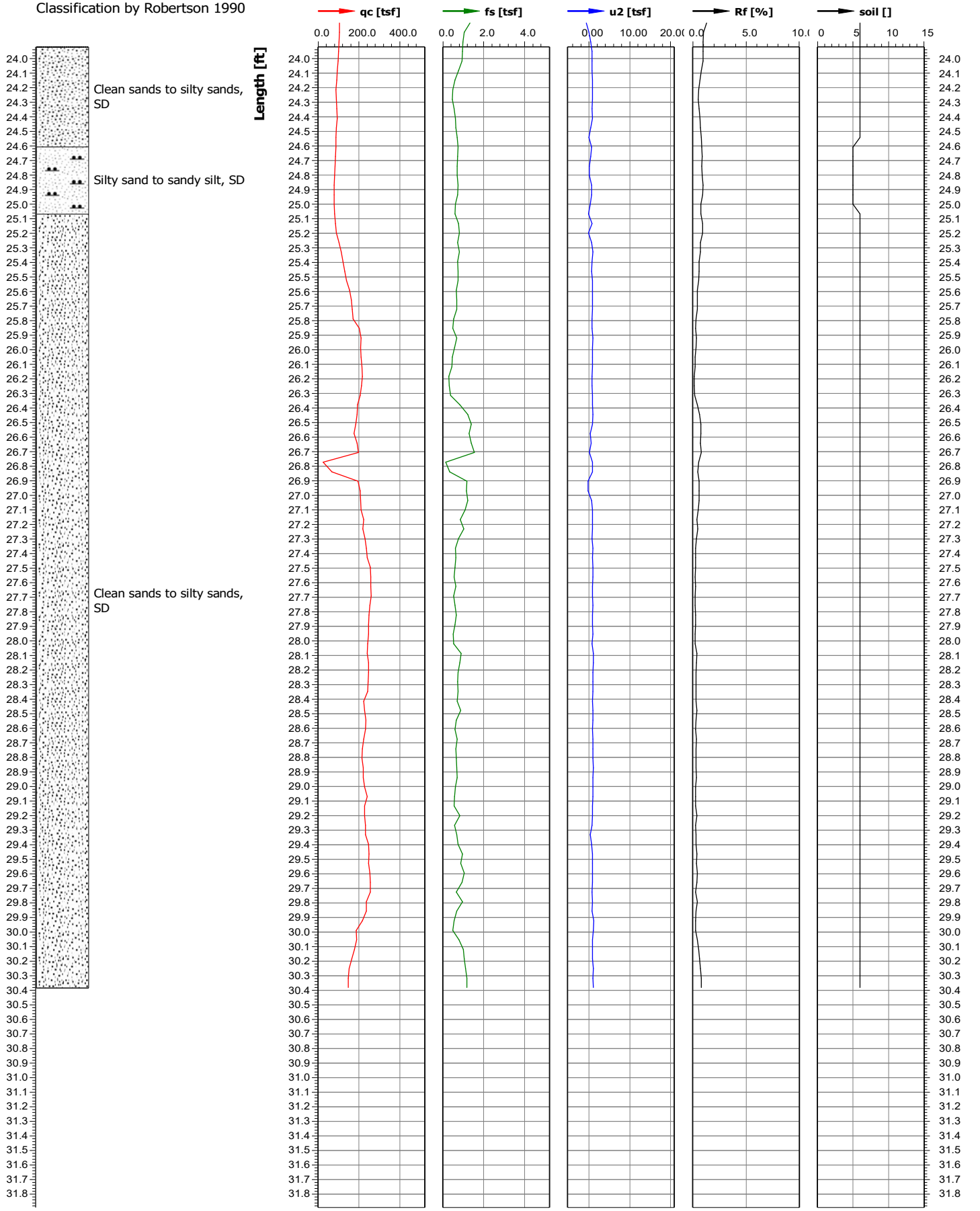
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT1	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



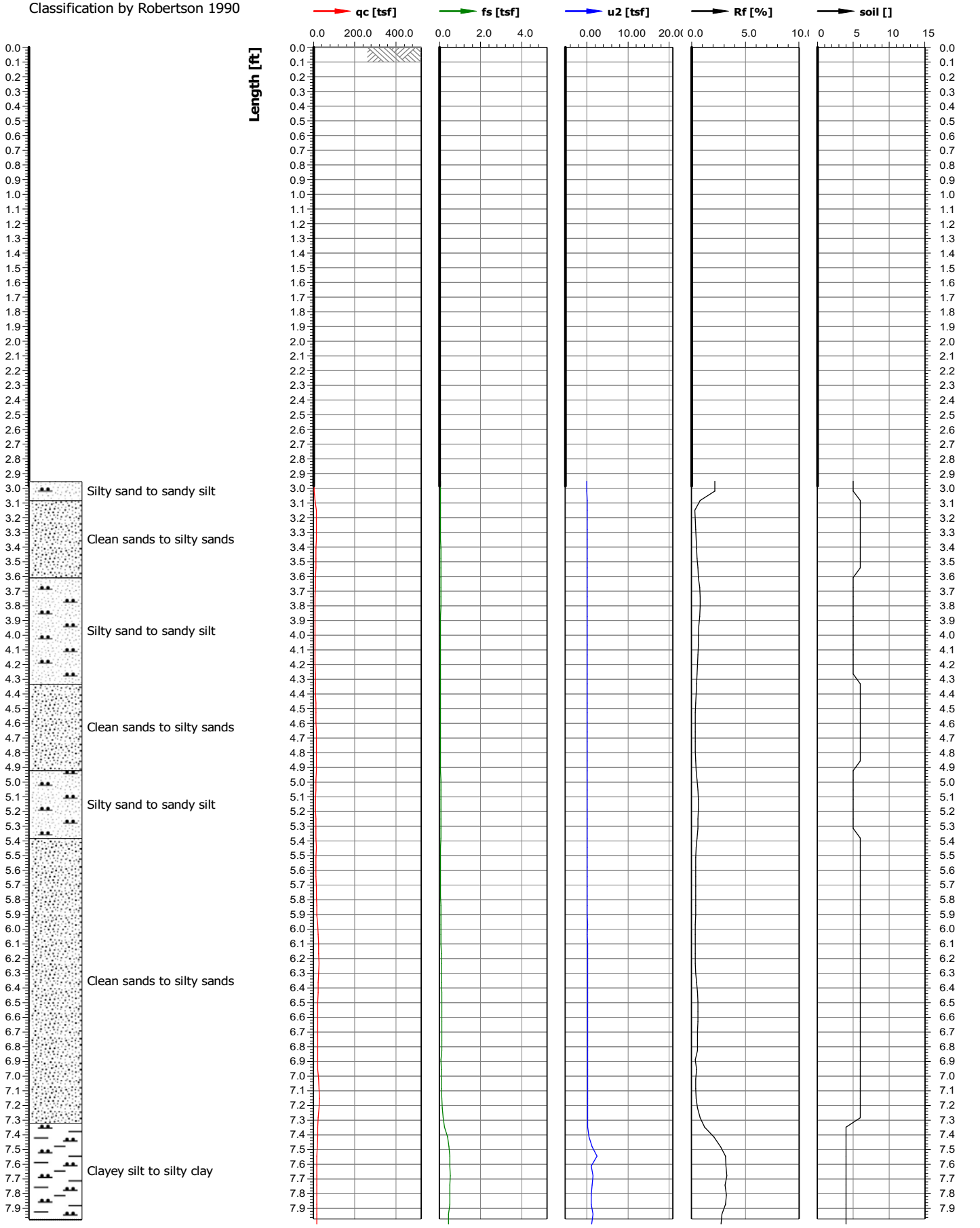
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT1	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



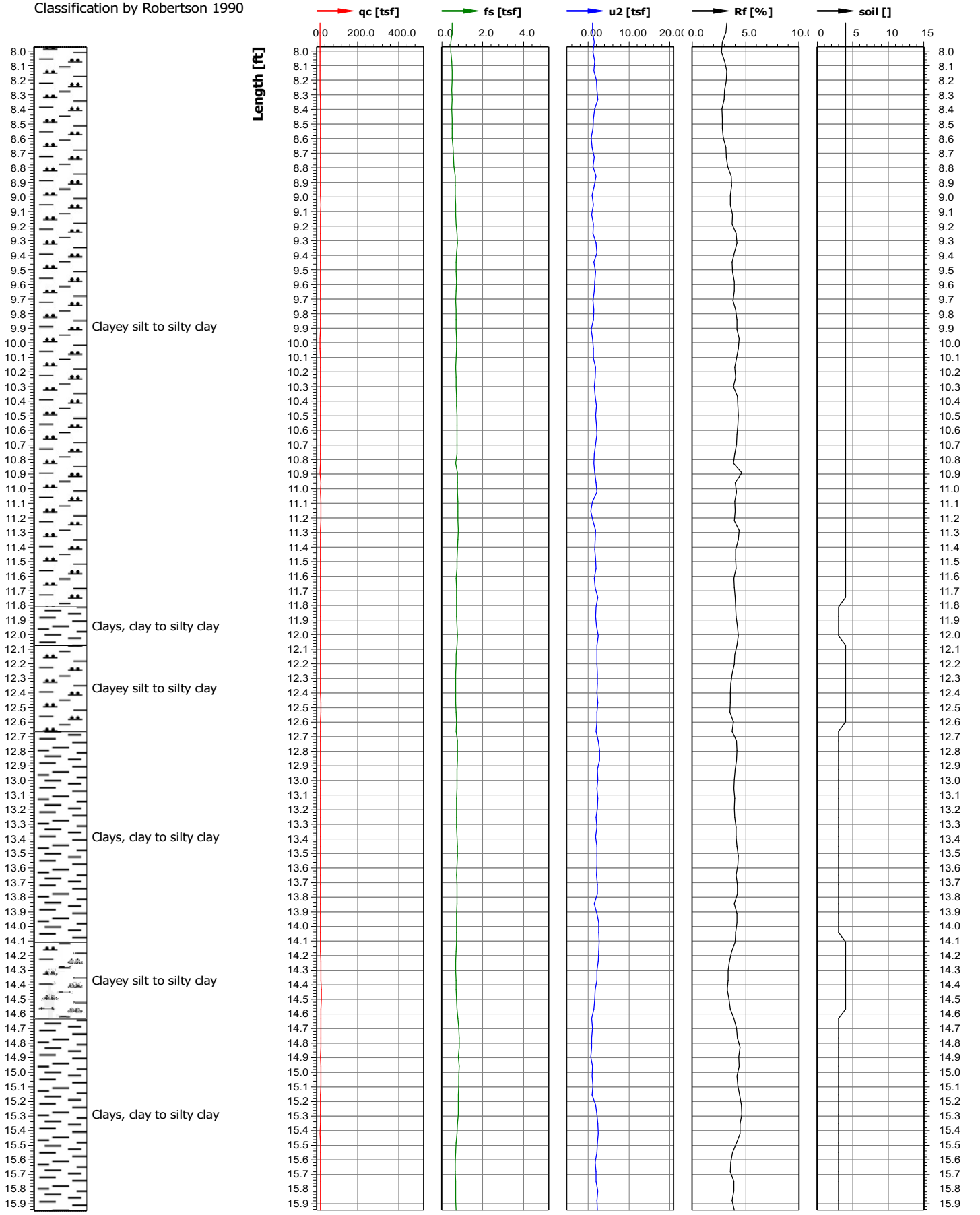
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT2	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/5	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



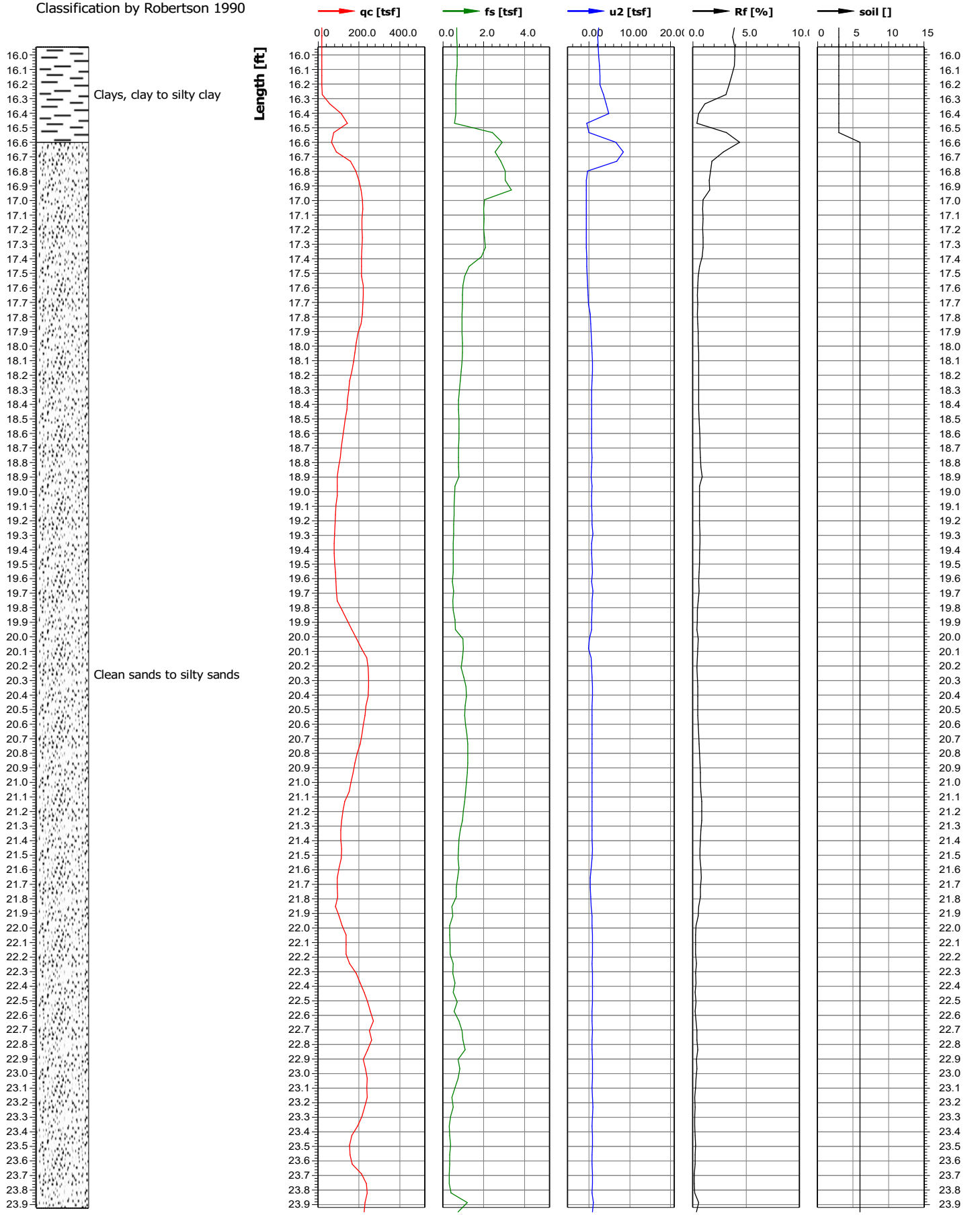
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT2	
Project ID	**Client**	**Investigation start ...**	**Standard/Standar...**	**Nominal surface area of...**
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		**Page**	**Scale**	**Net surface area quotie...**
Knife River Elbee Bend Bank Stabilization		2/5	1:10	0.820/0.000
Remarks1		**Coordinate system used**		**U**
				u2

Classification by Robertson 1990



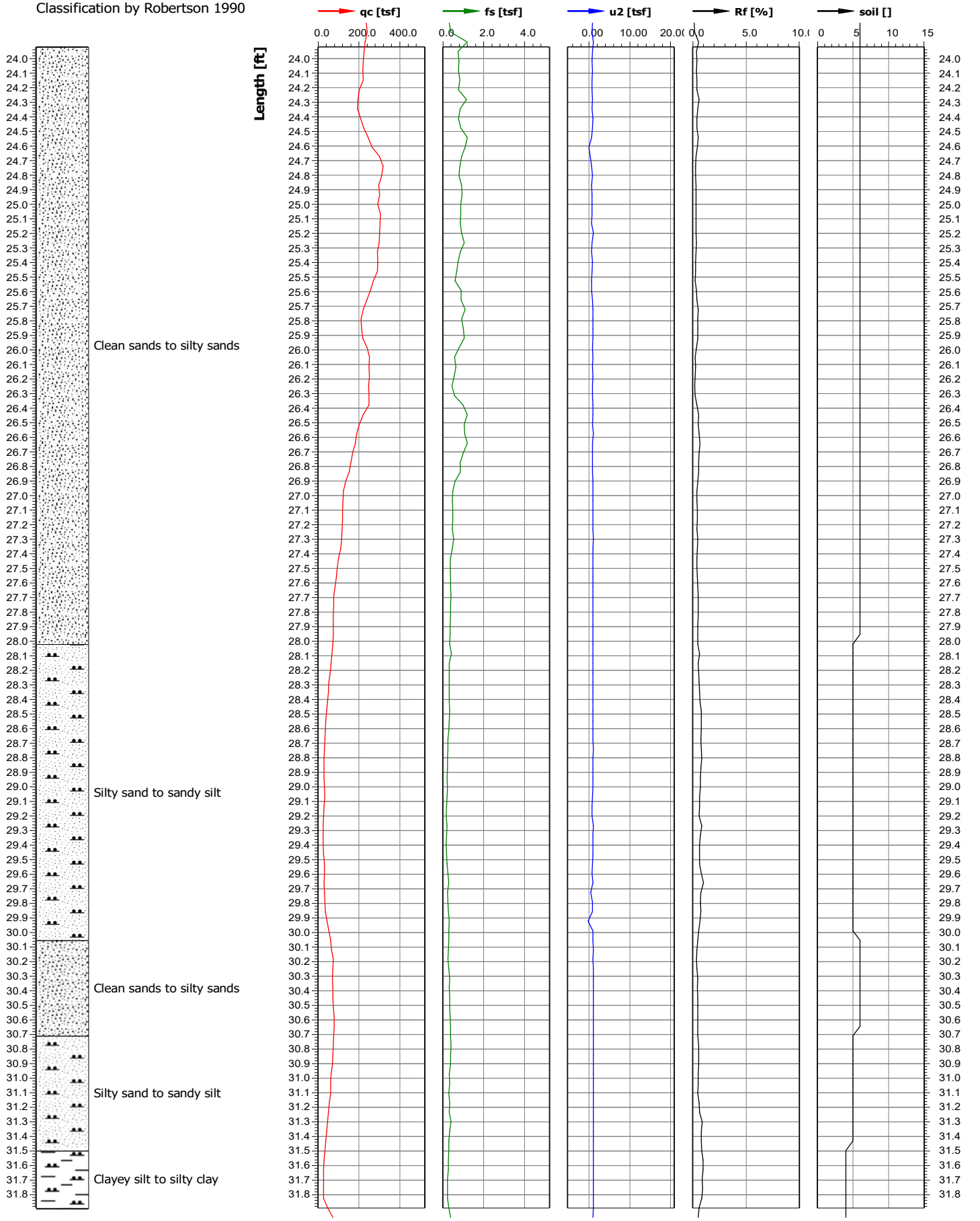
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT2	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/5	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



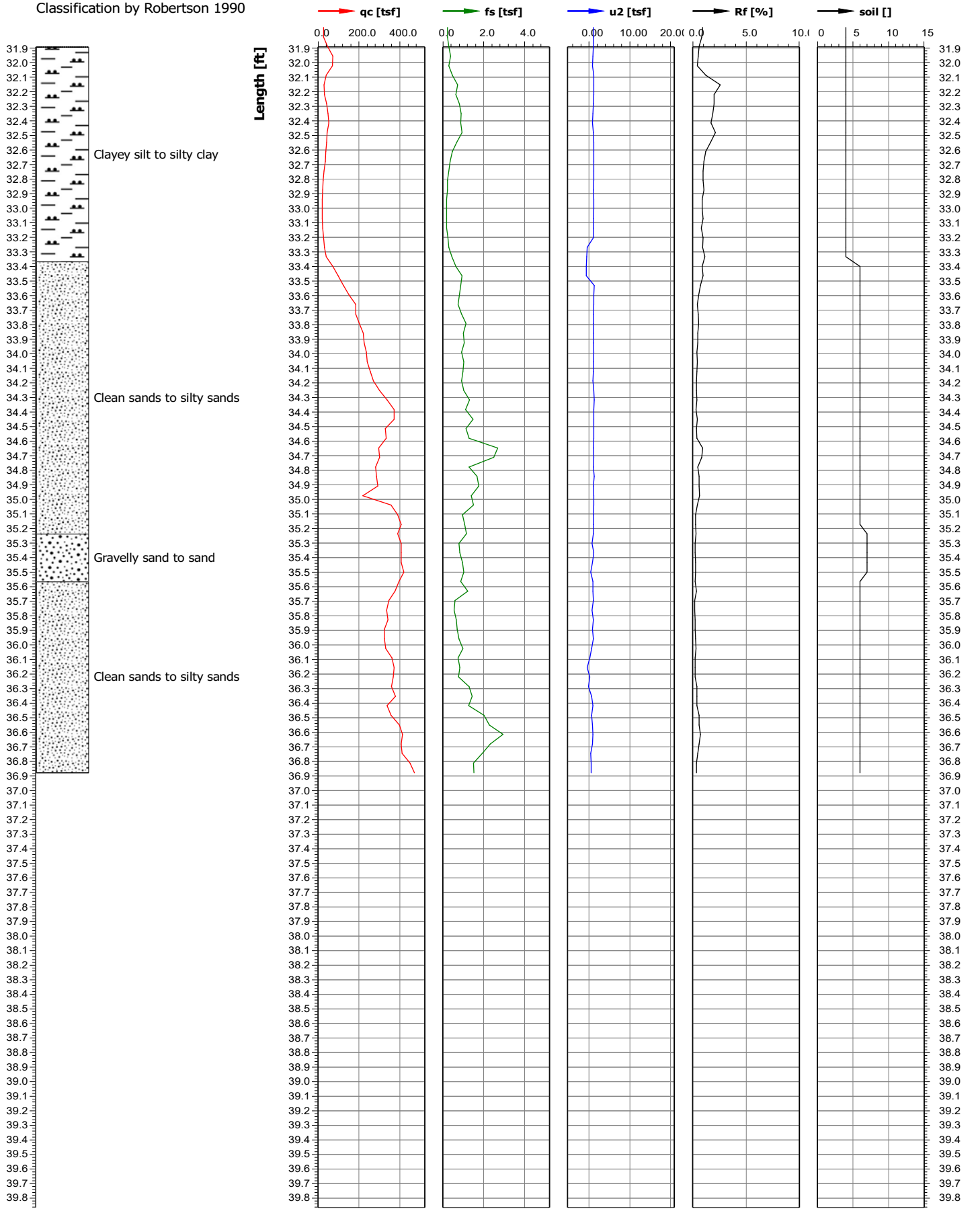
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT2	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/5	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



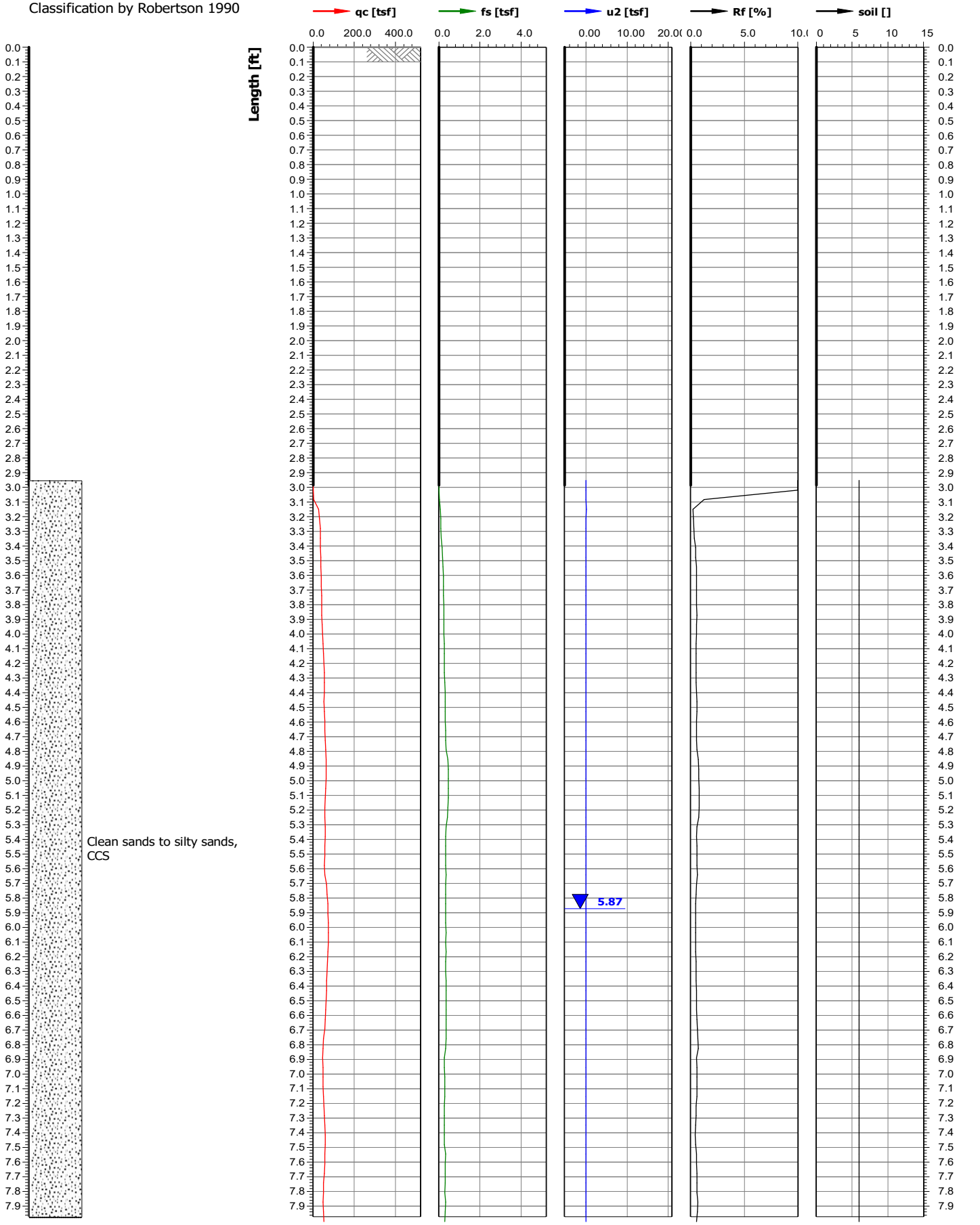
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT2	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/5	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



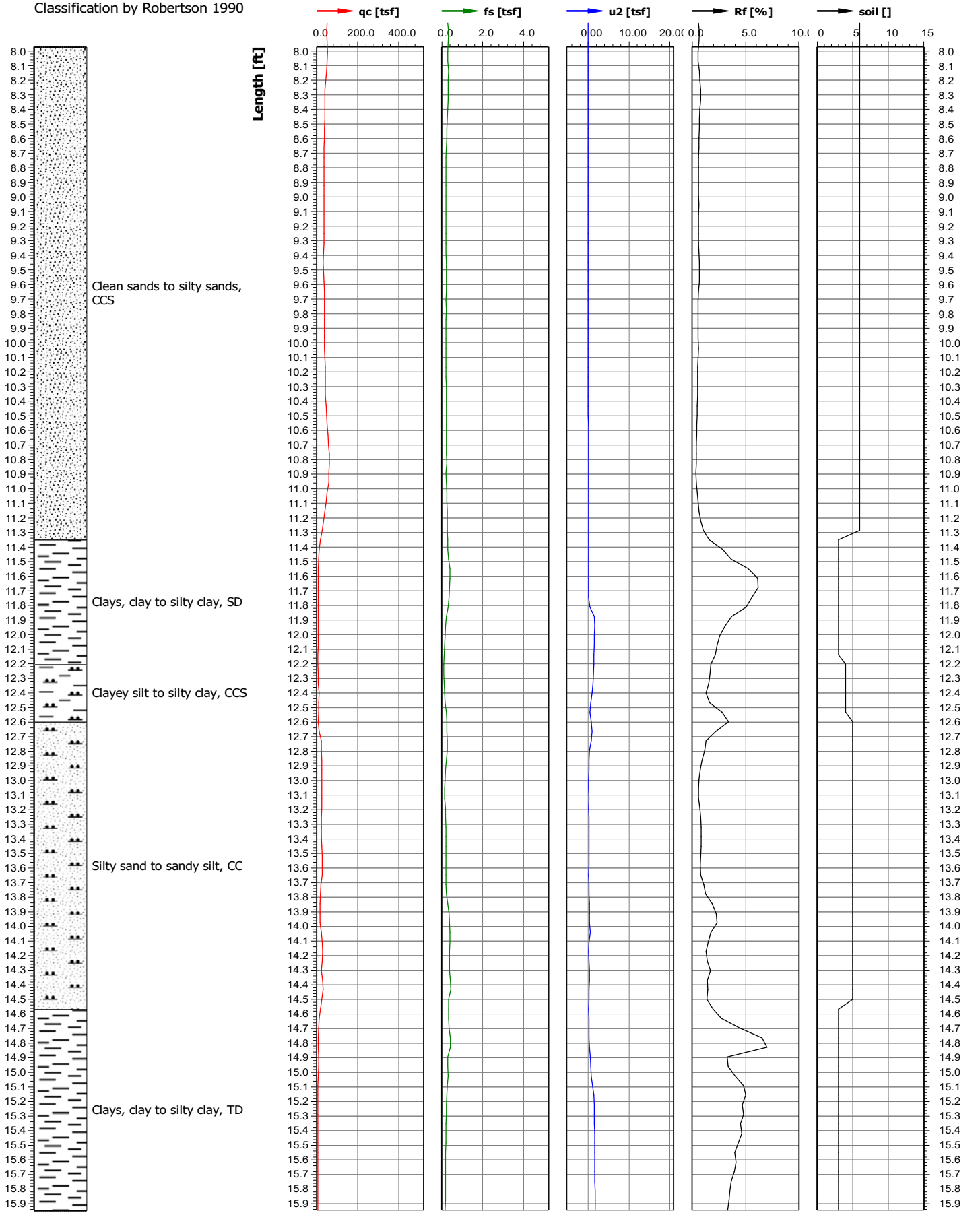
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT3	
Project ID	**Client**	**Investigation start ...**	**Standard/Standar...**	**Nominal surface area of...**
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		**Page**	**Scale**	**Net surface area quotie...**
Knife River Elbee Bend Bank Stabilization		1/4	1:10	0.840/0.000
Remarks1		**Coordinate system used**		**U**
				u2

Classification by Robertson 1990



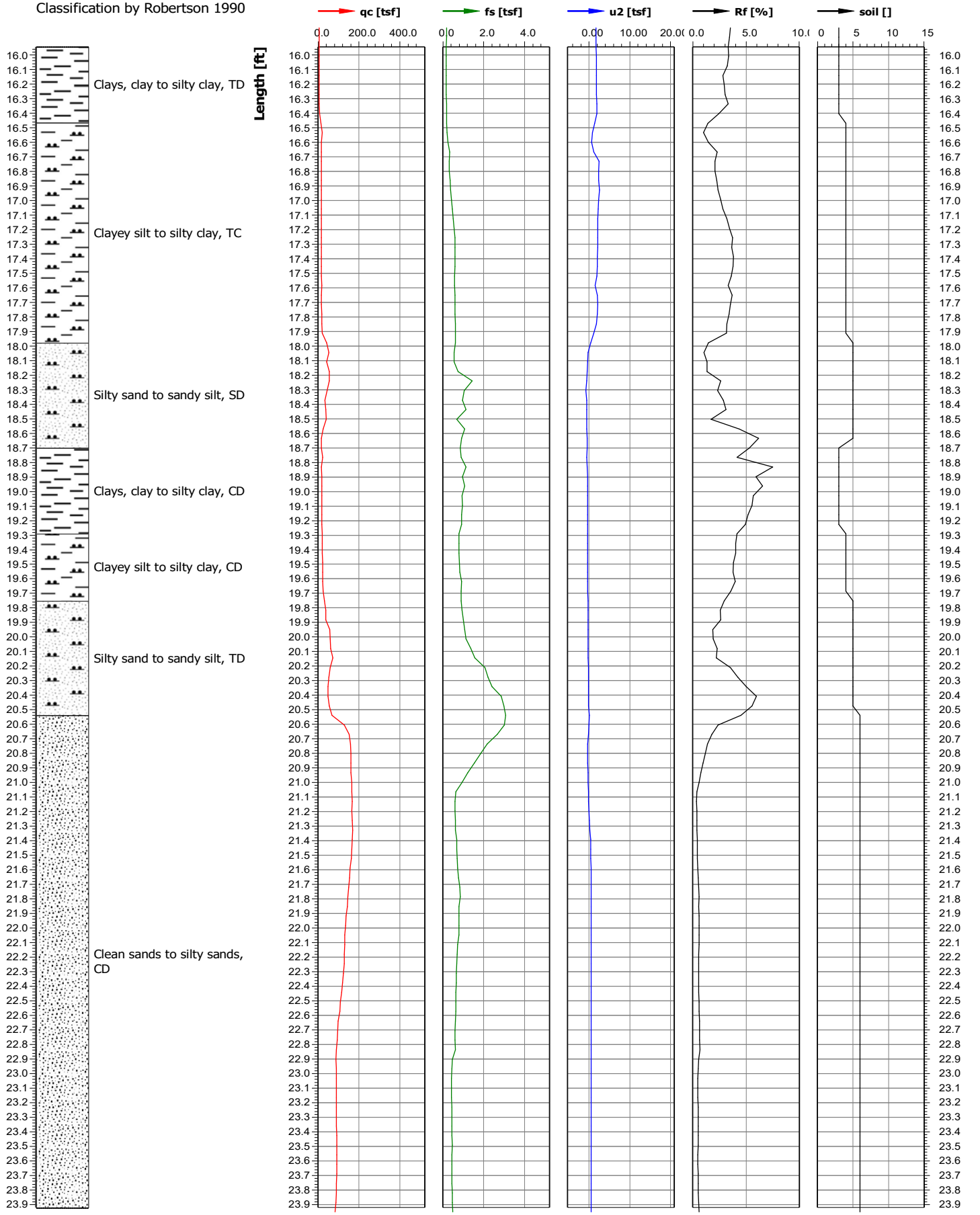
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT3	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



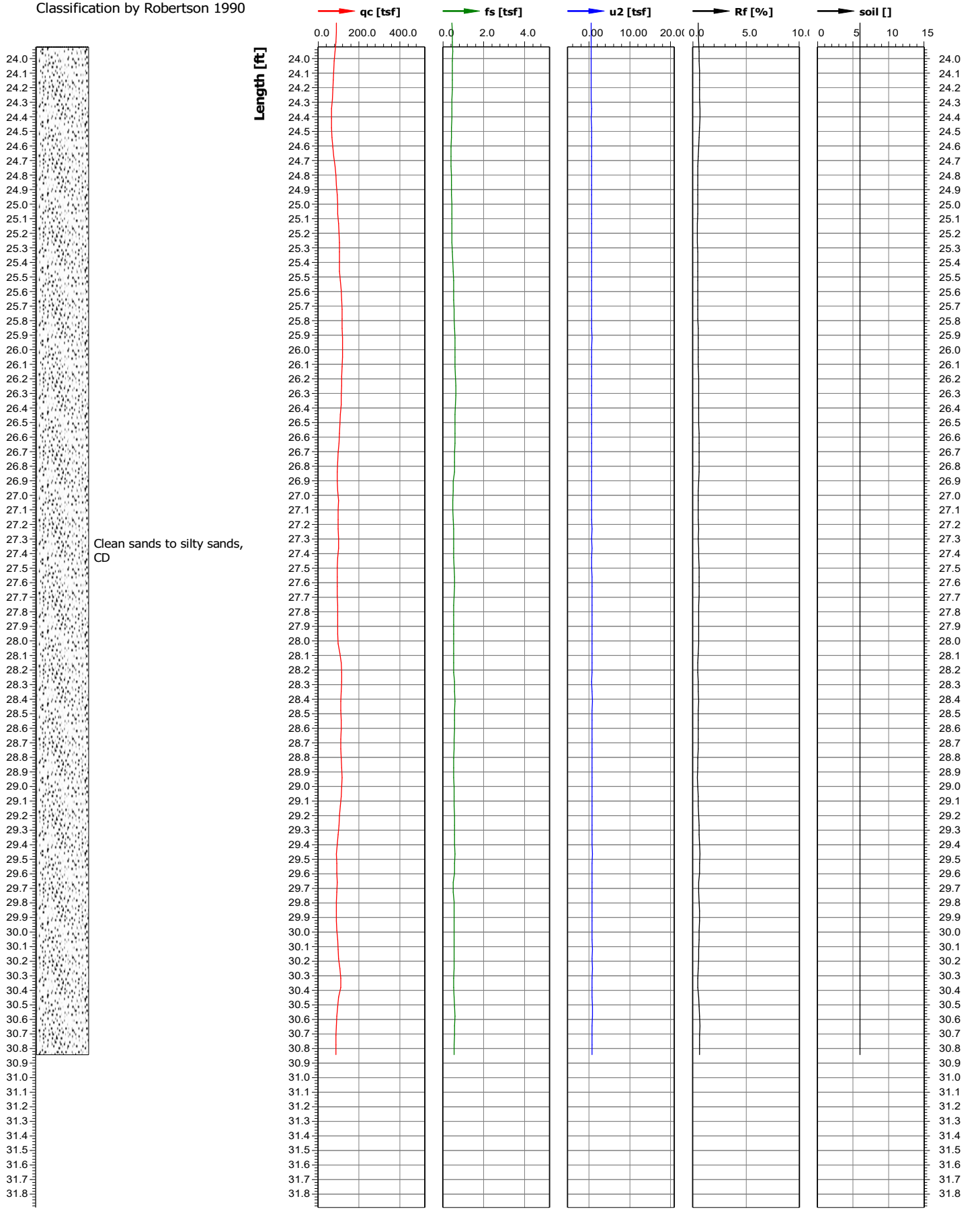
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT3	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



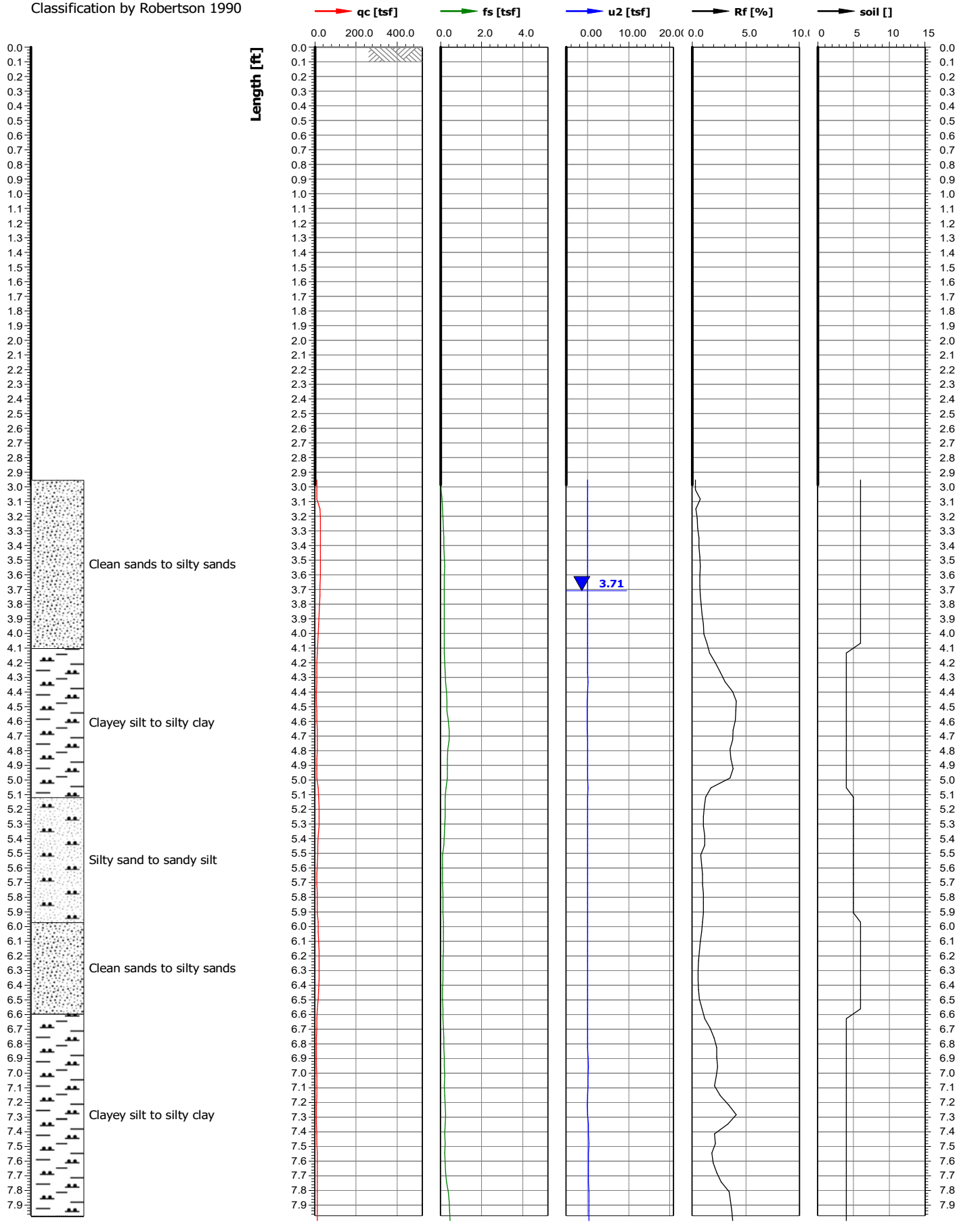
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT3	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



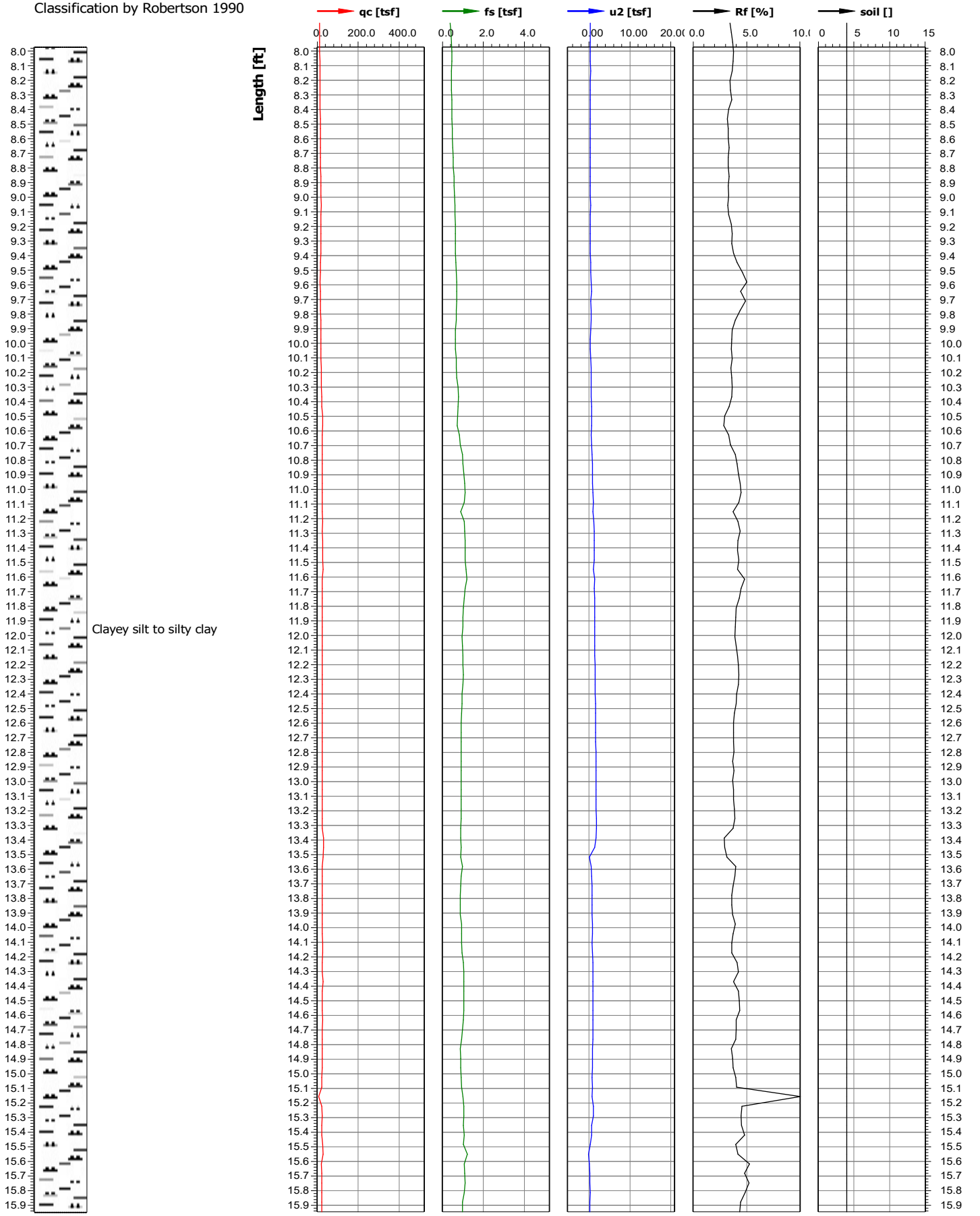
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT4	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



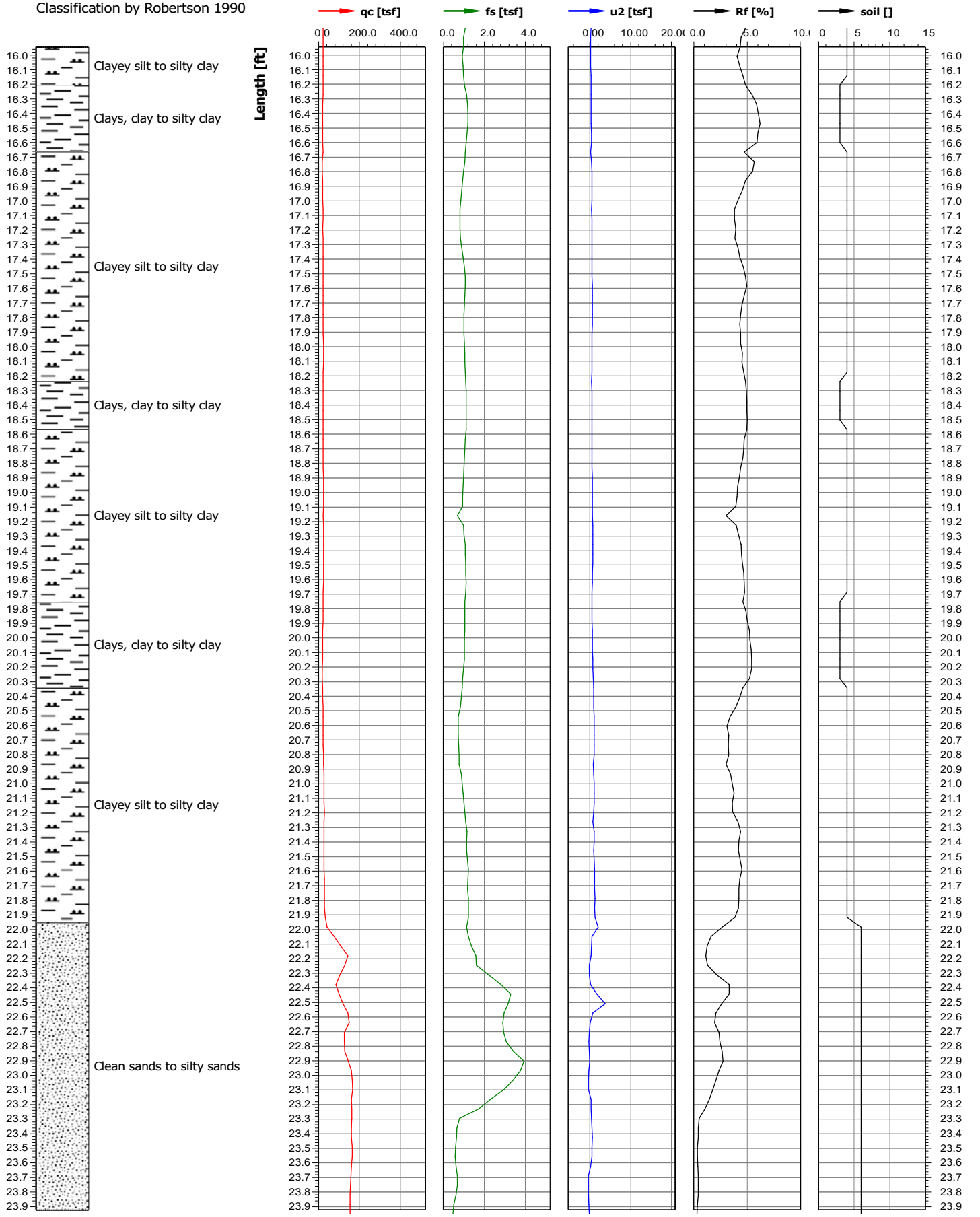
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT4	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



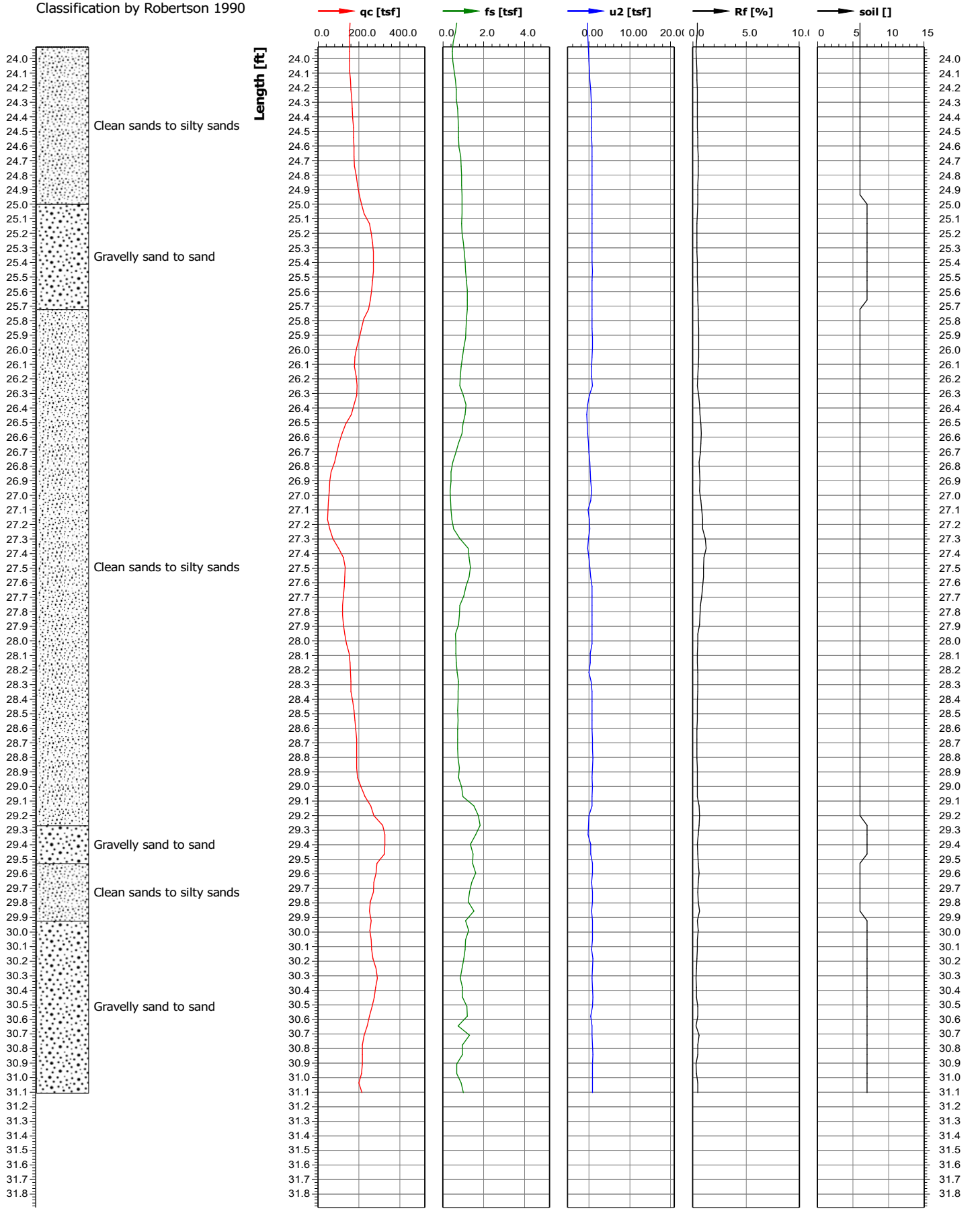
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT4	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



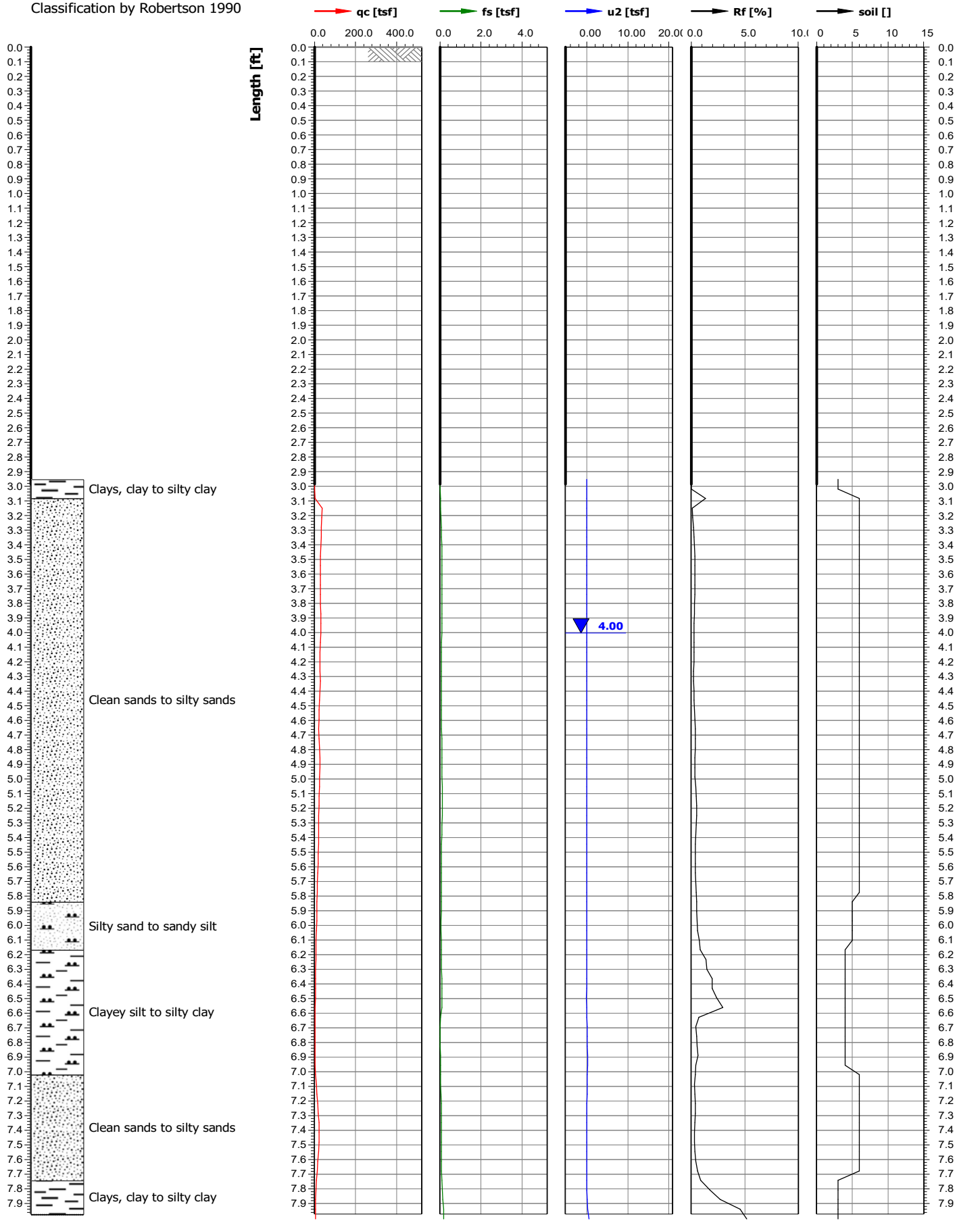
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT4	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/4	1:10	0.820/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



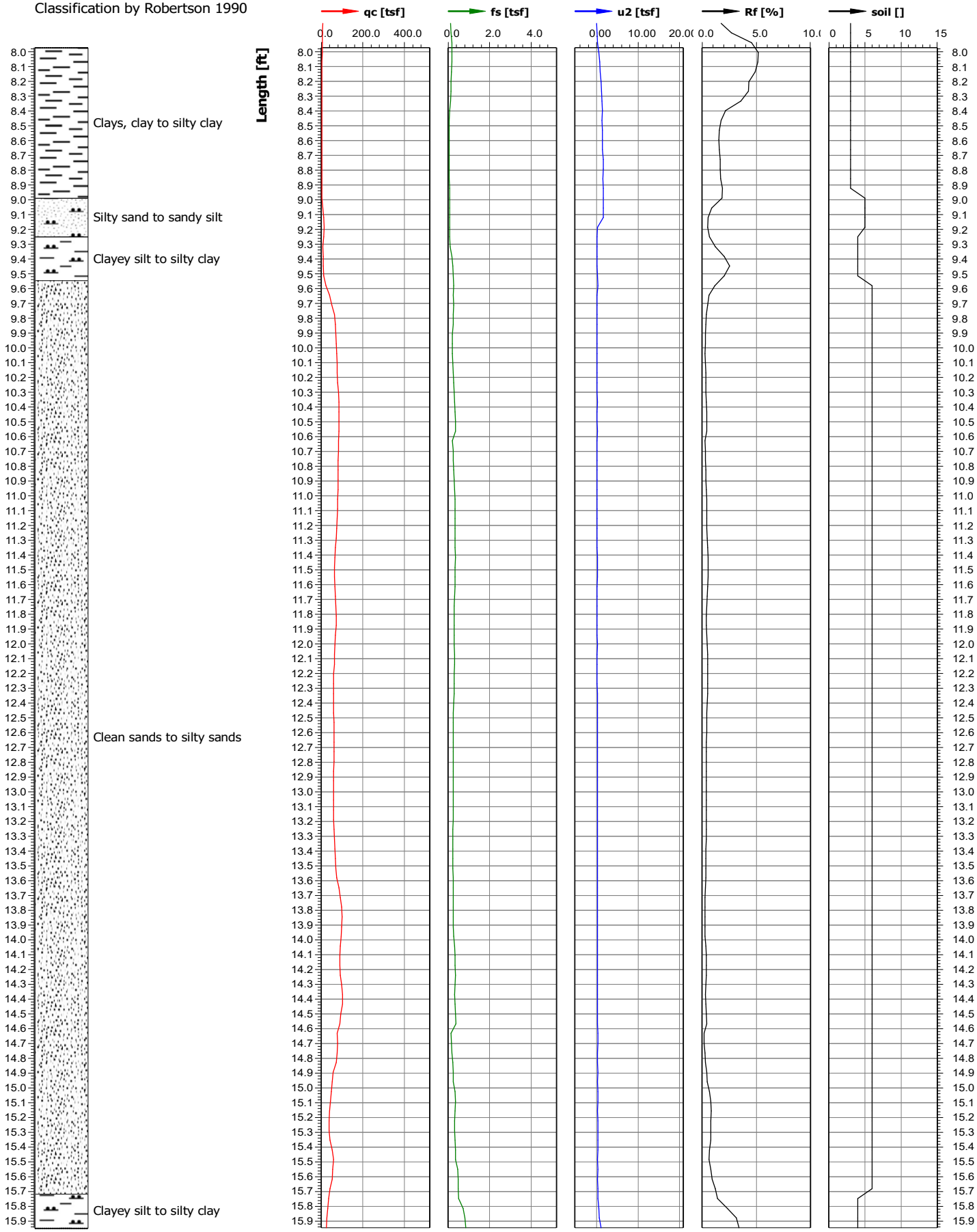
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT5	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



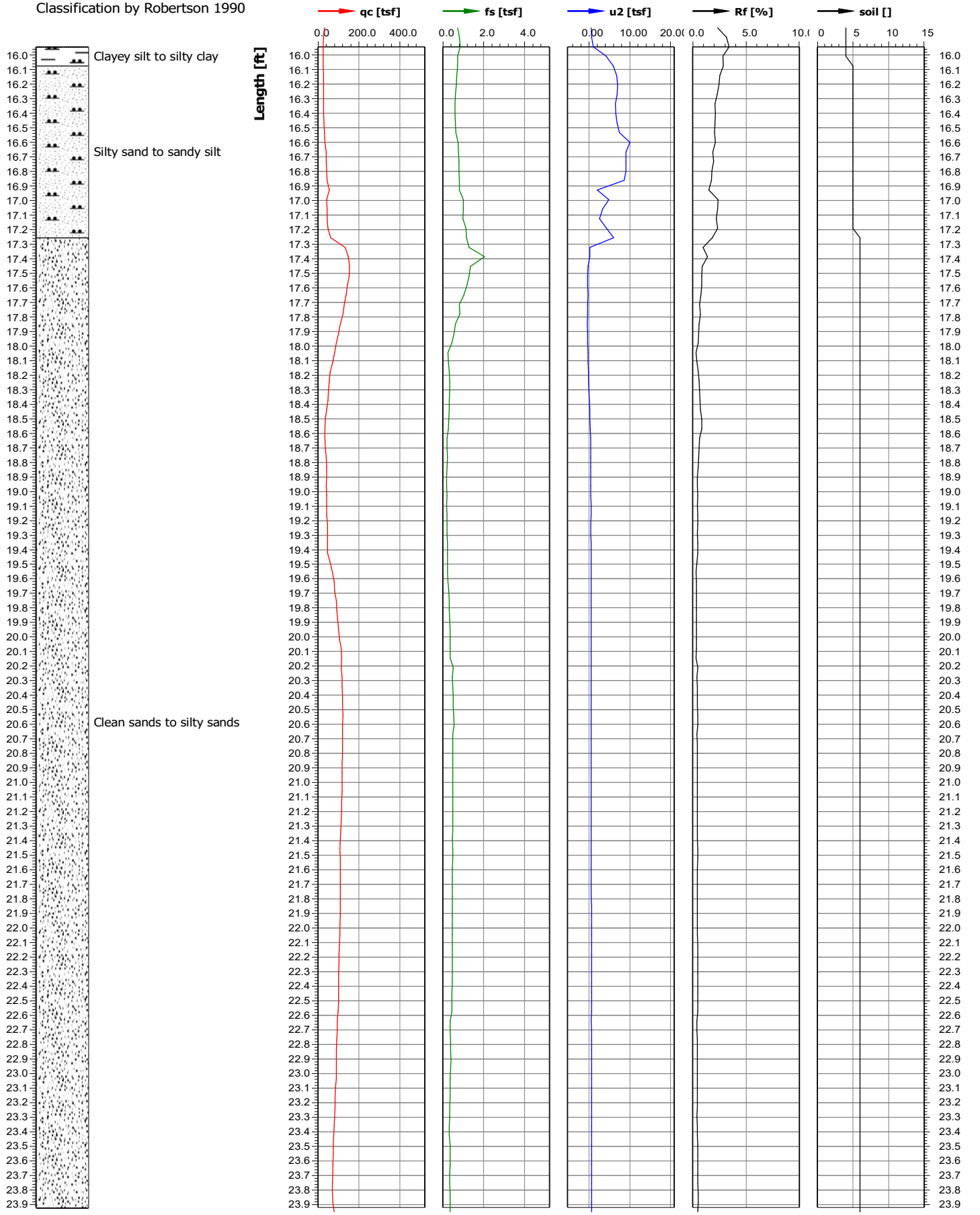
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT5	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



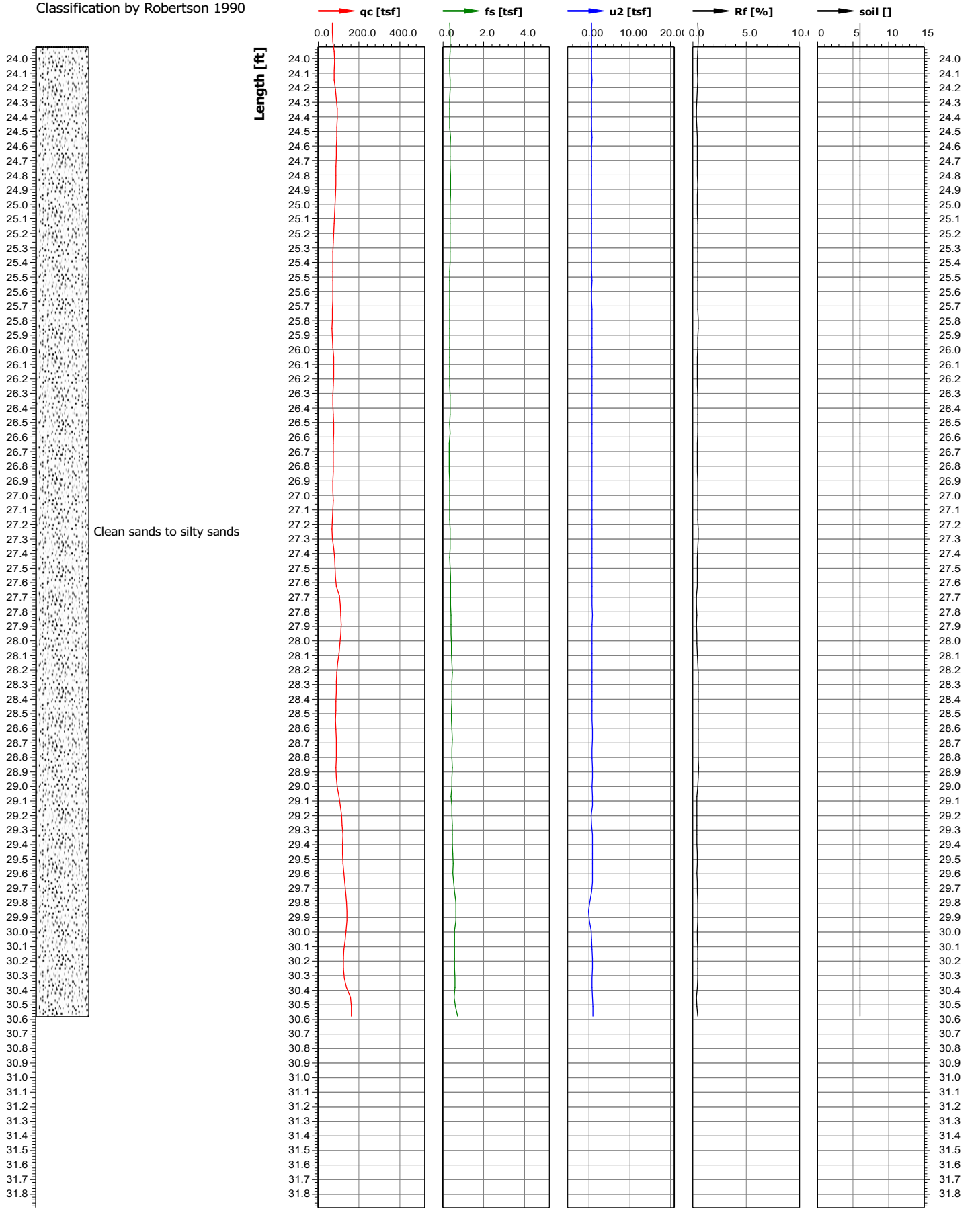
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT5	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



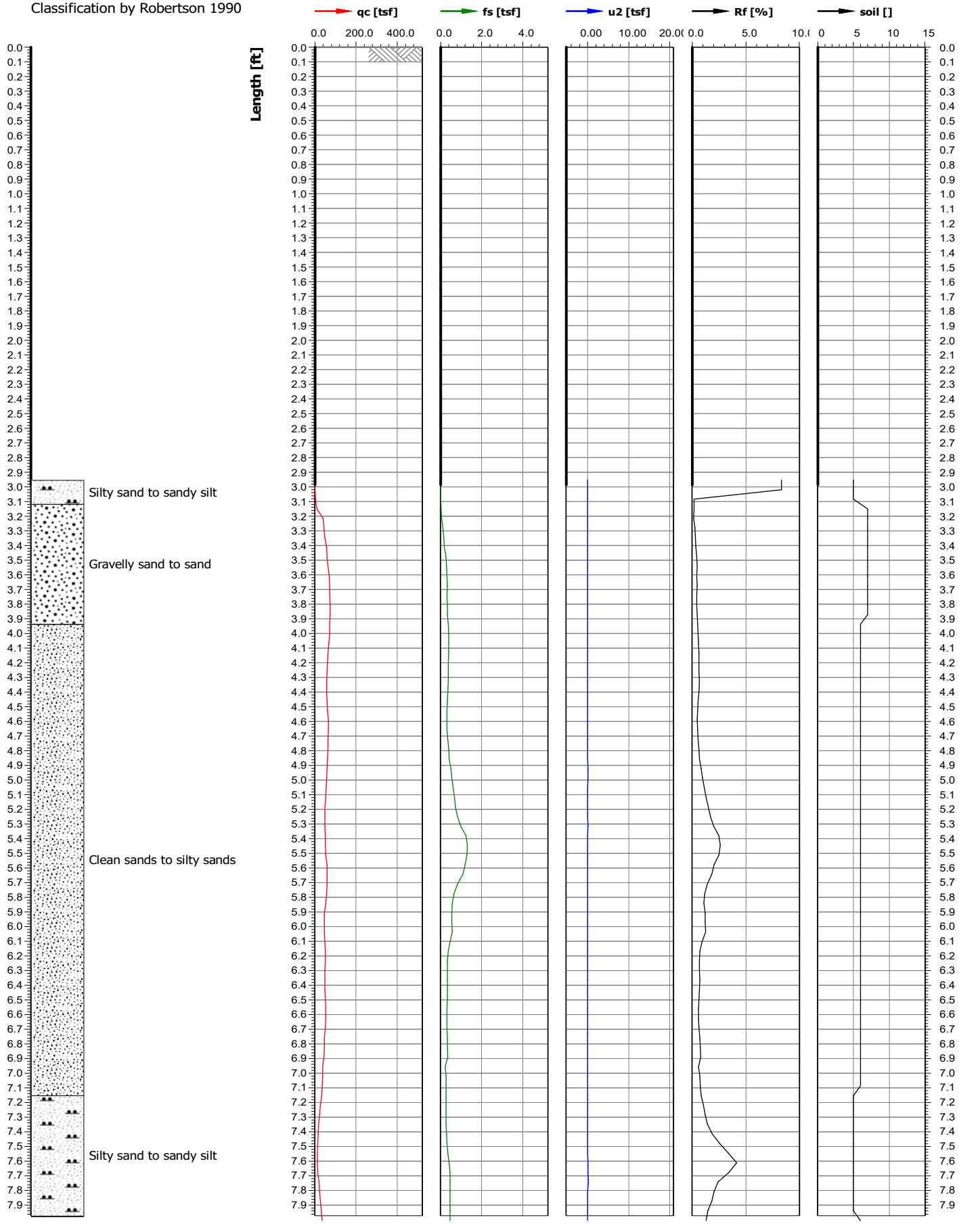
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT5	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/1/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



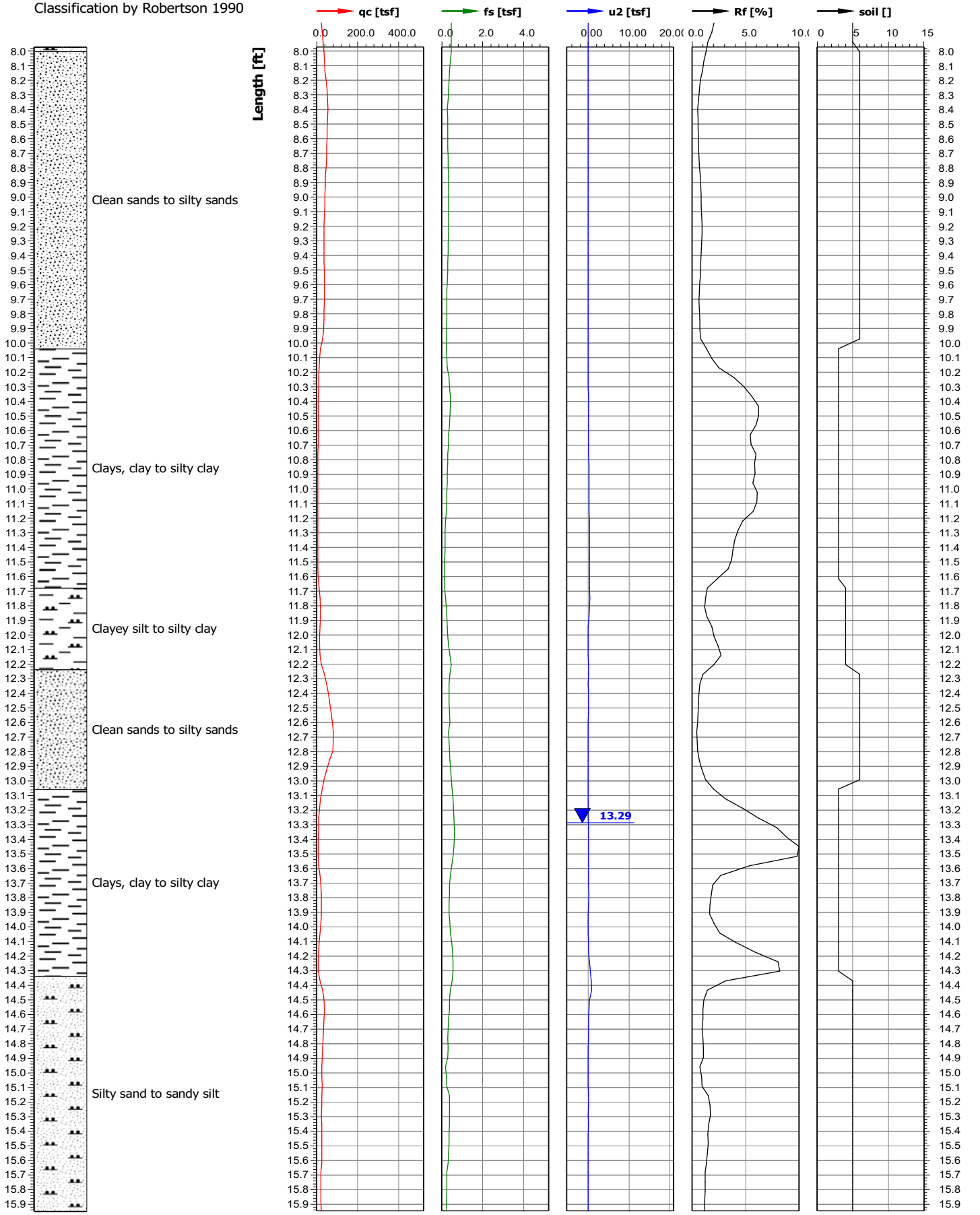
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



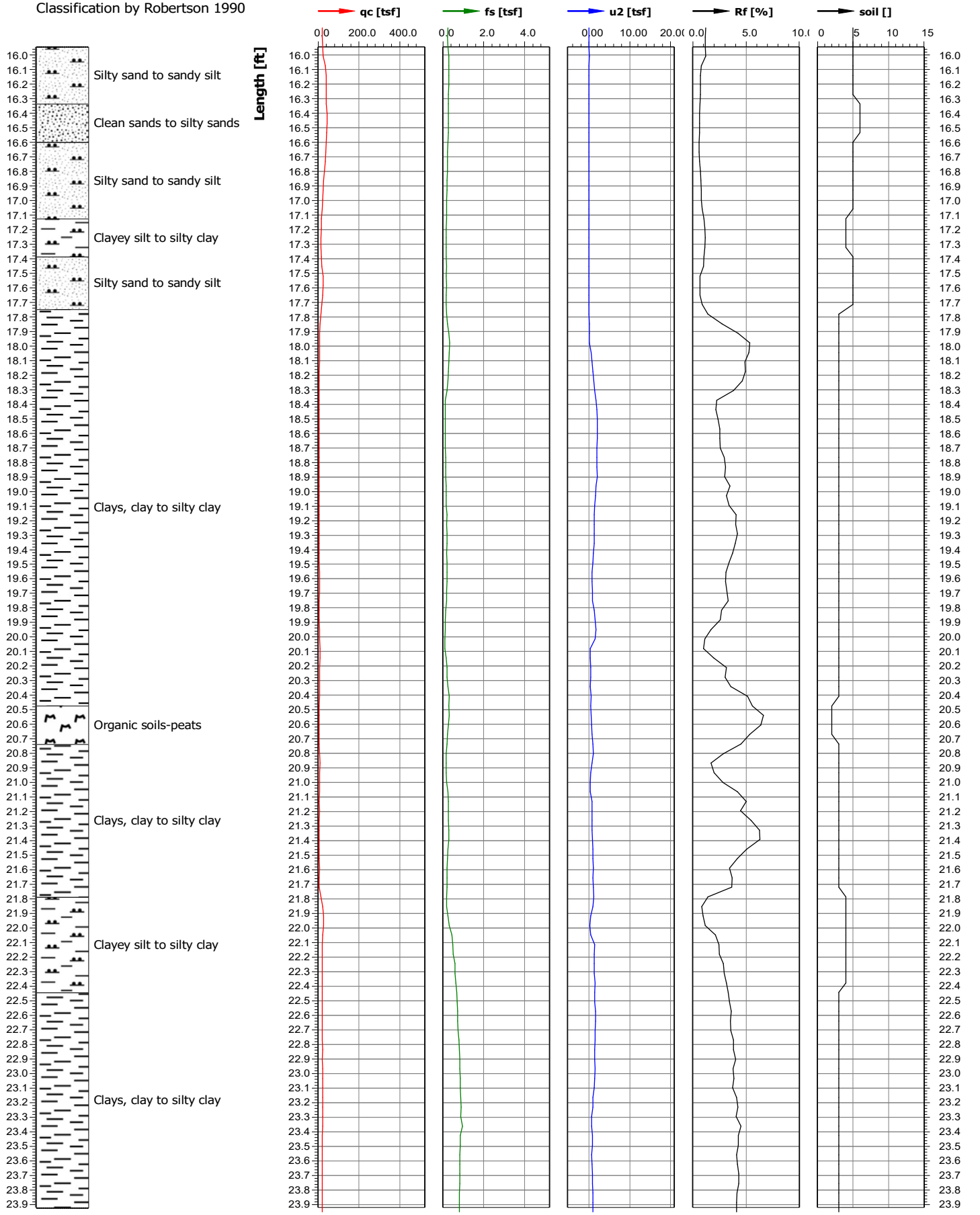
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



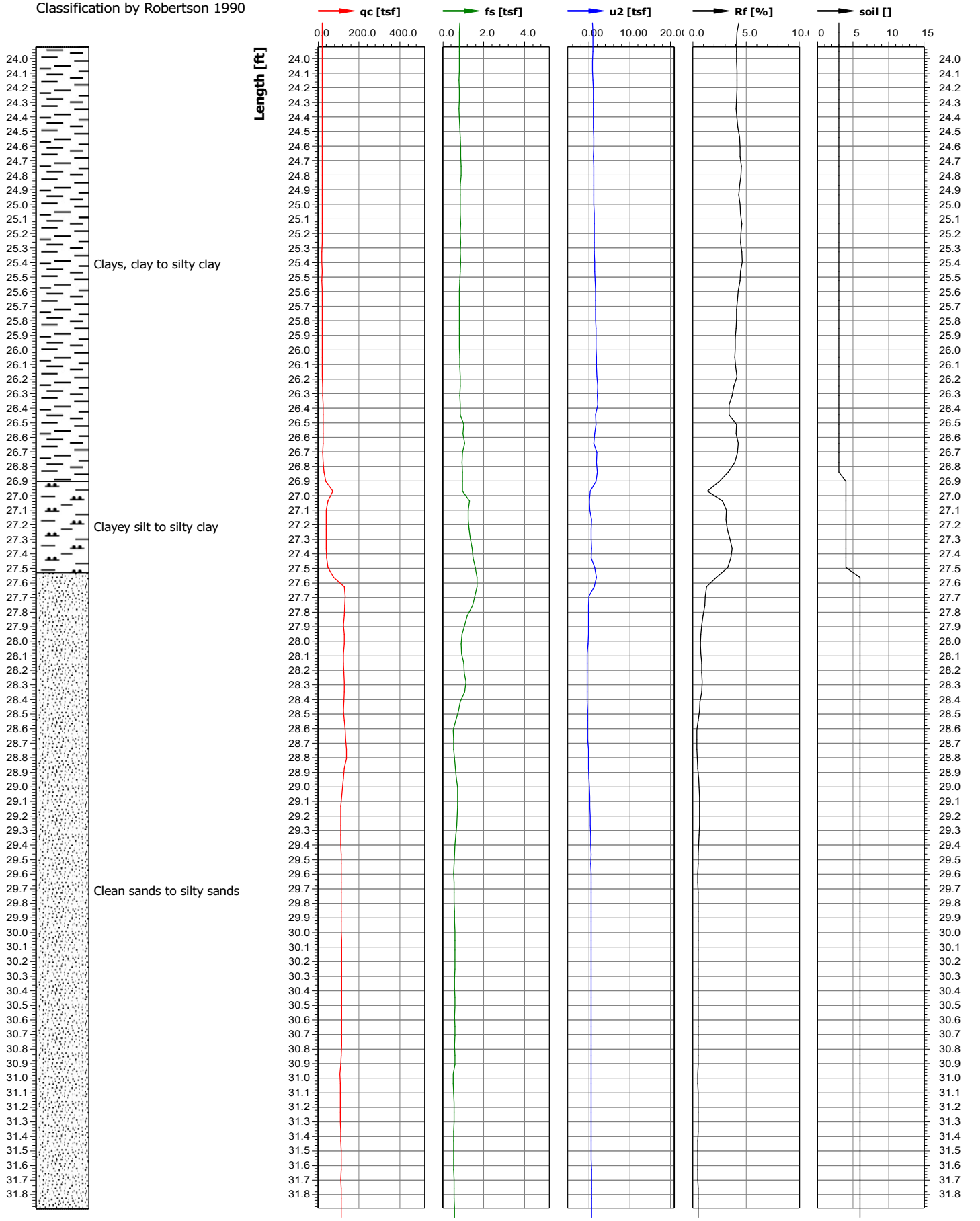
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



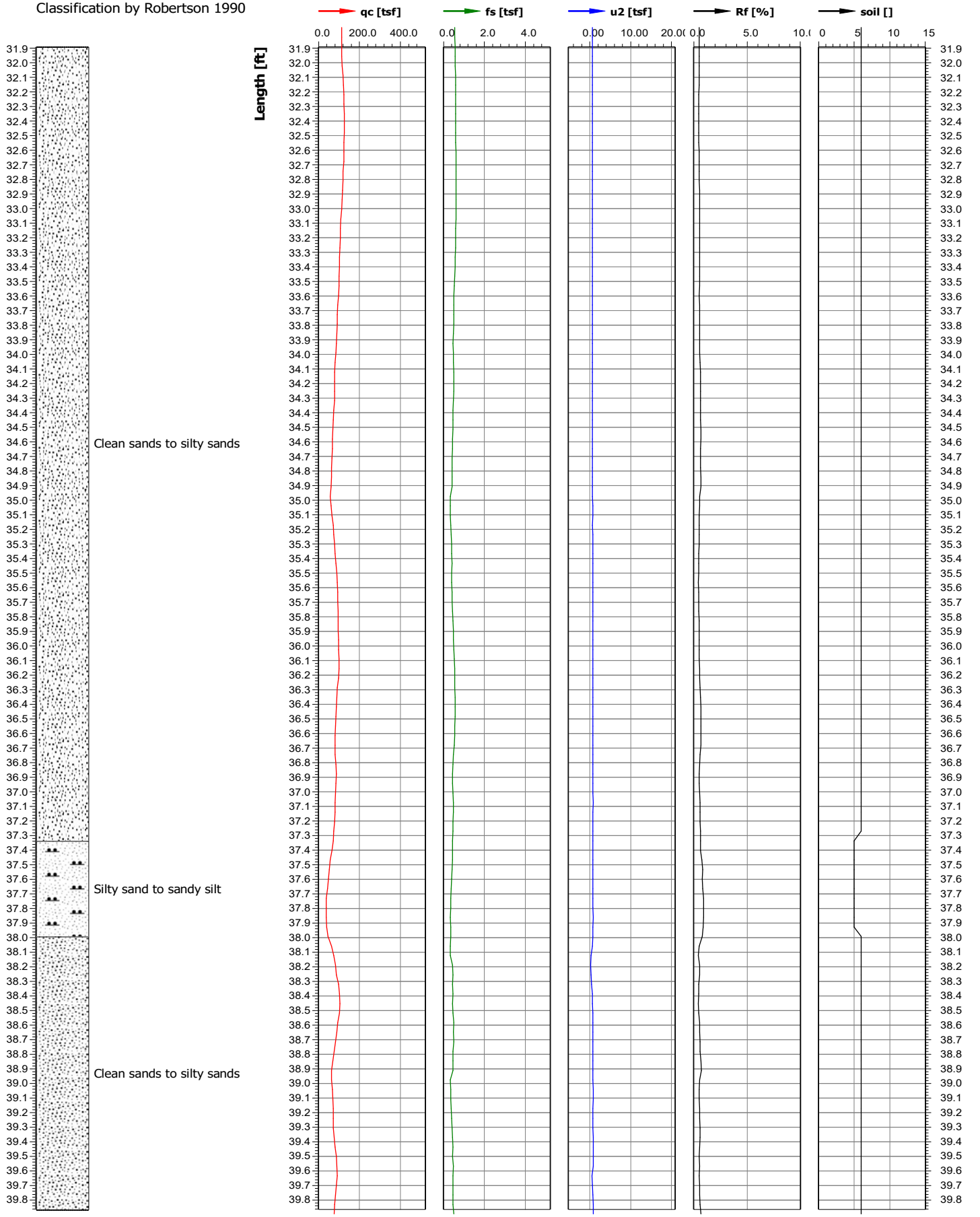
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



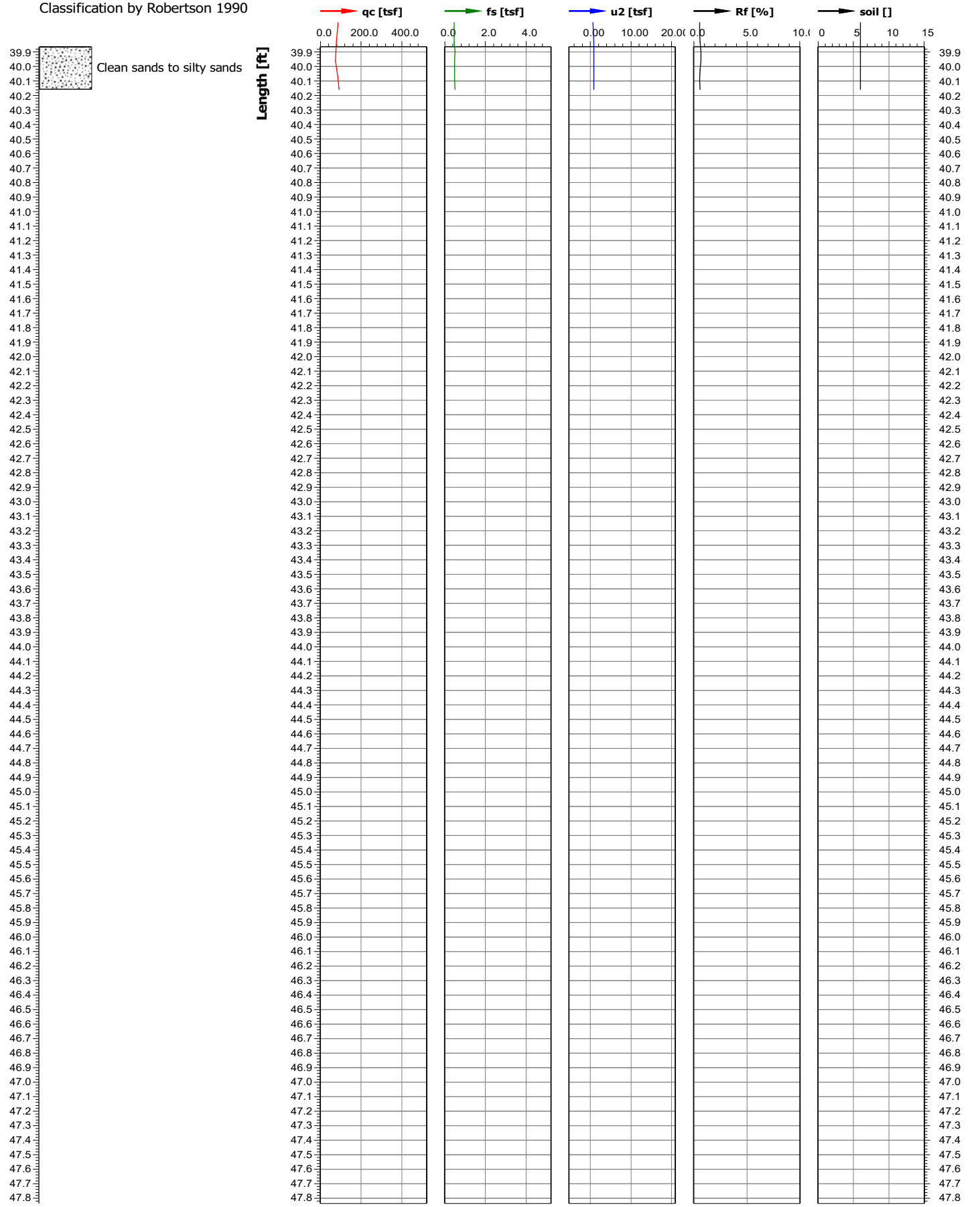
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



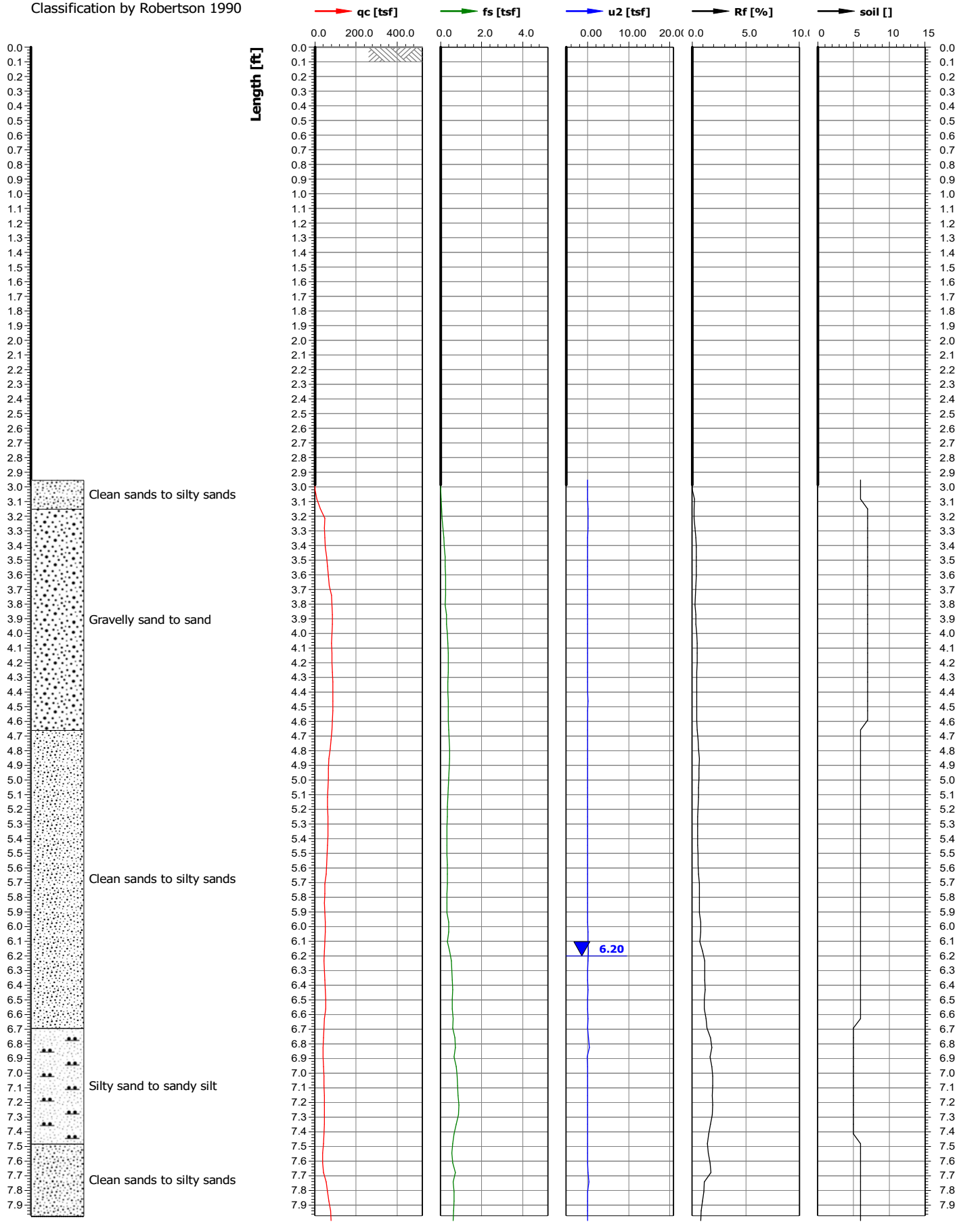
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	kn-fy21-cpt6	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		6/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



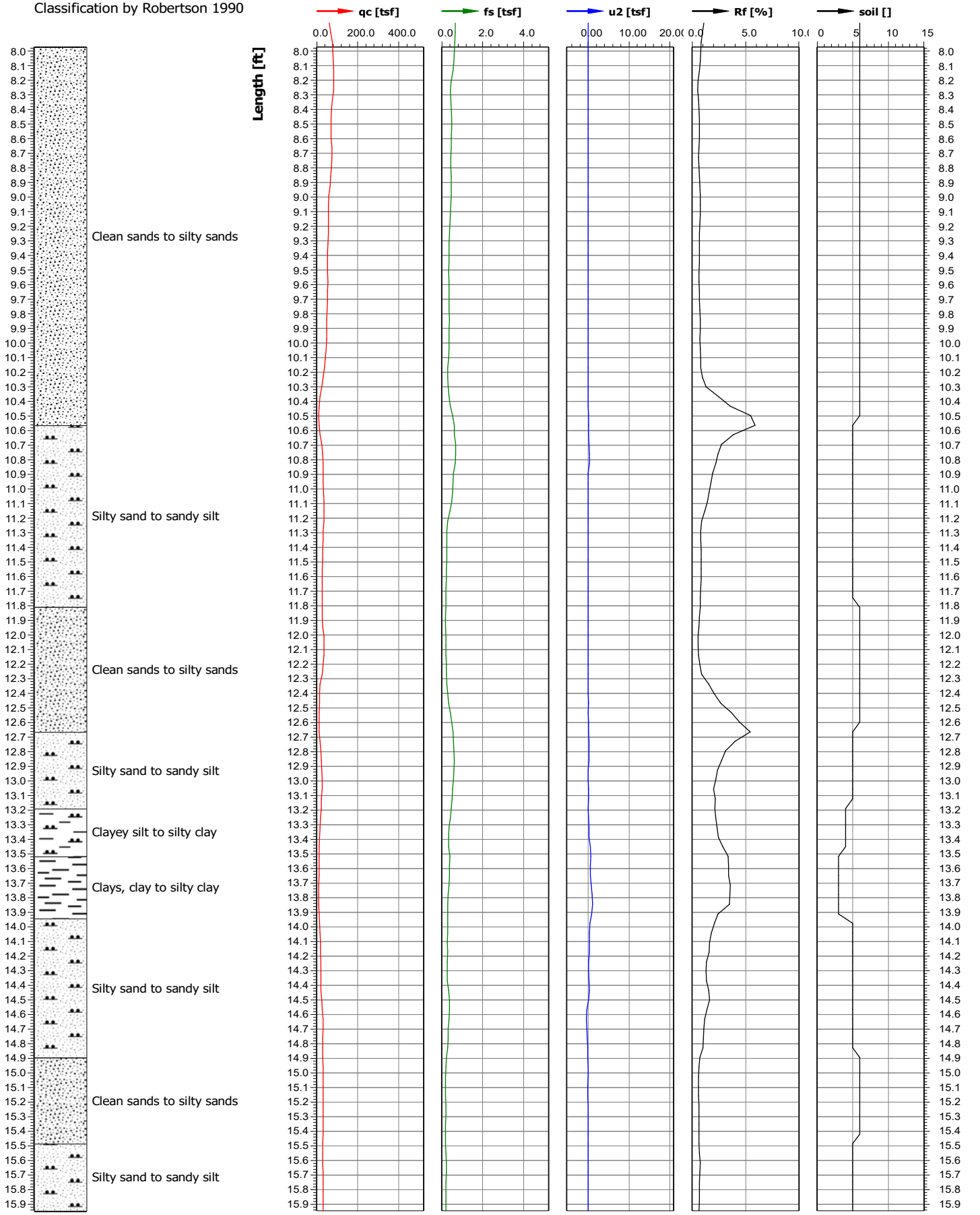
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT7	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



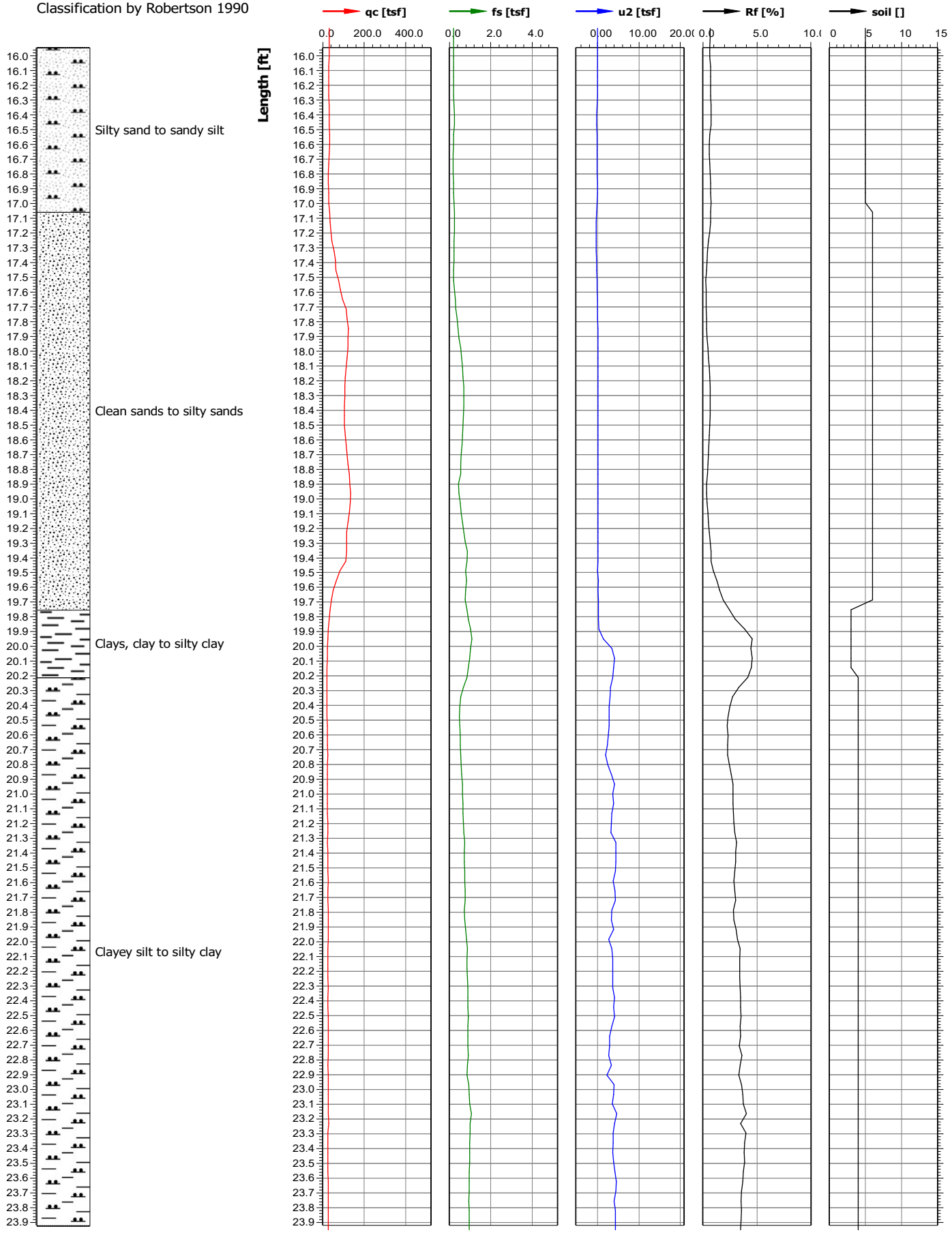
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT7	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



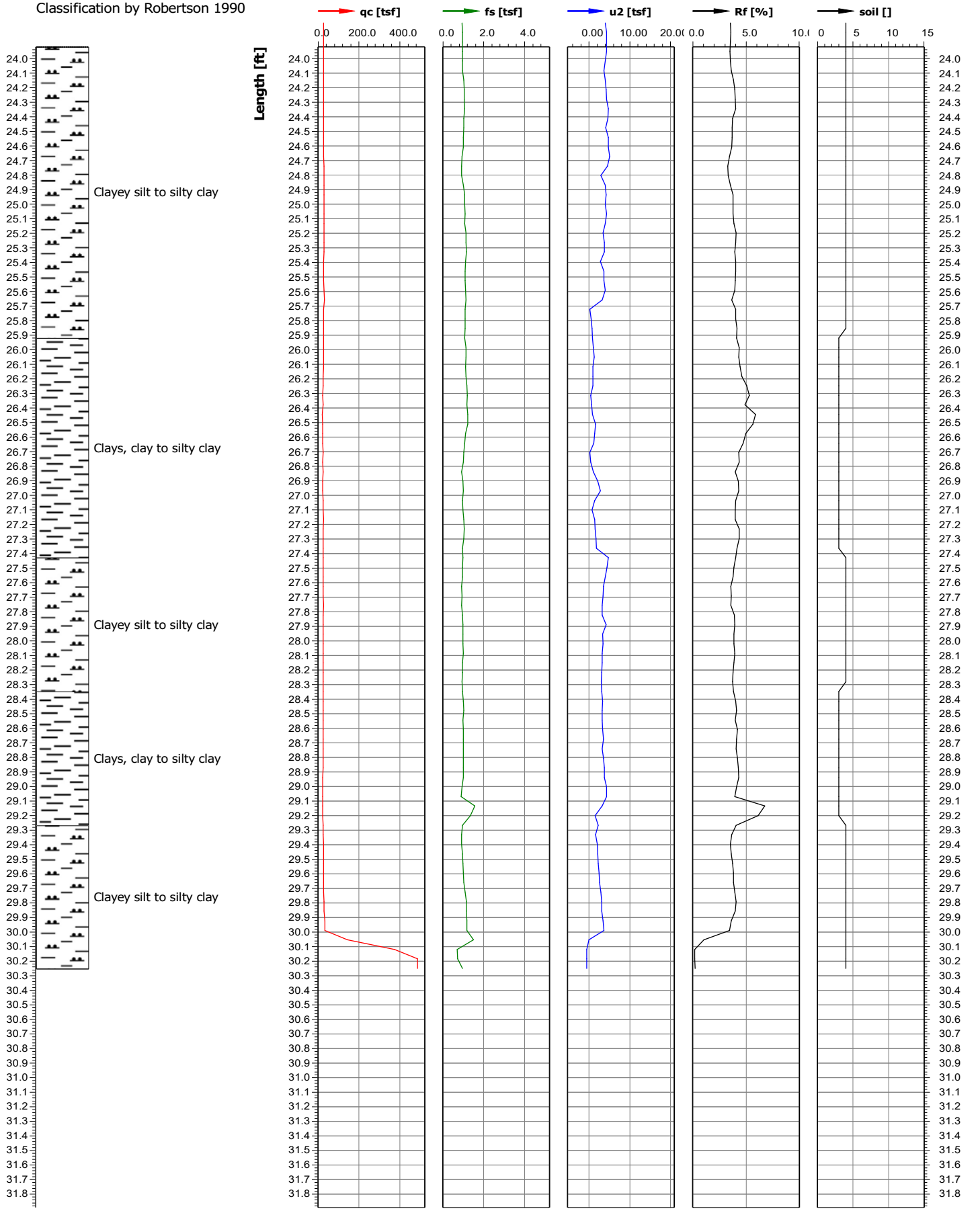
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT7	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



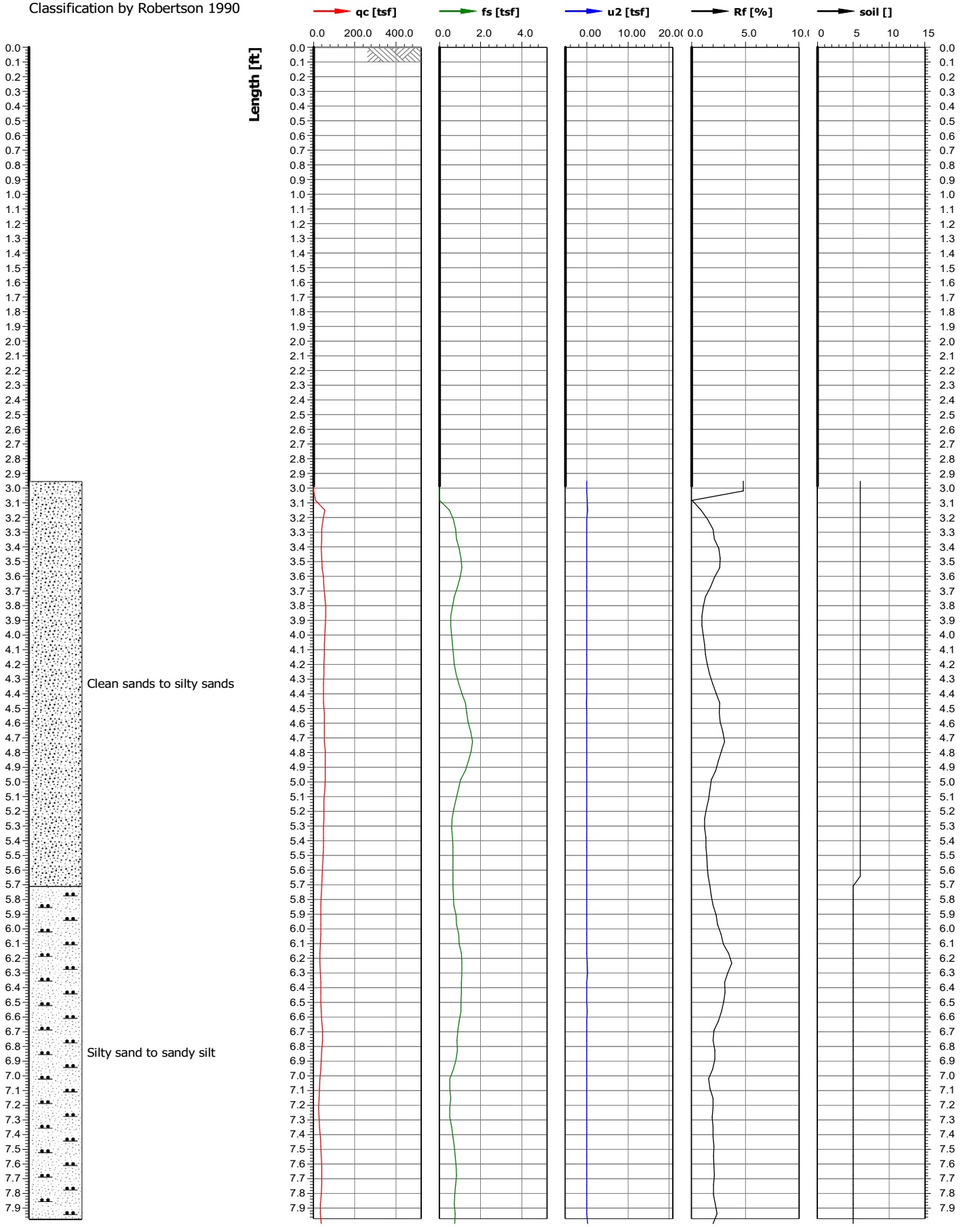
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT7	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/2/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/4	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



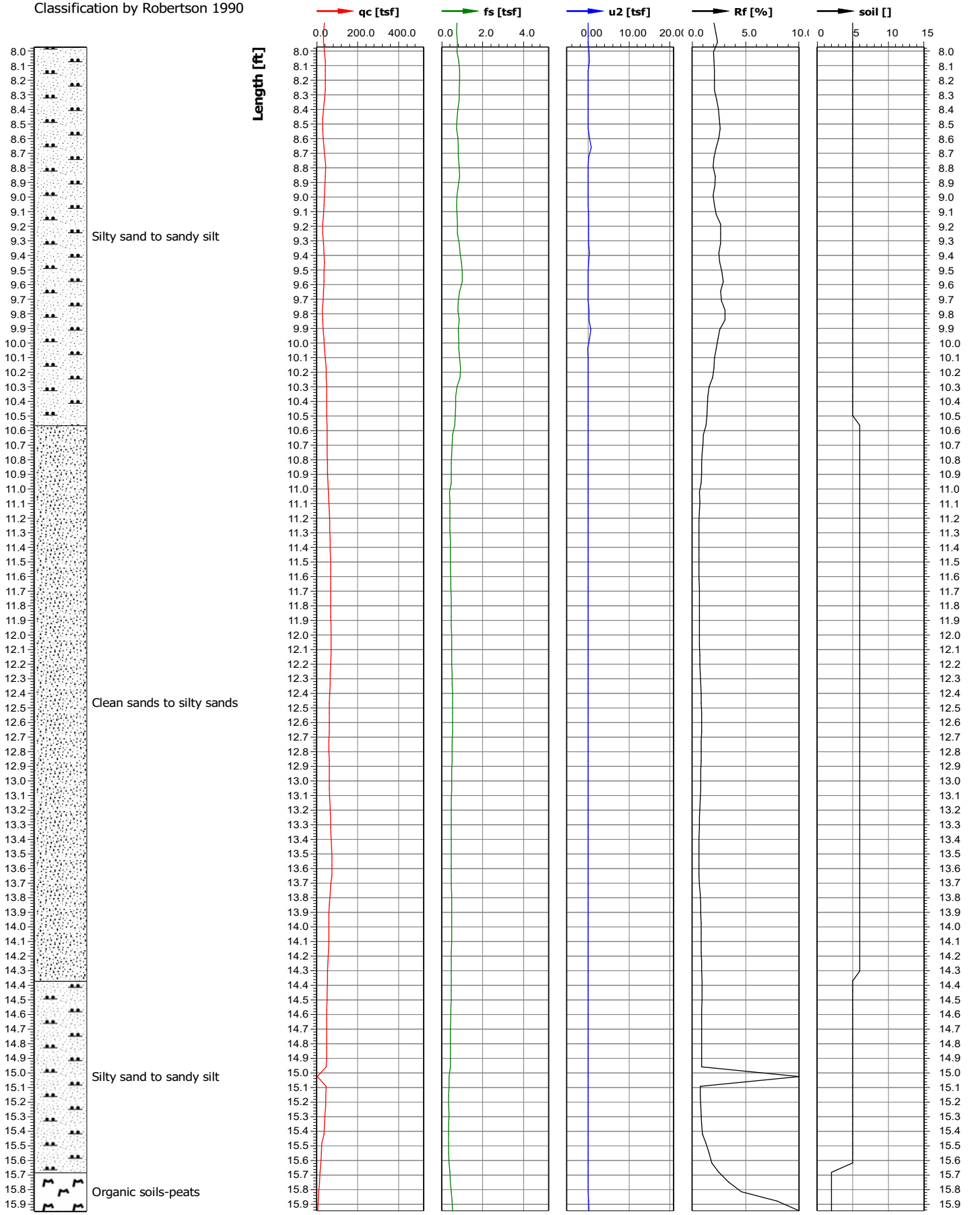
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



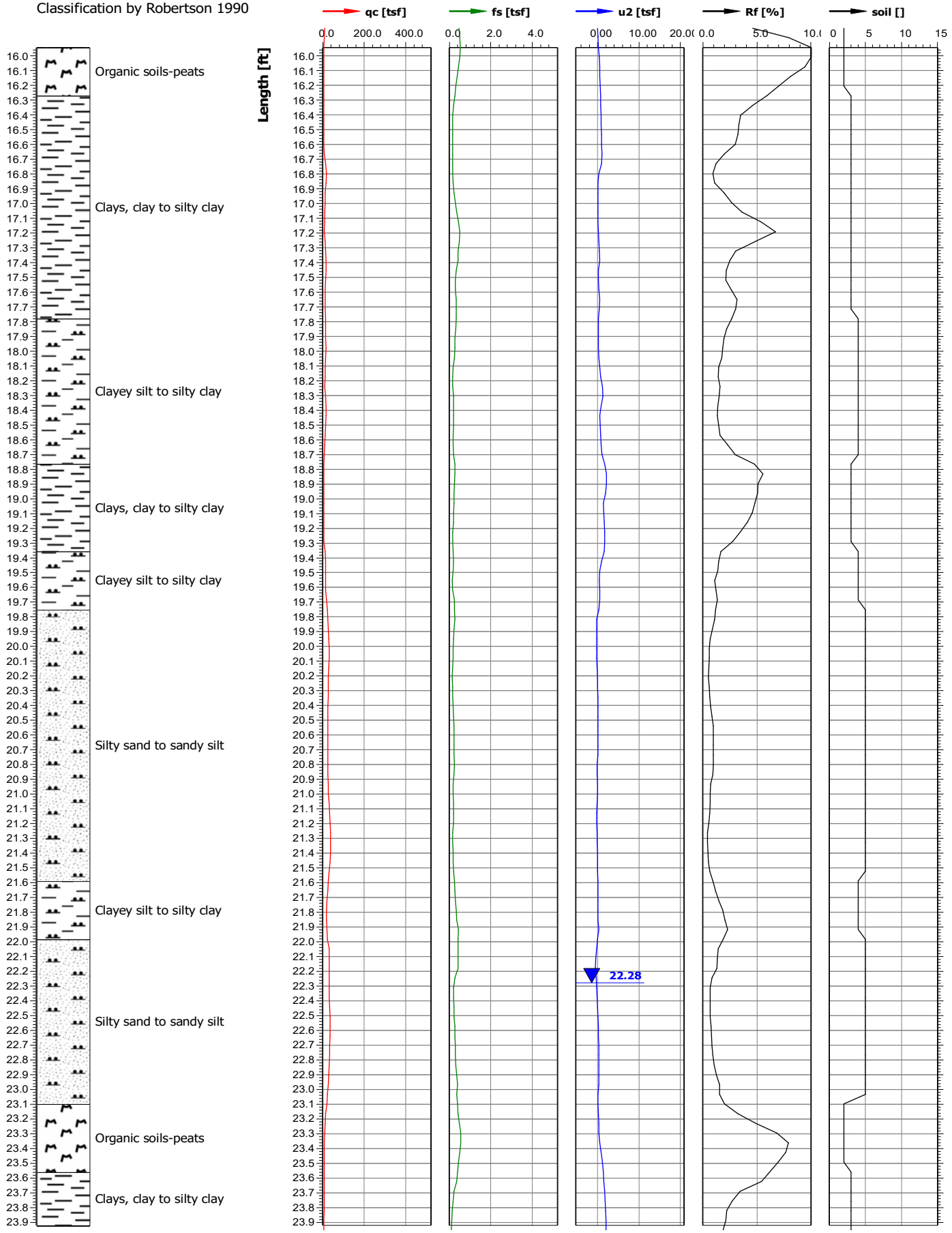
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



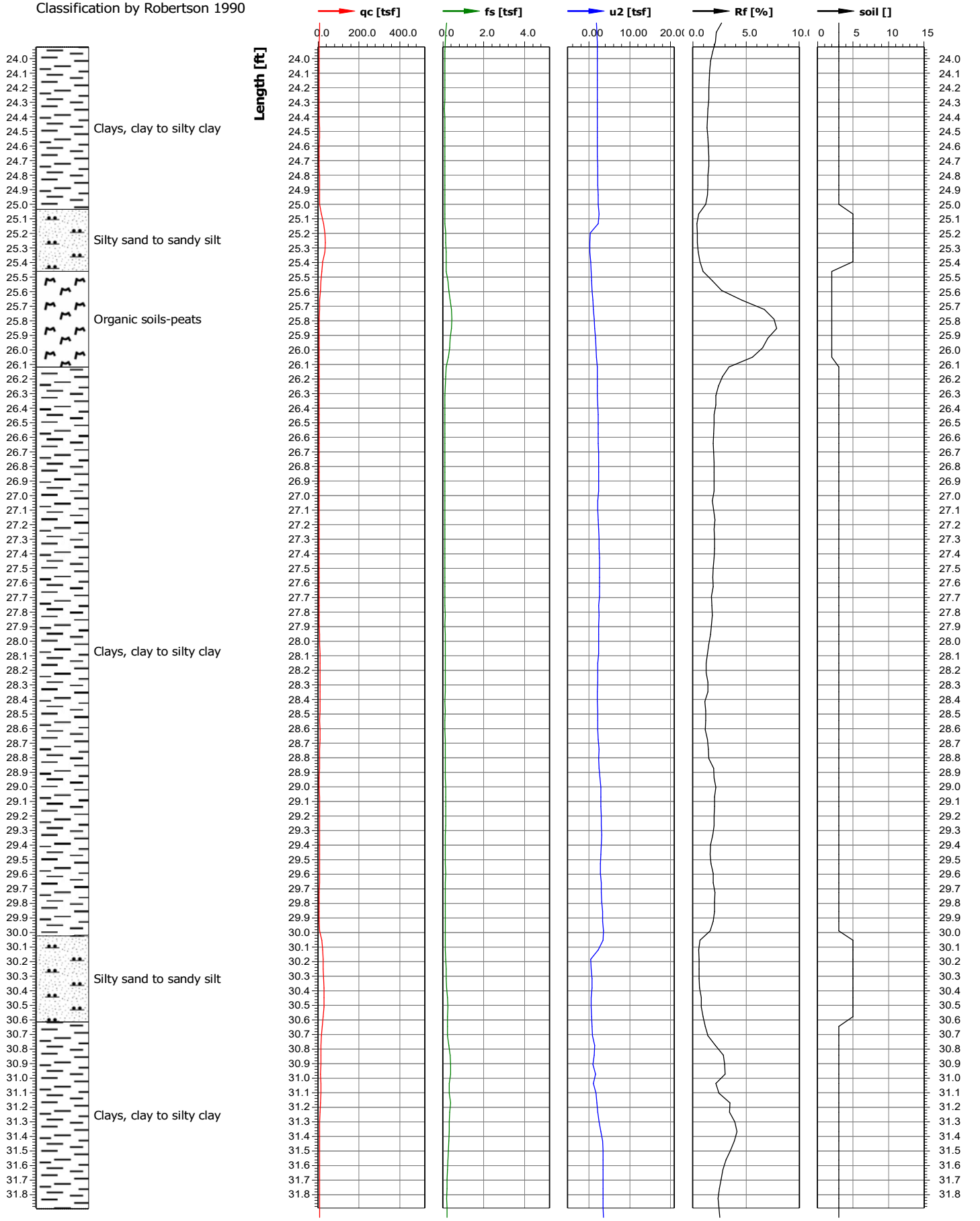
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



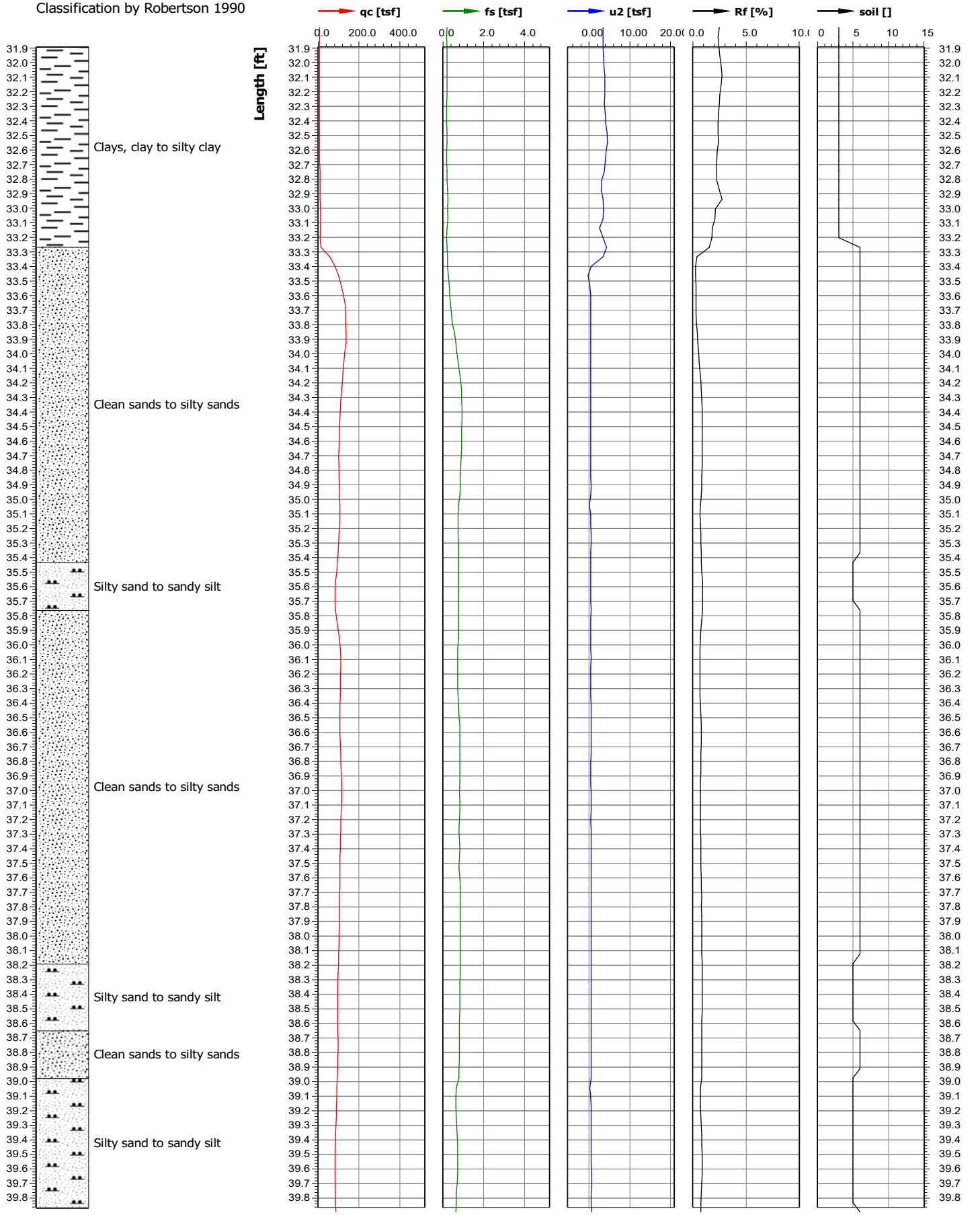
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



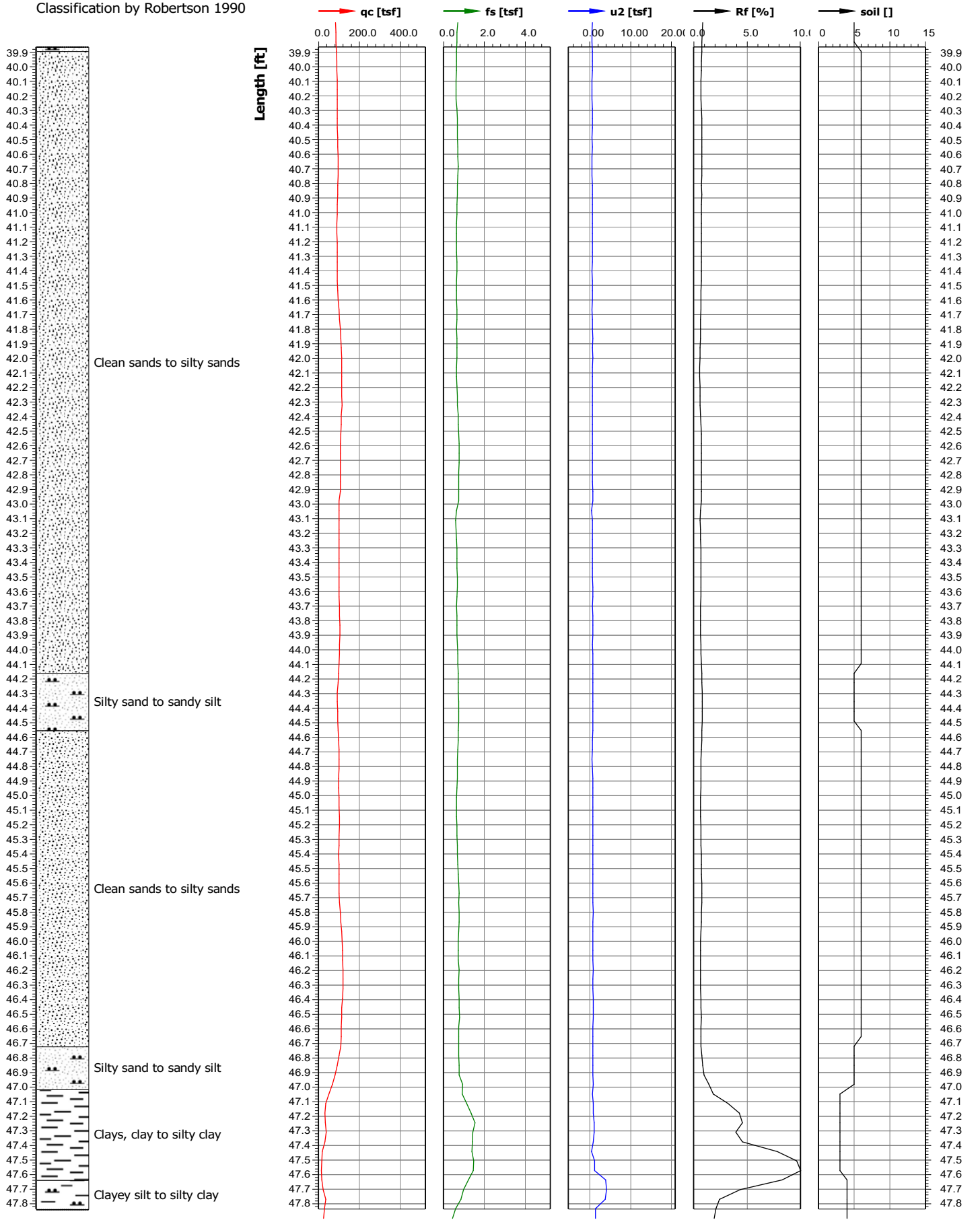
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



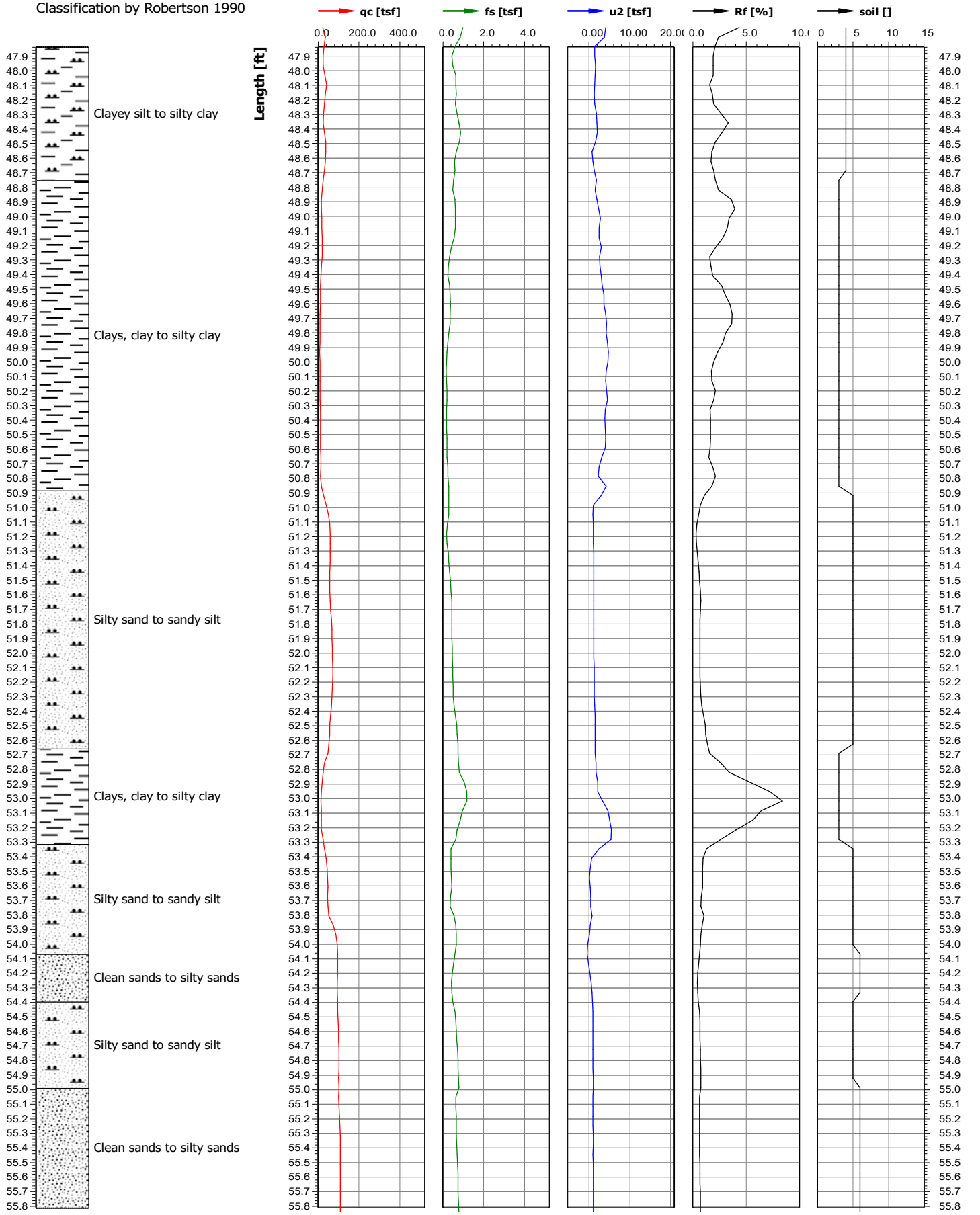
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		6/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



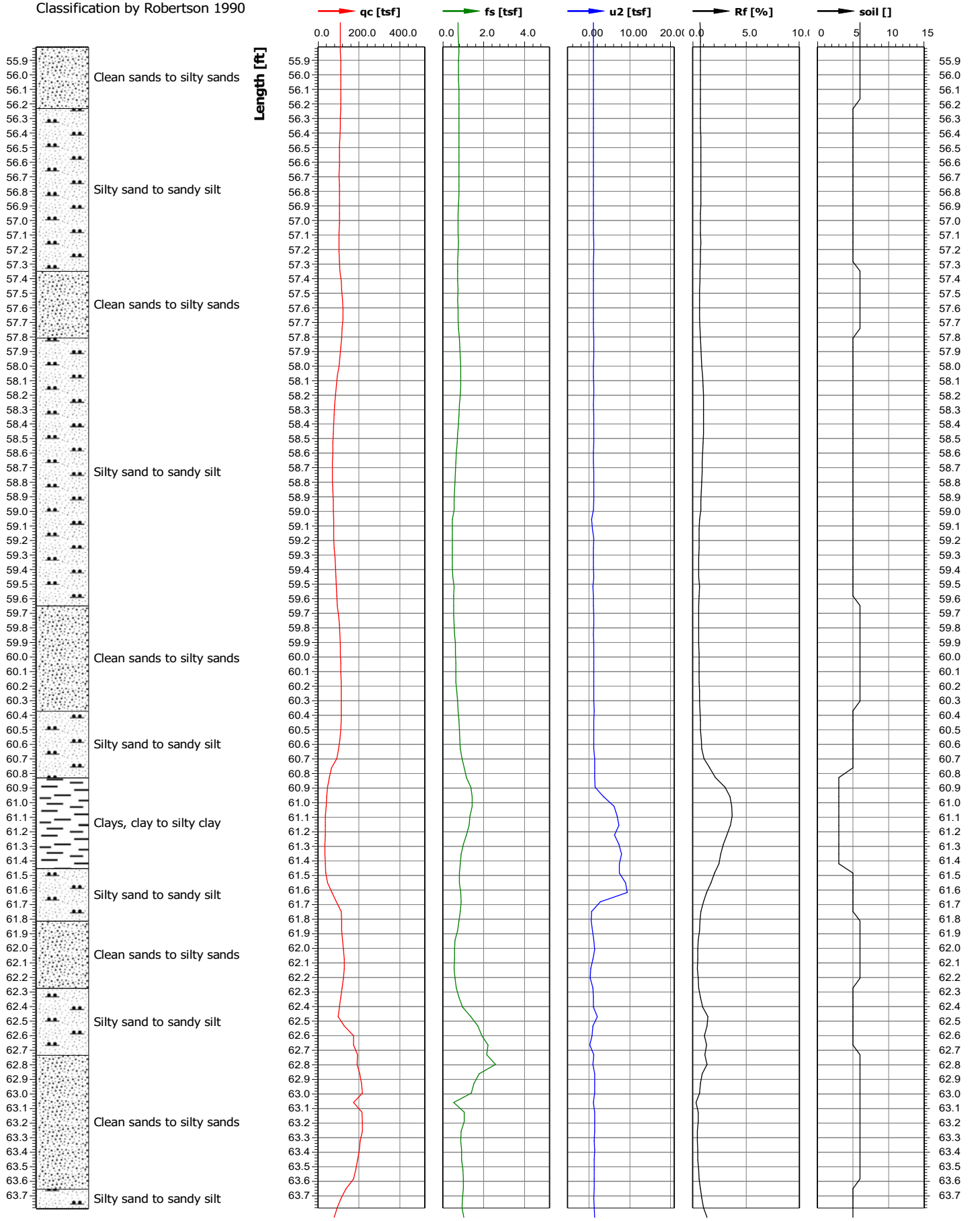
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		7/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



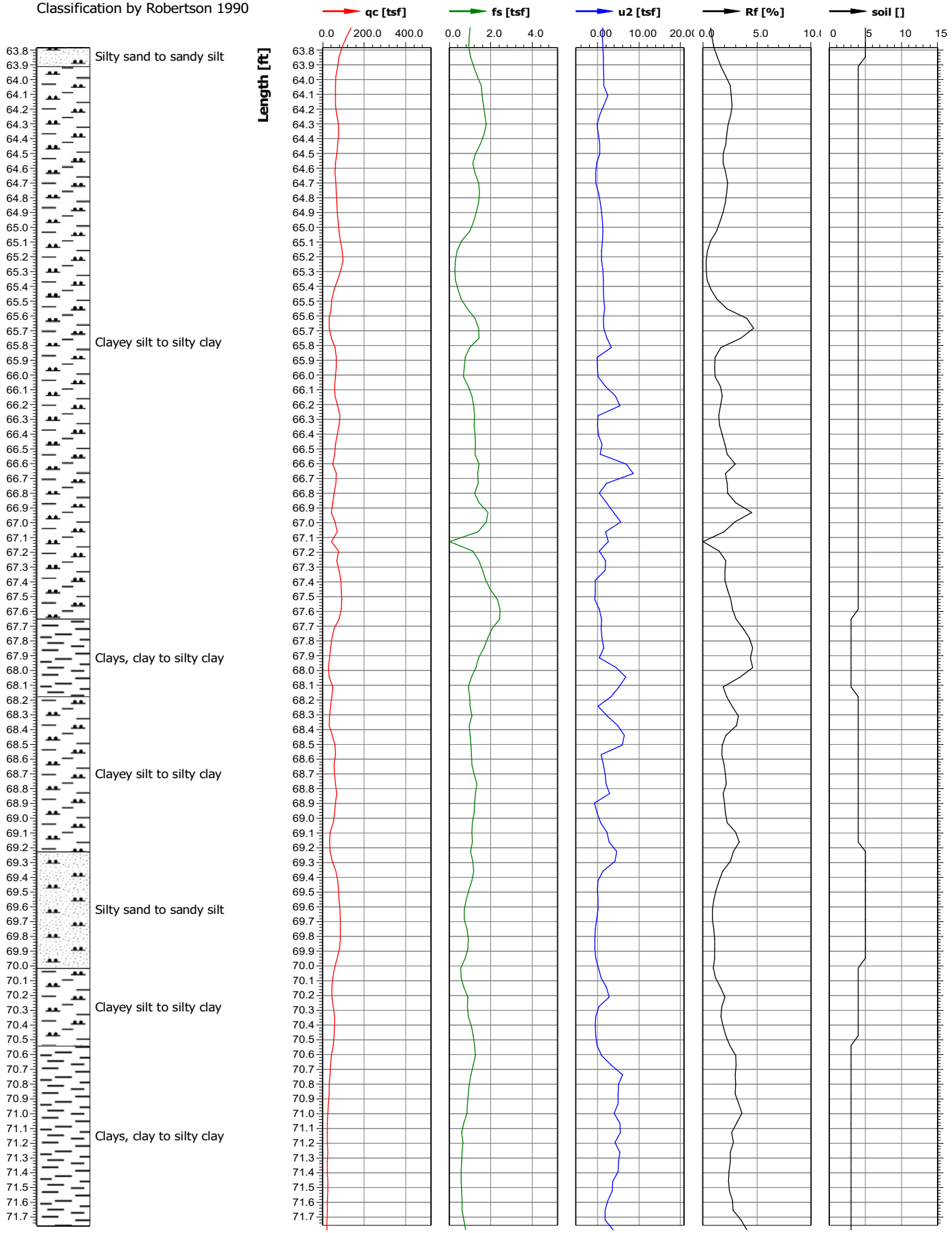
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		8/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



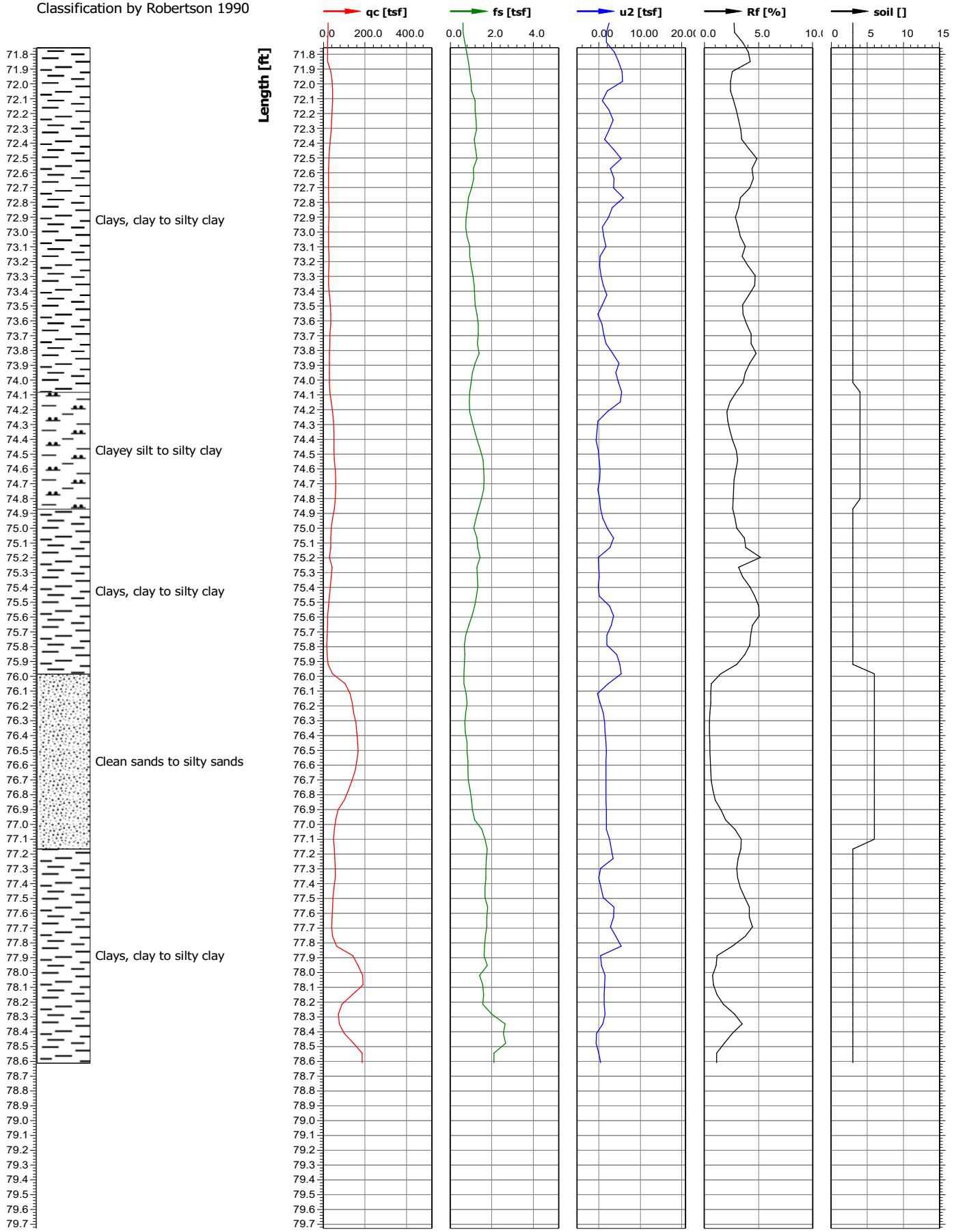
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		9/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



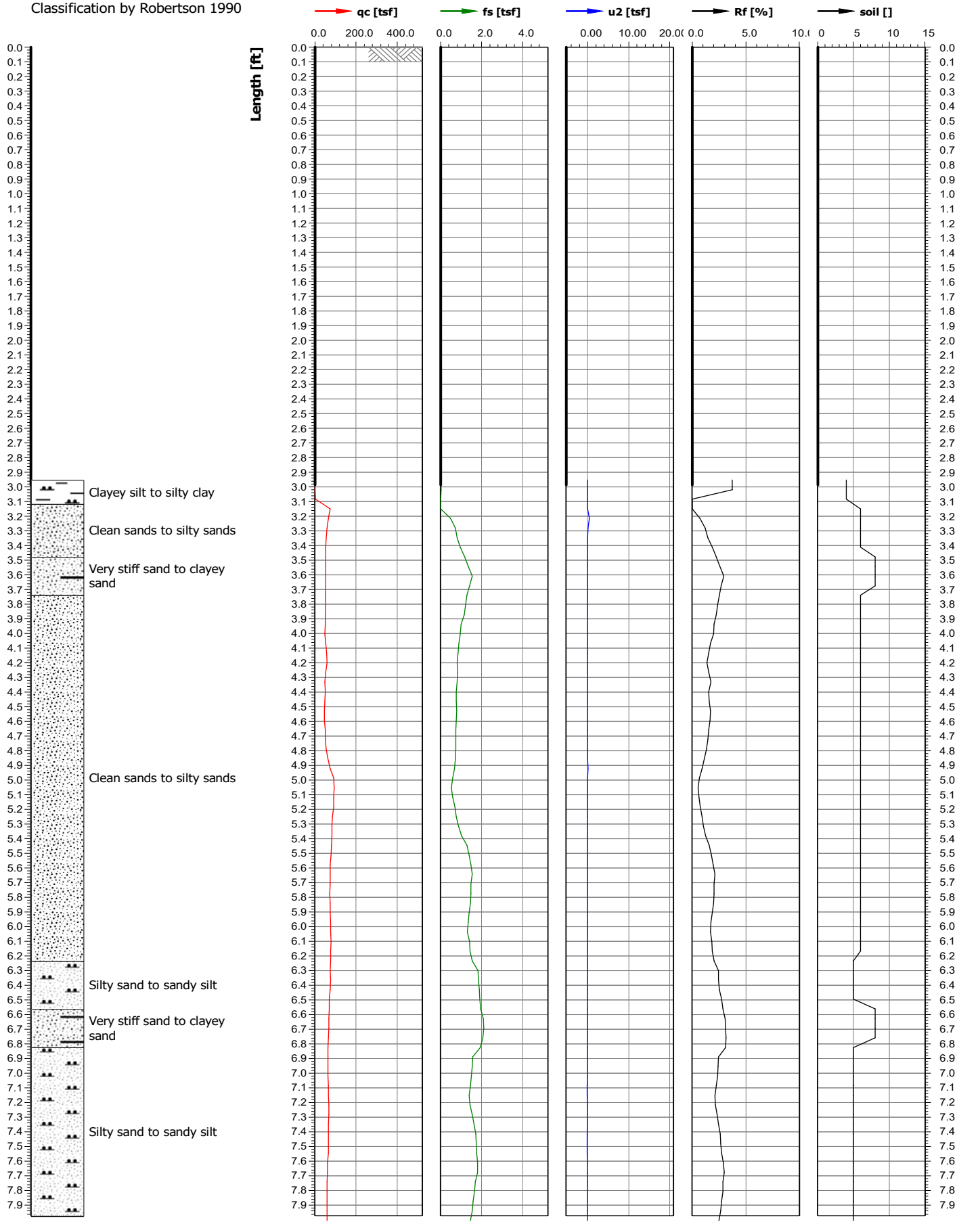
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT8	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		10/10	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



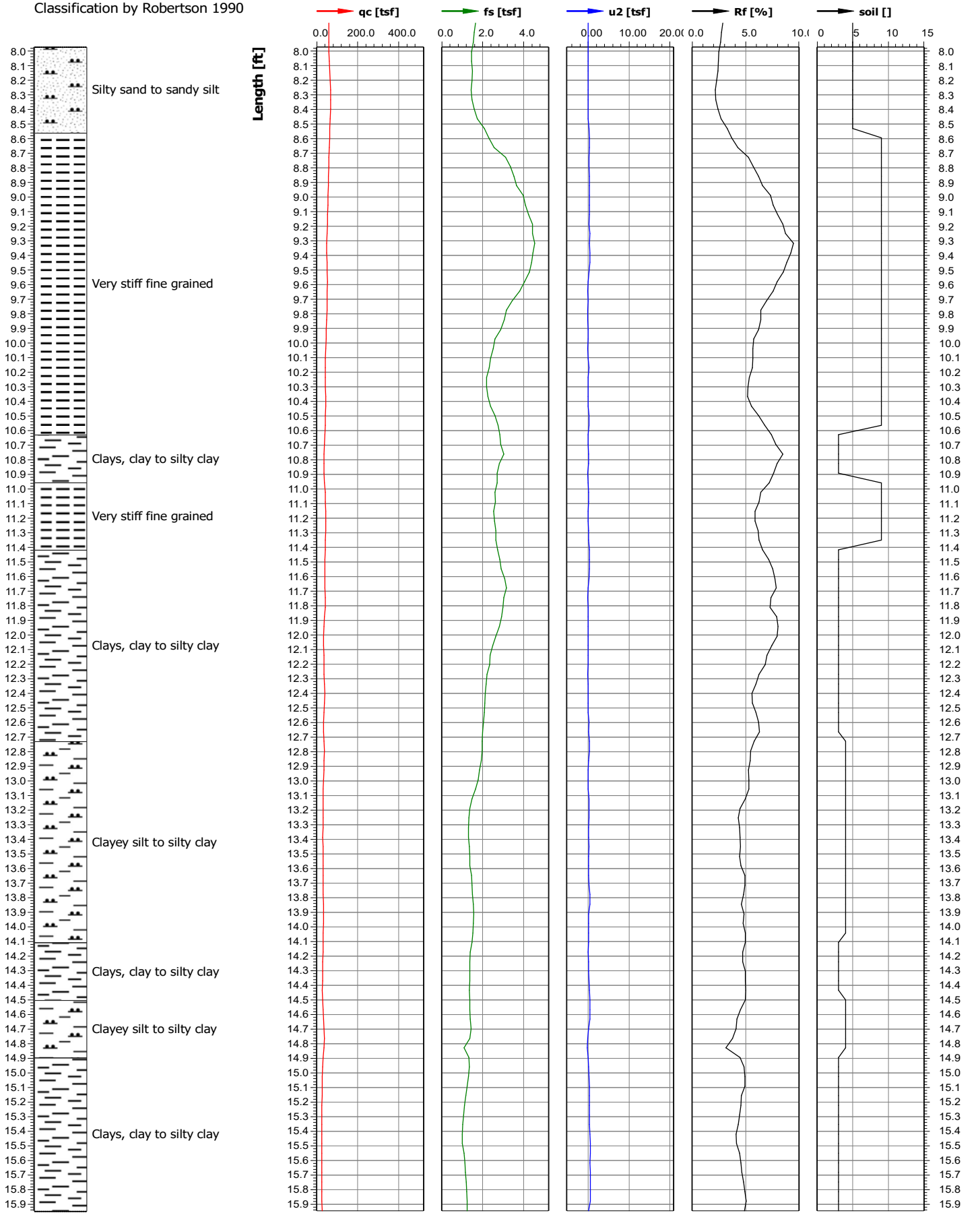
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



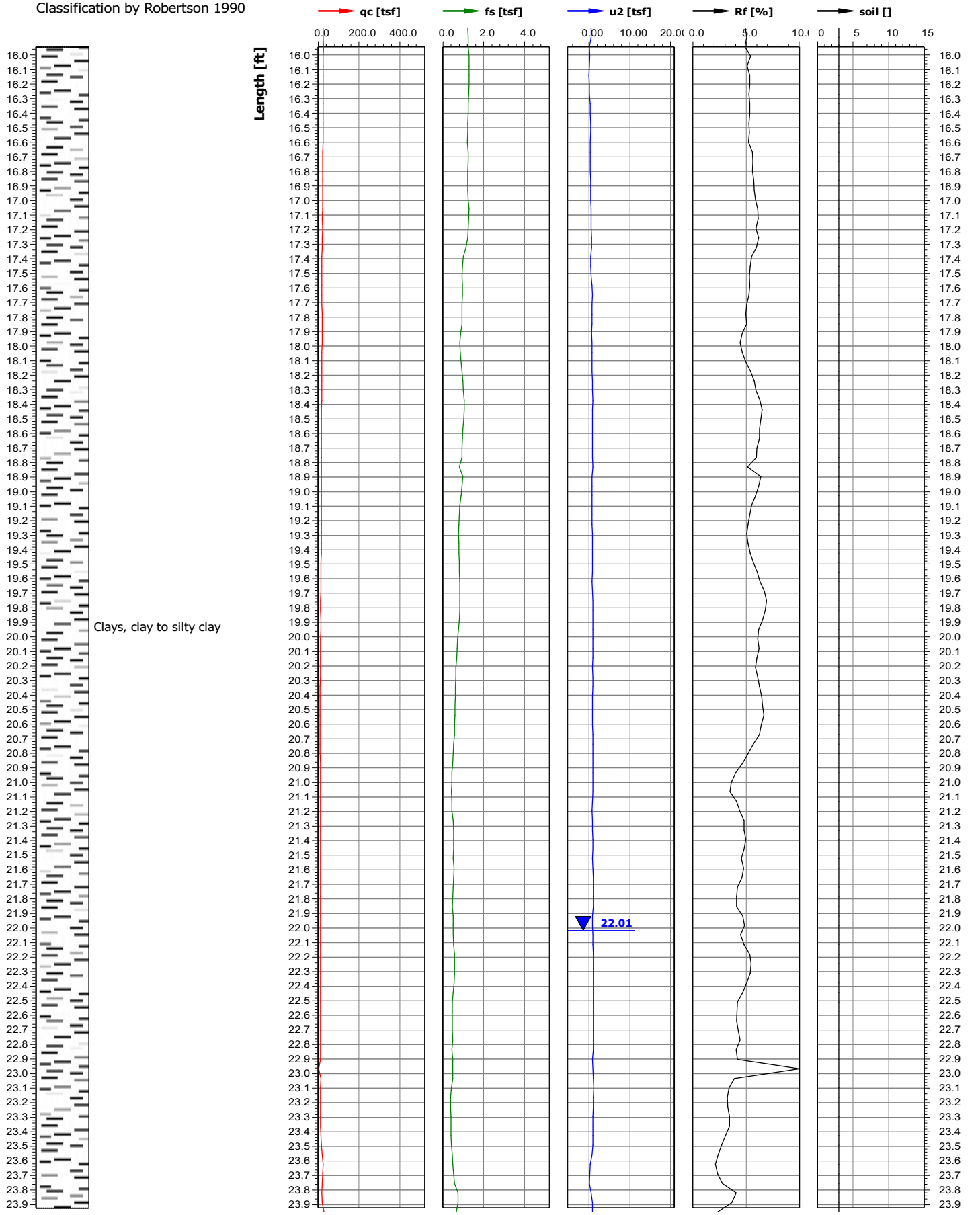
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



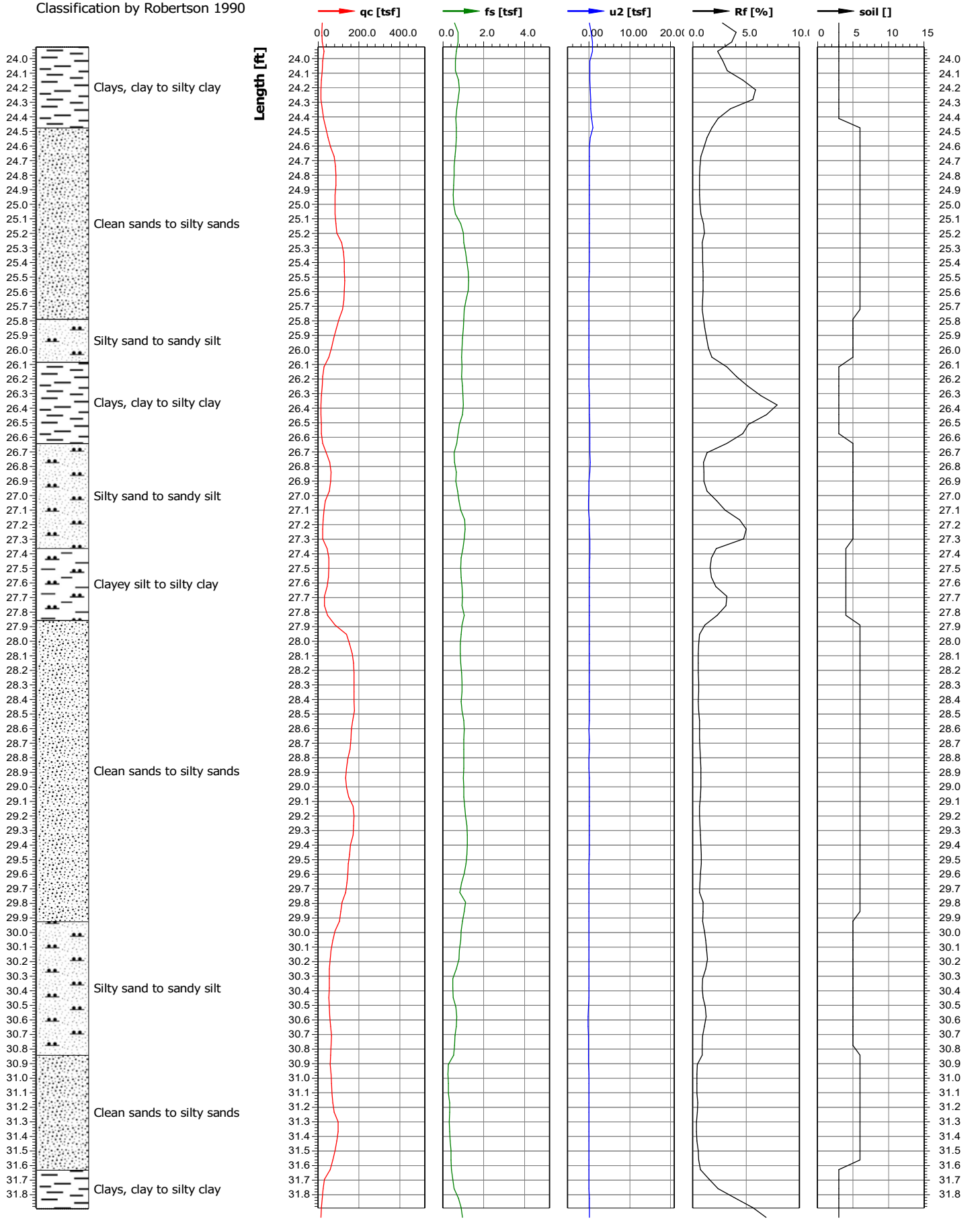
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



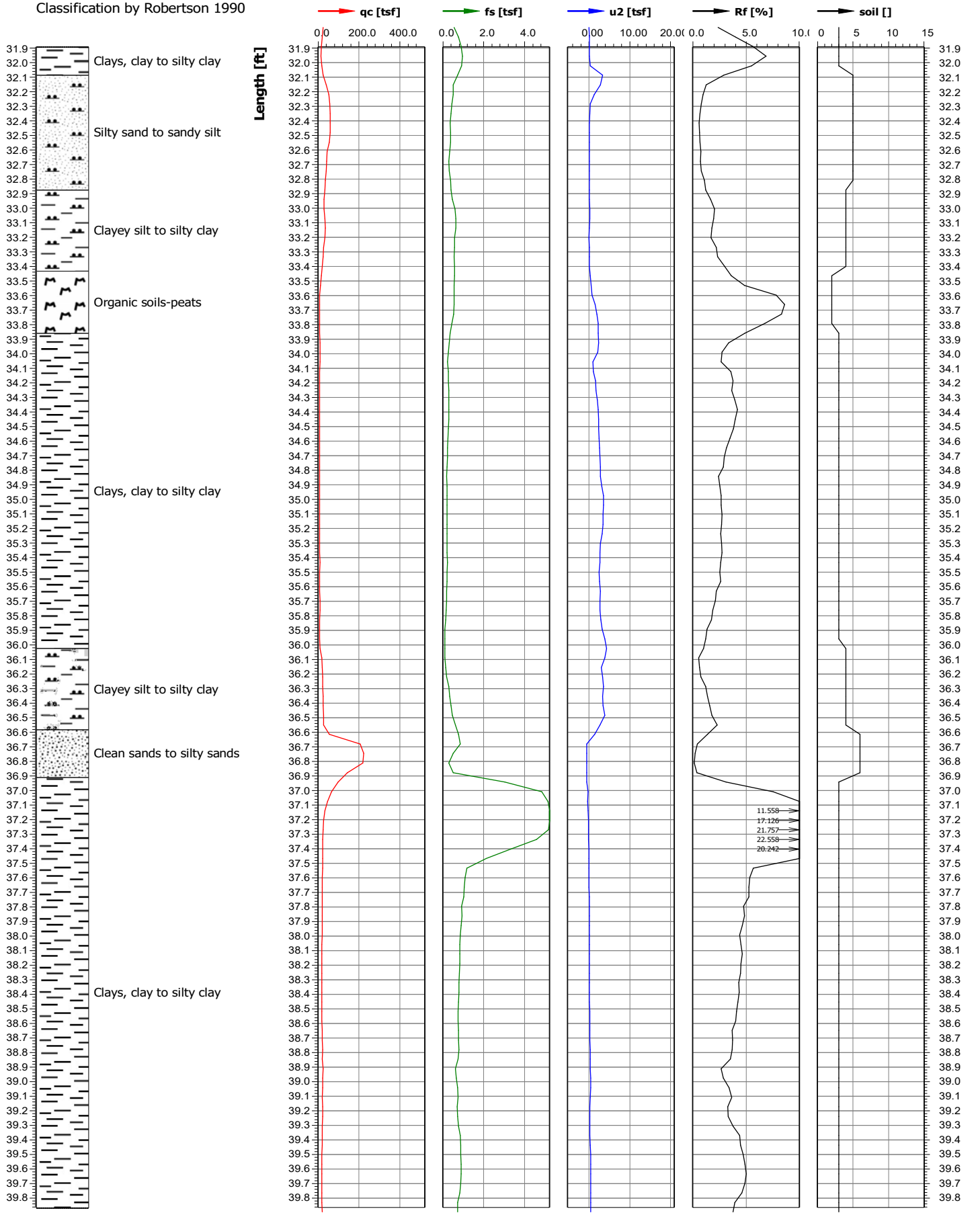
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



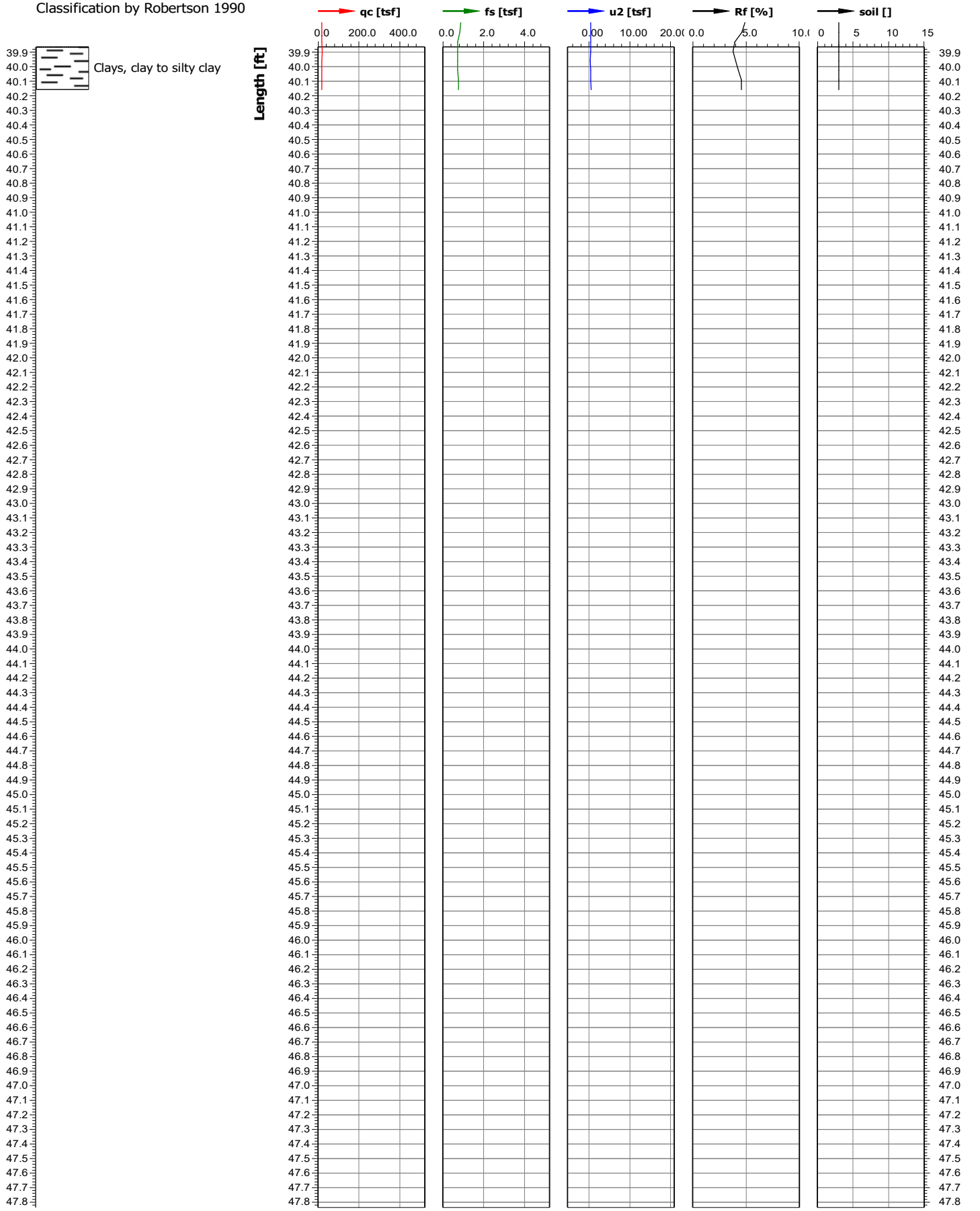
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



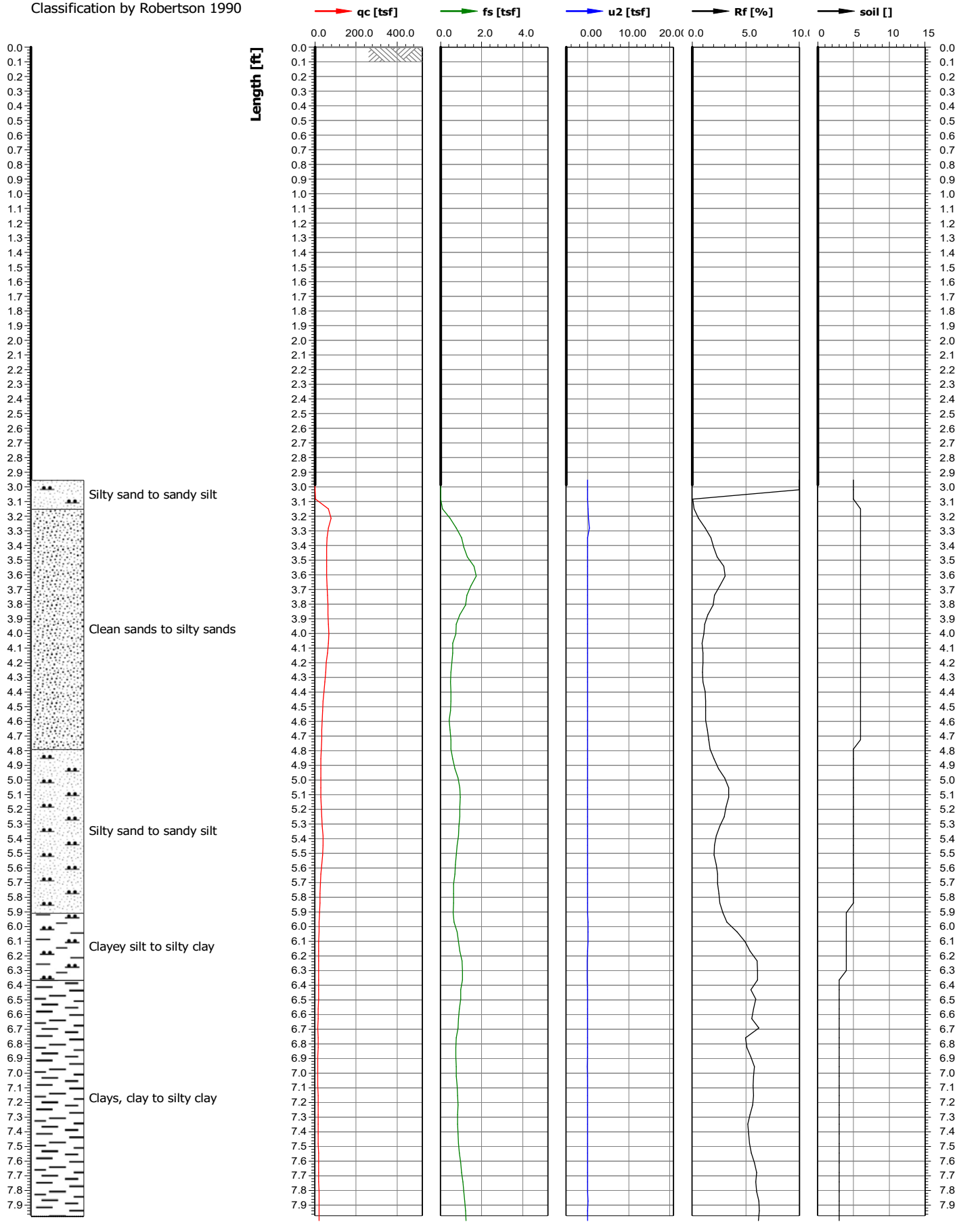
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CPT9	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		6/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



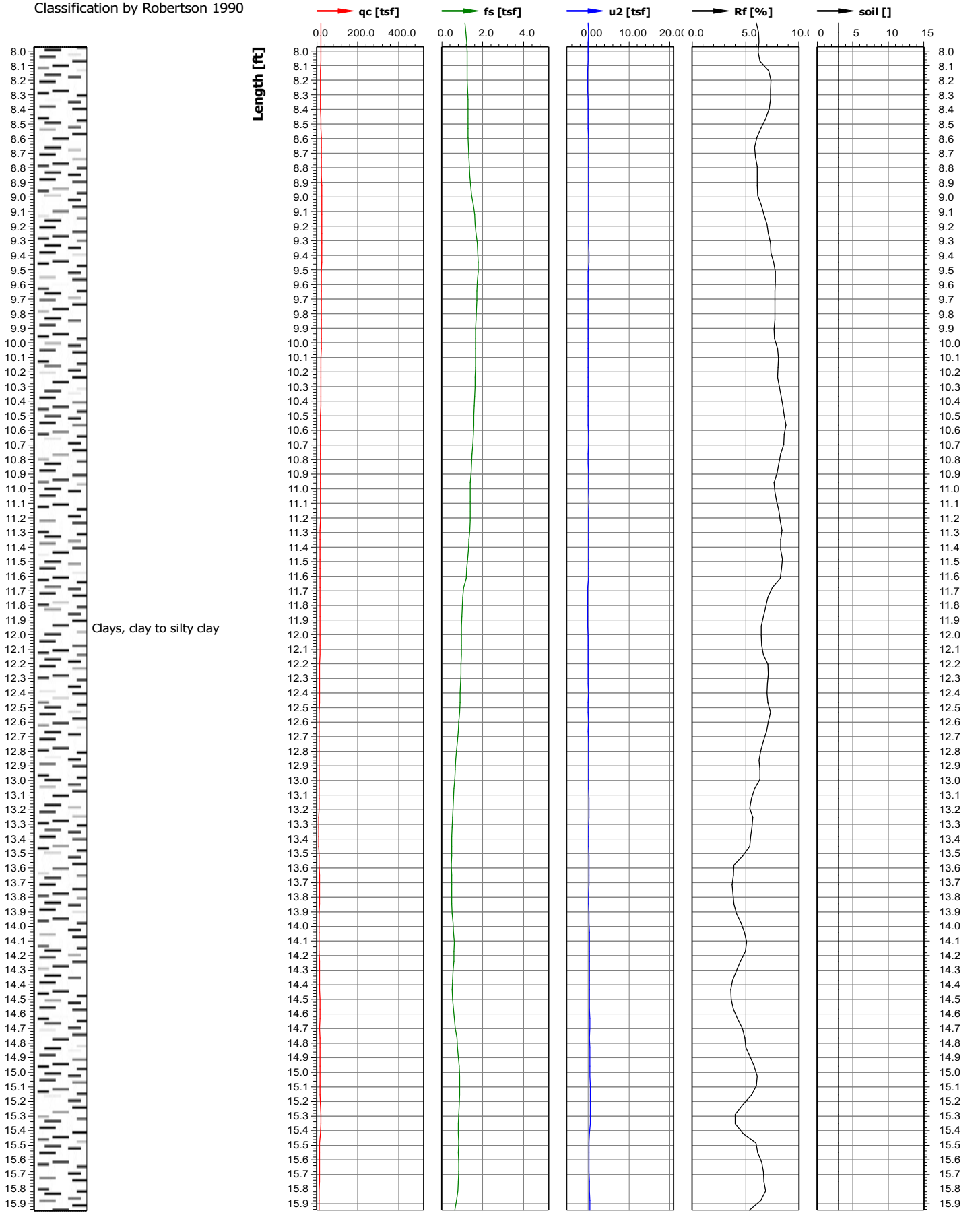
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



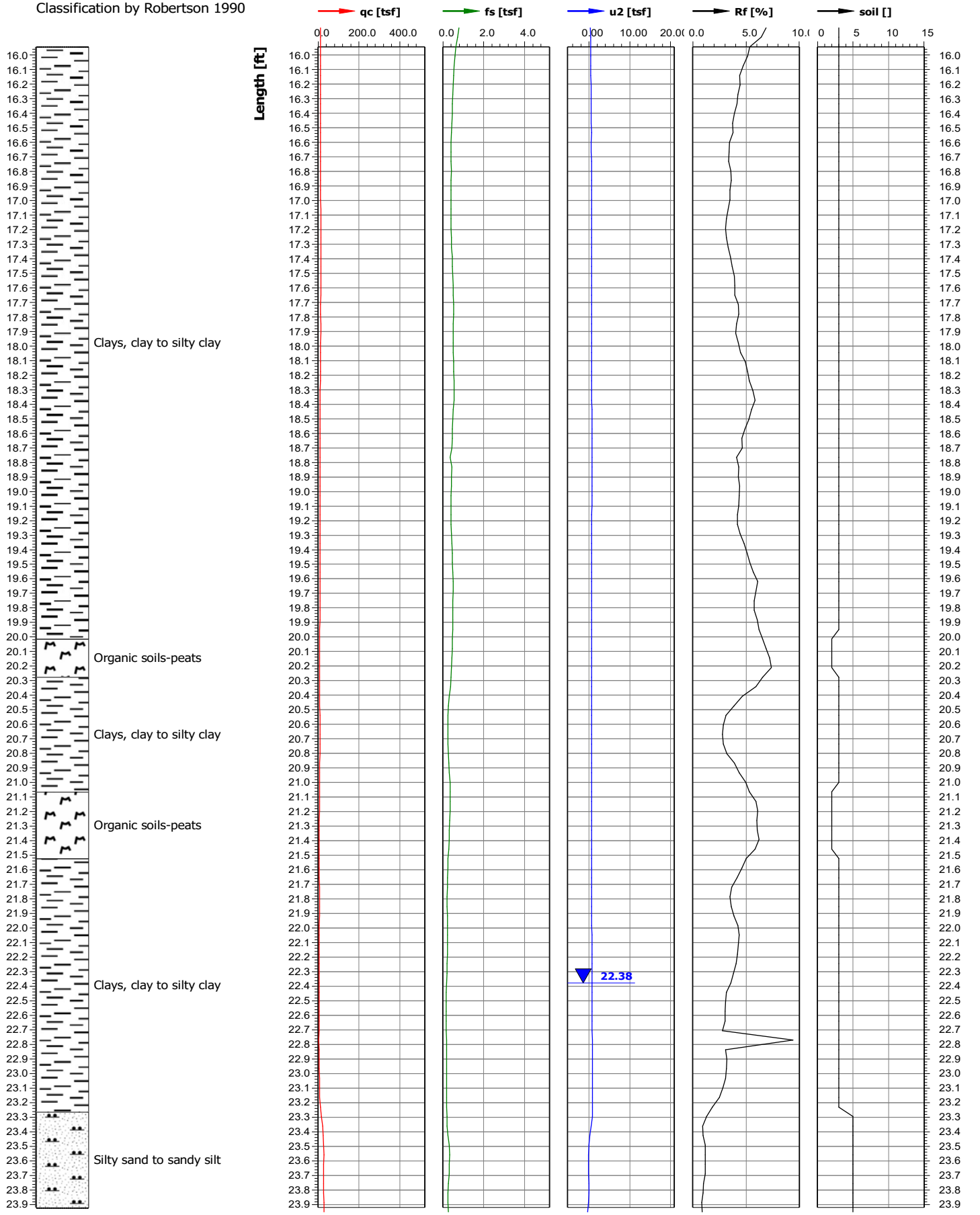
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



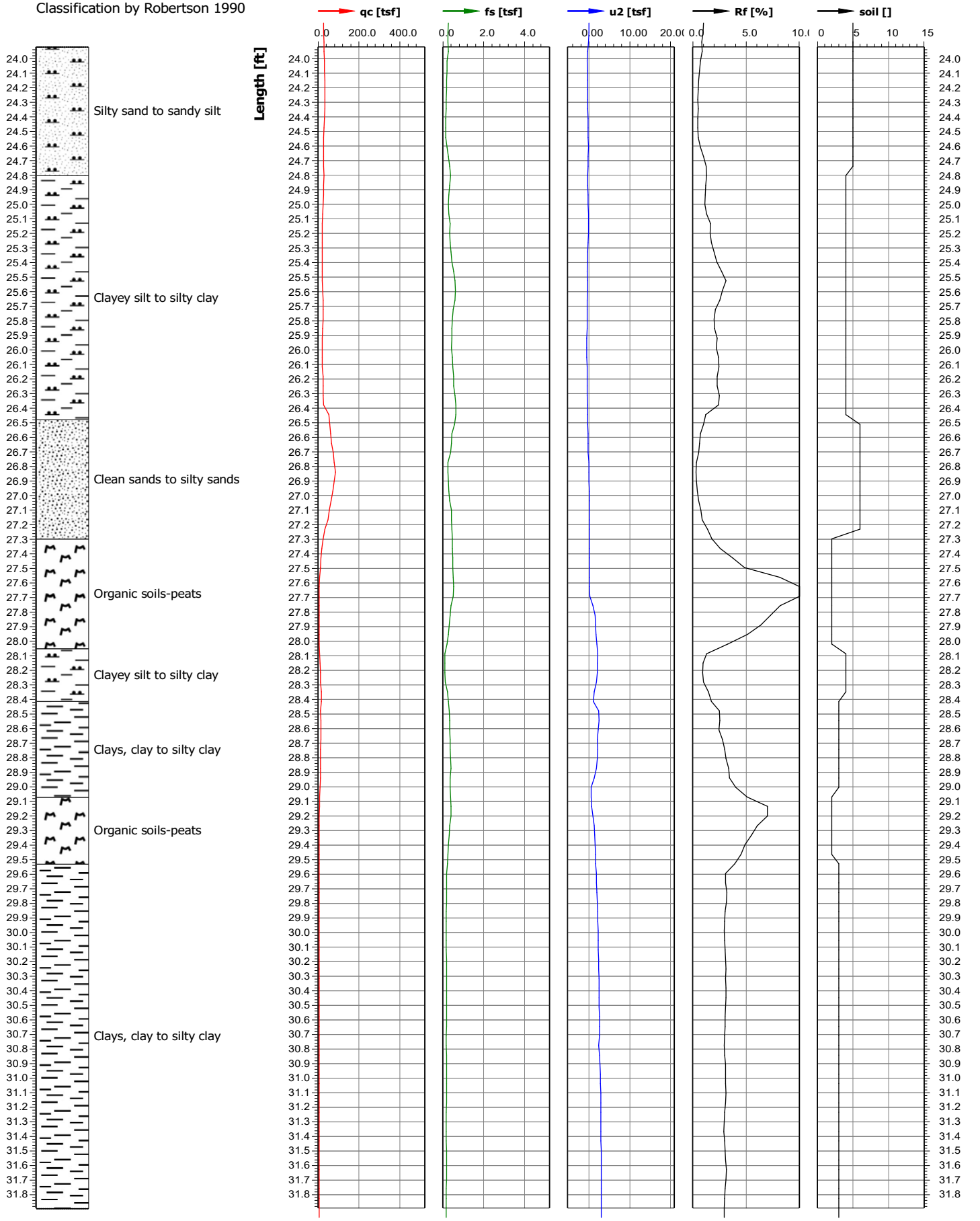
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



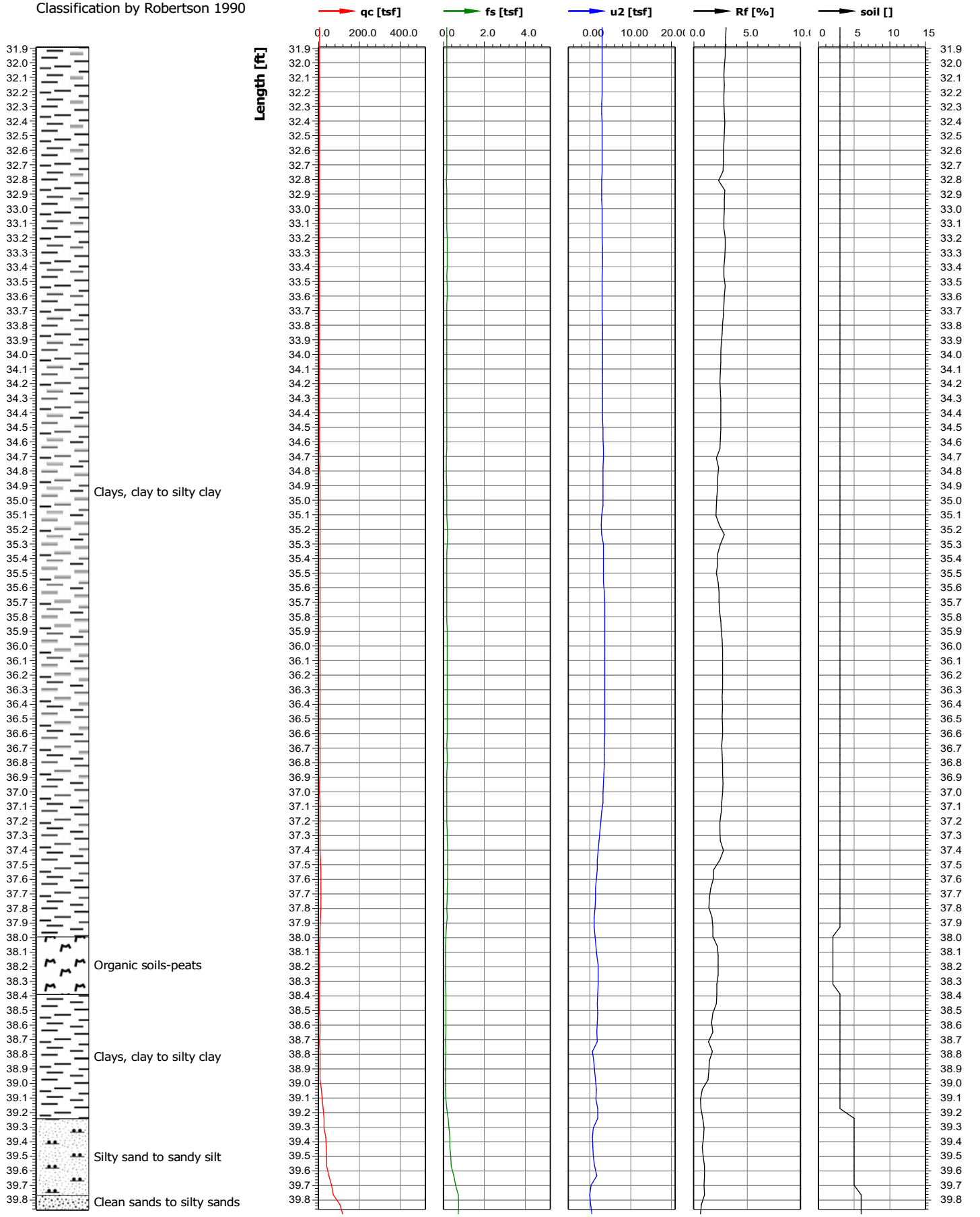
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



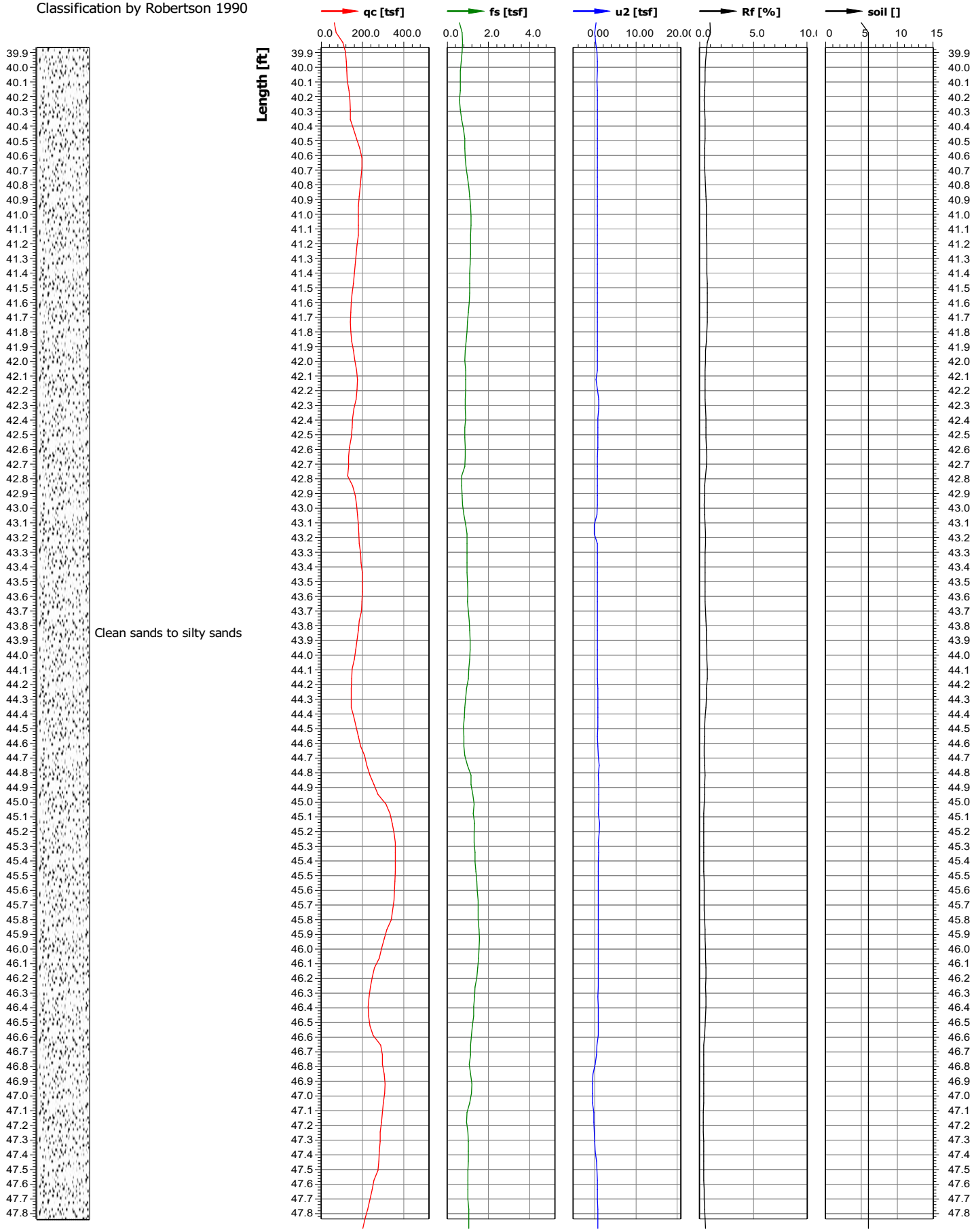
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



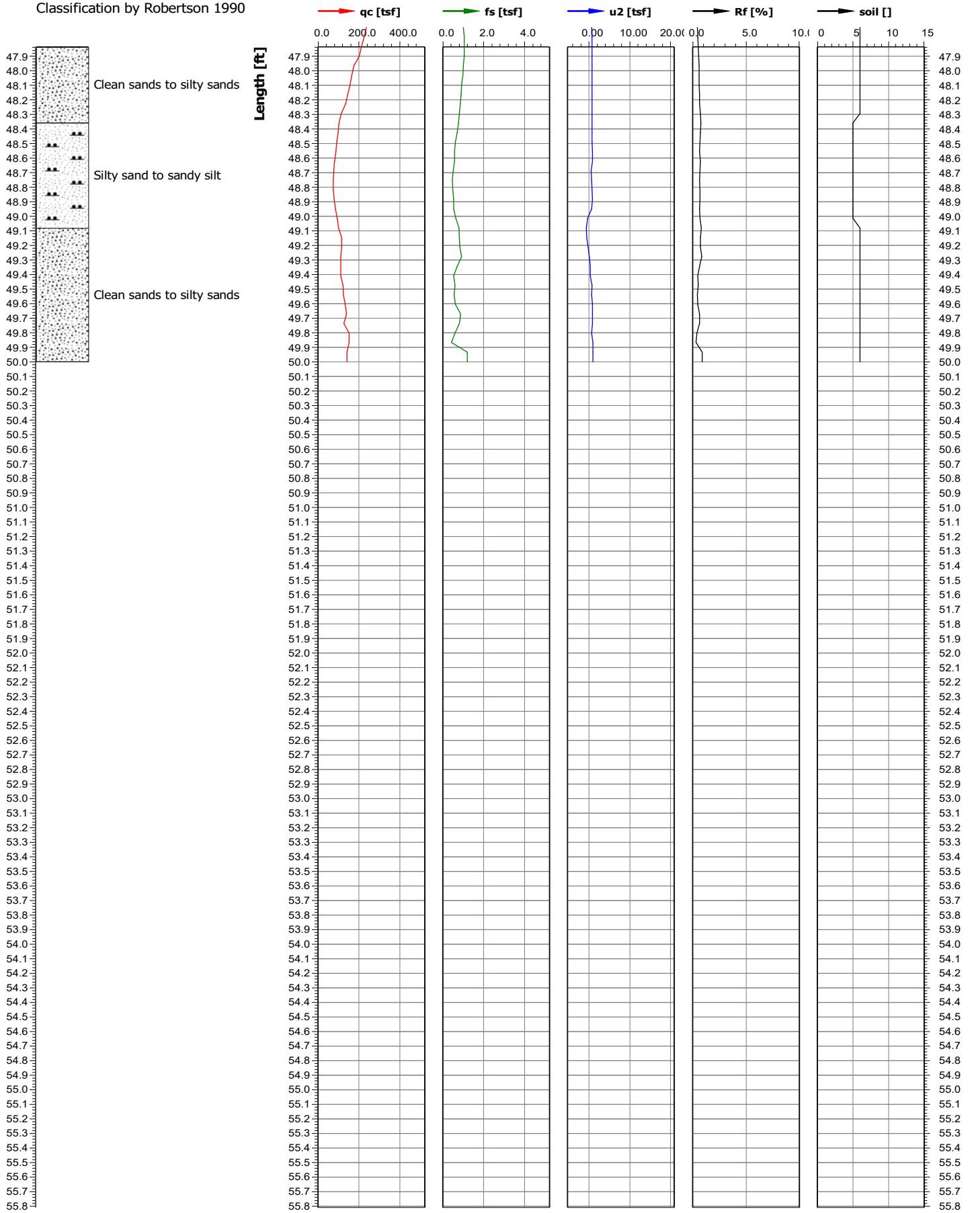
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		6/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



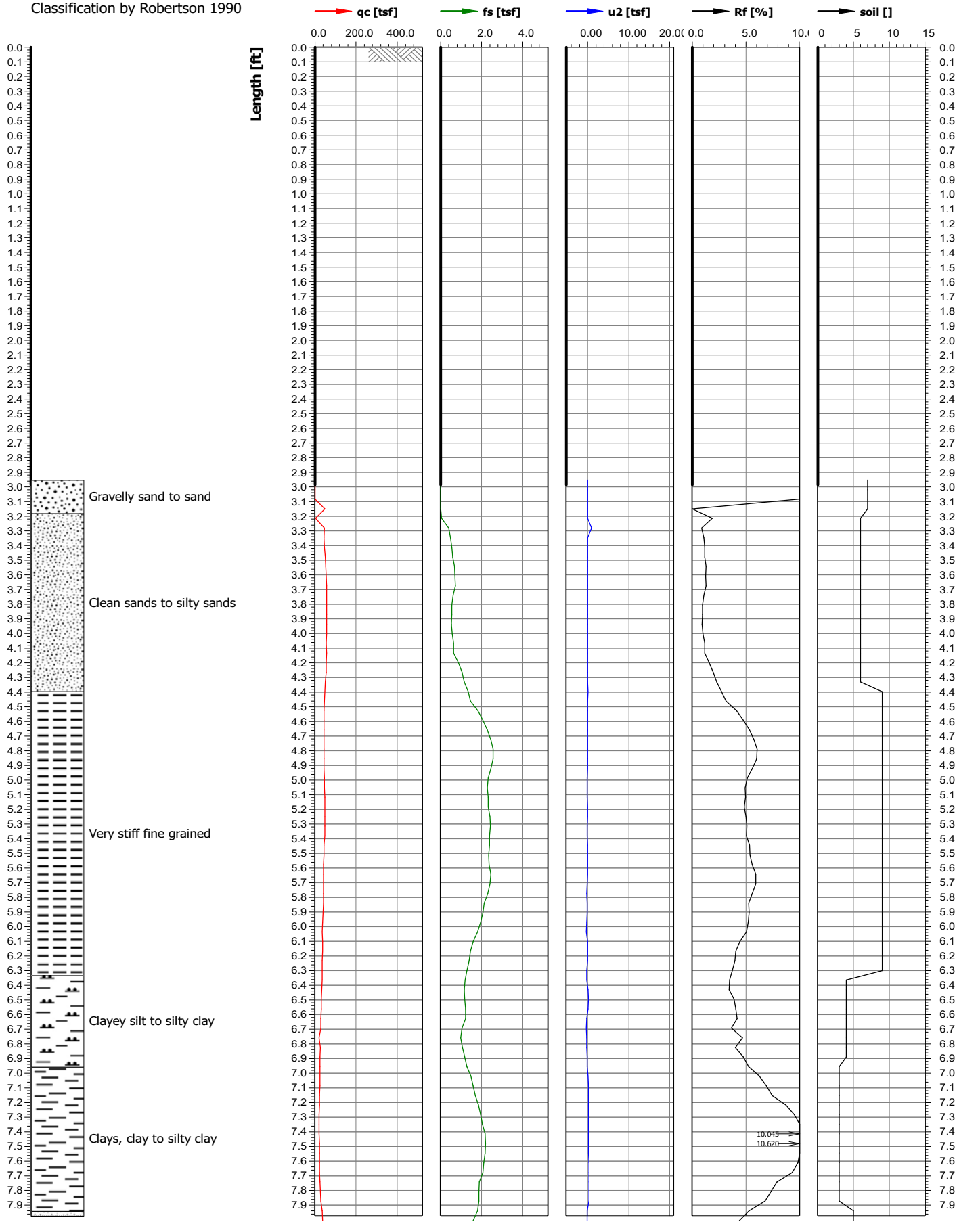
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP10	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		7/7	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



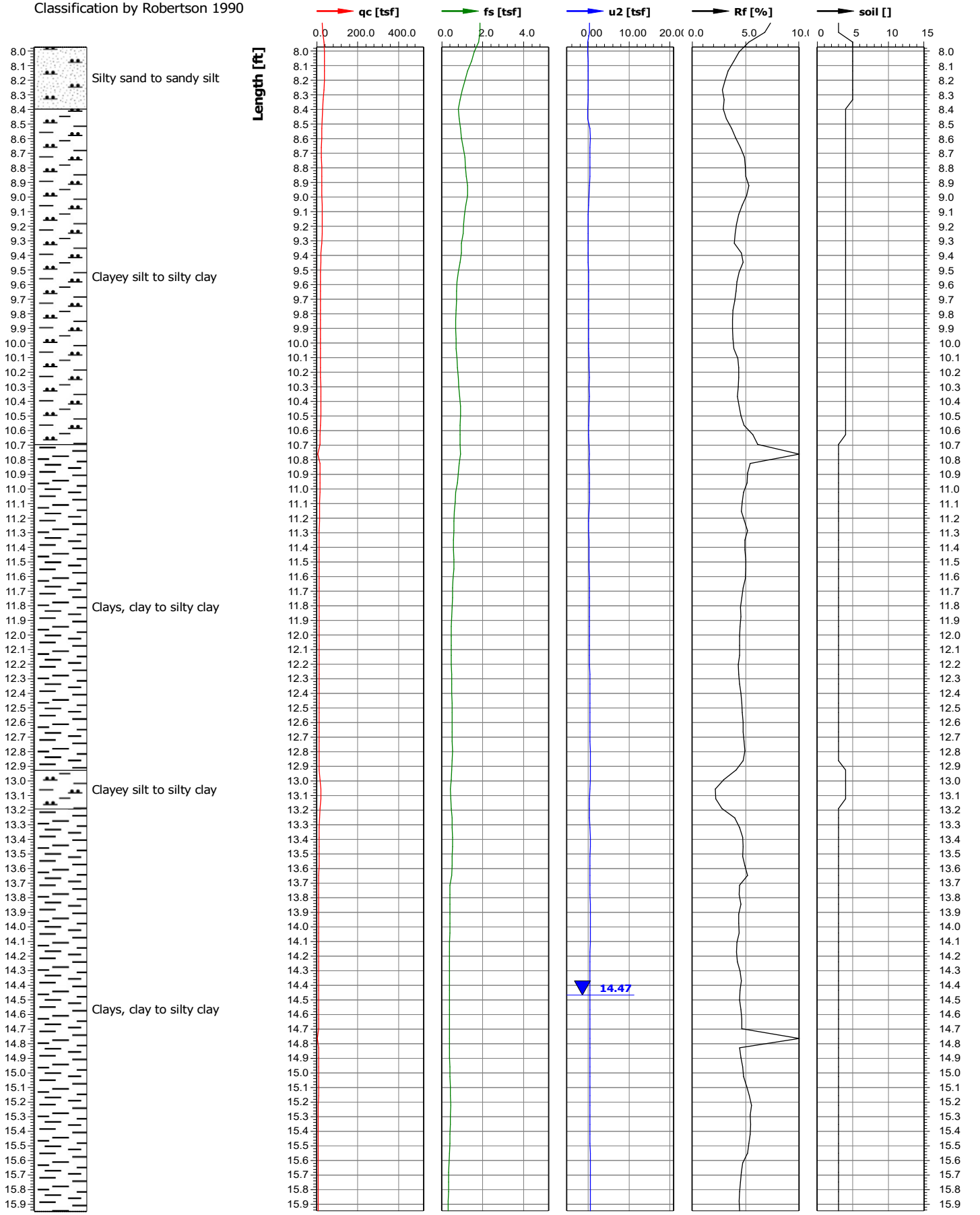
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



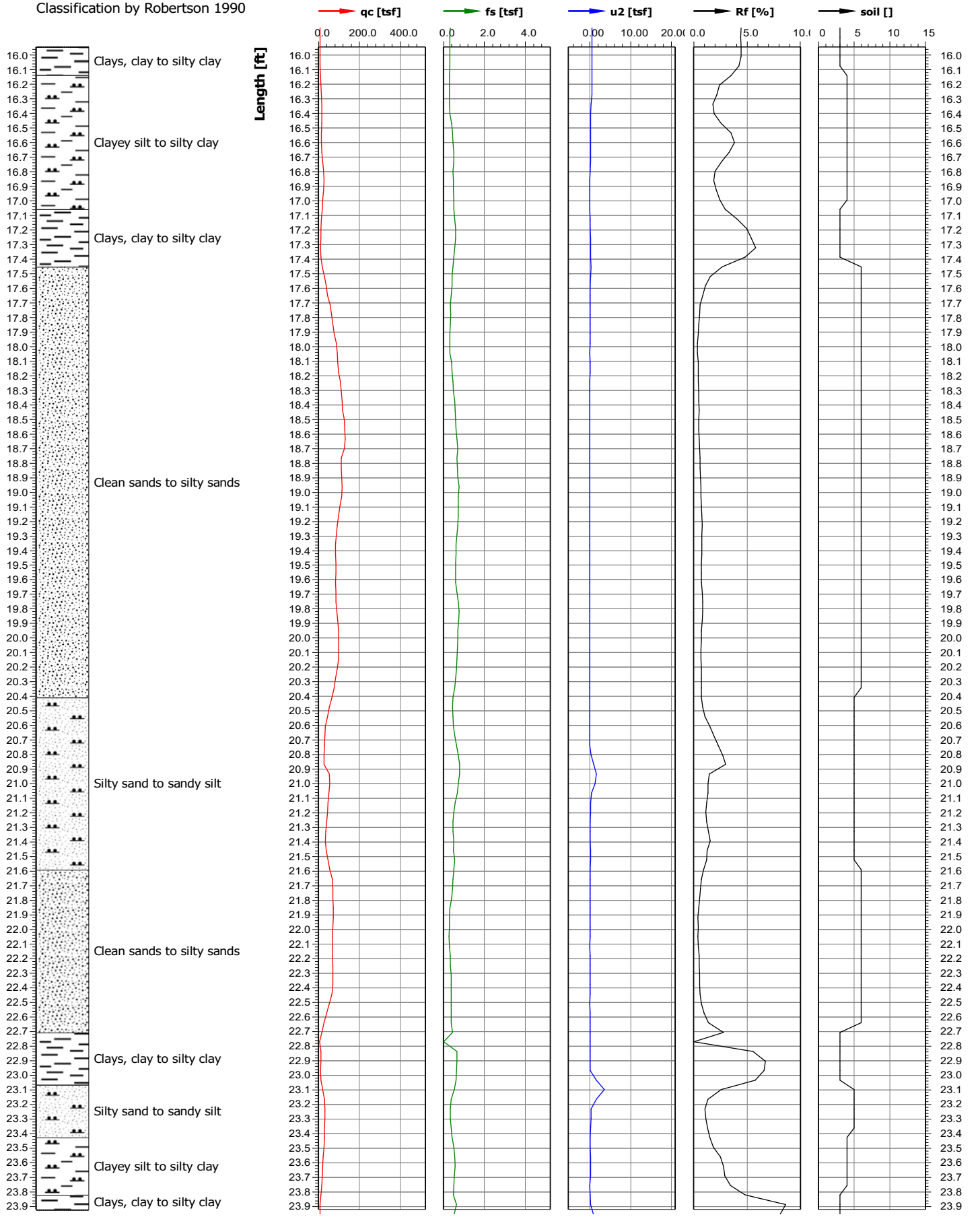
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



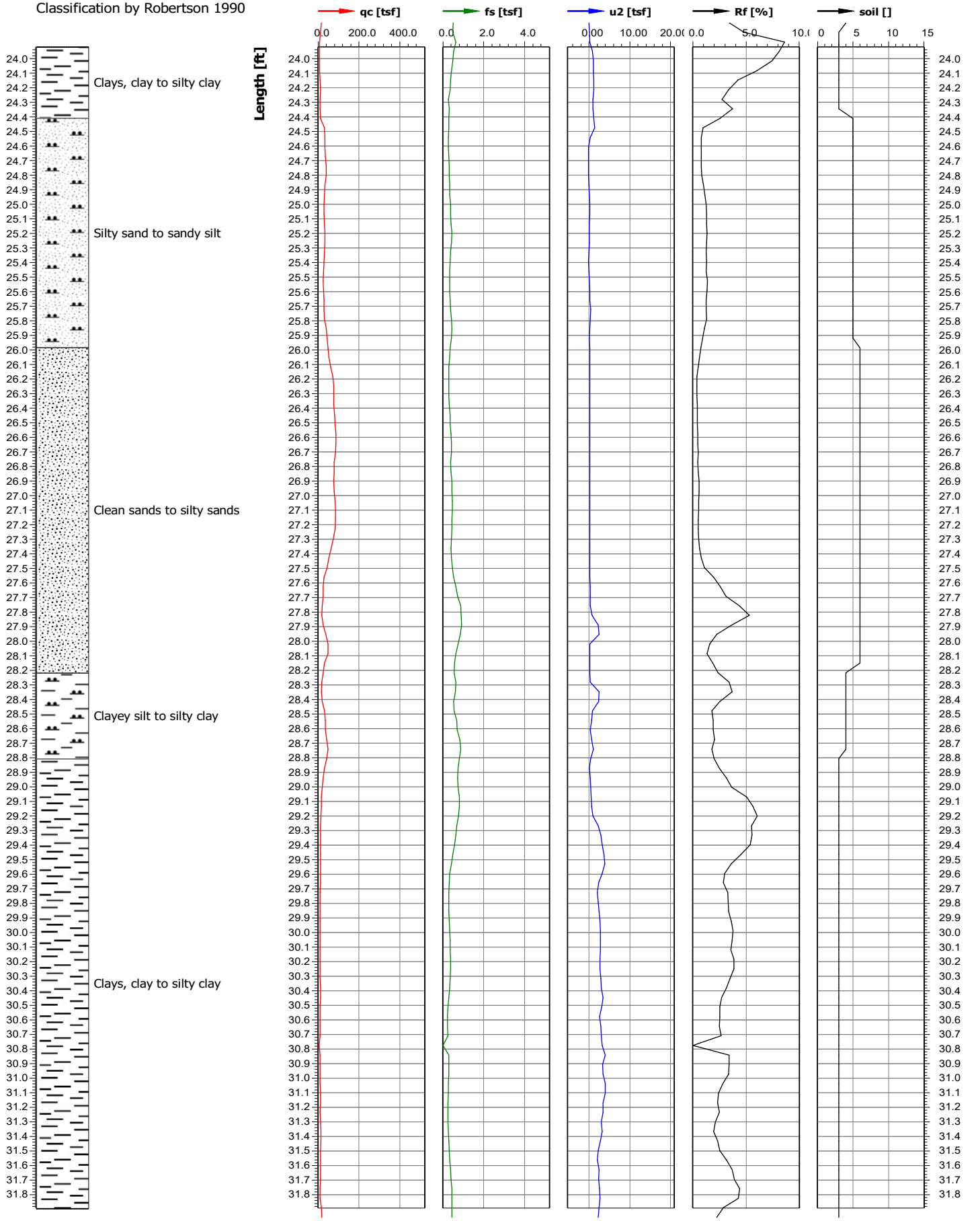
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



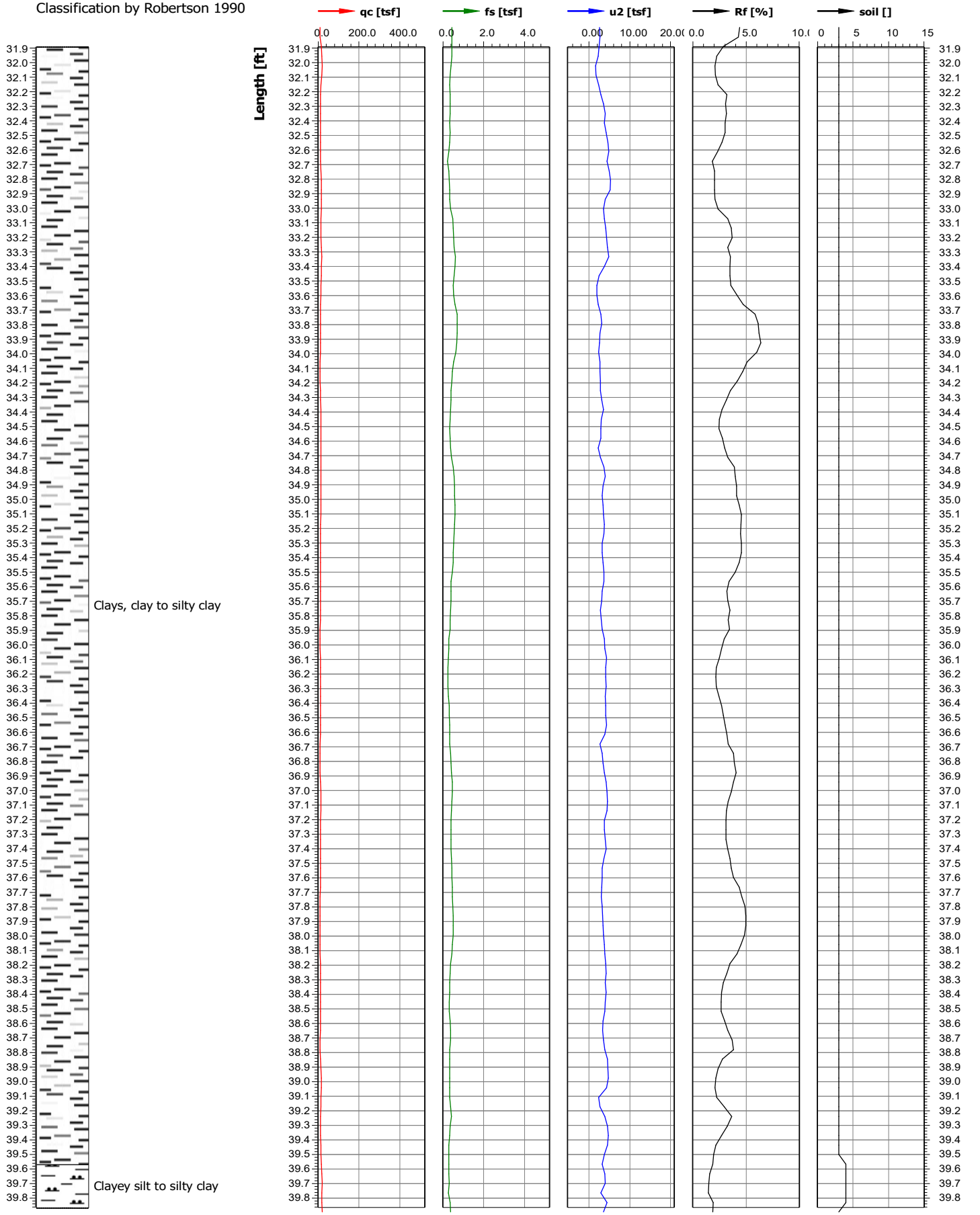
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



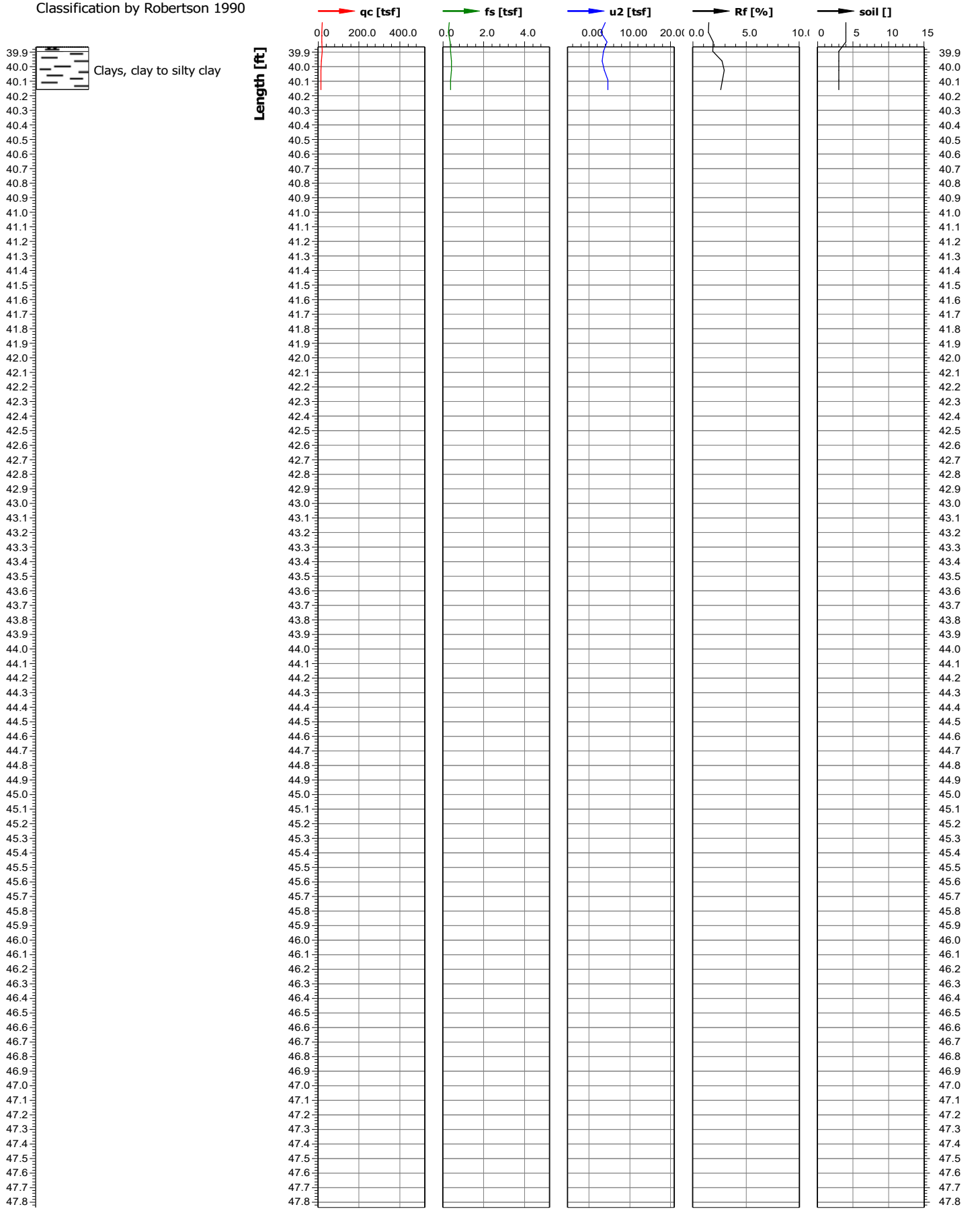
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



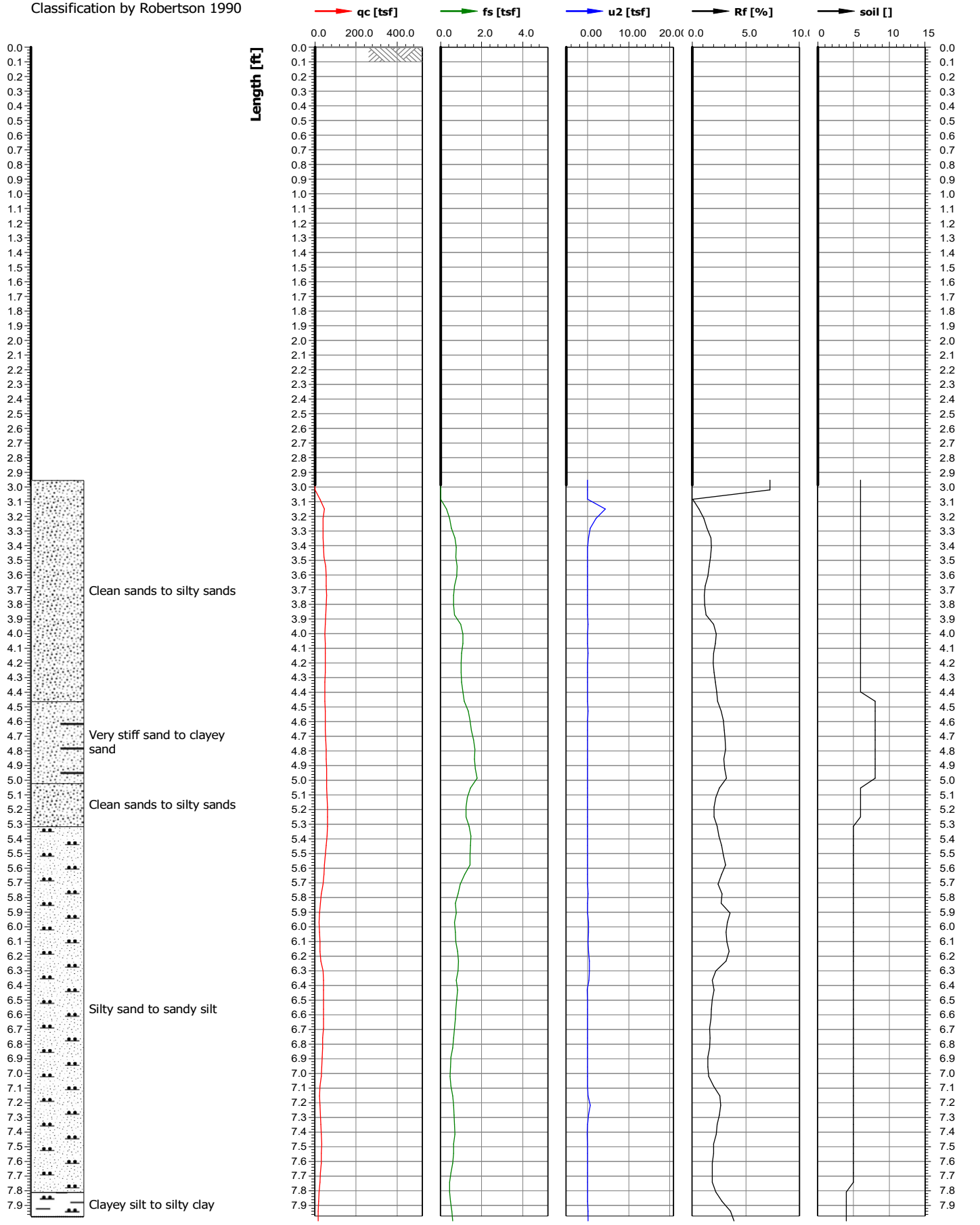
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP11	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		6/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



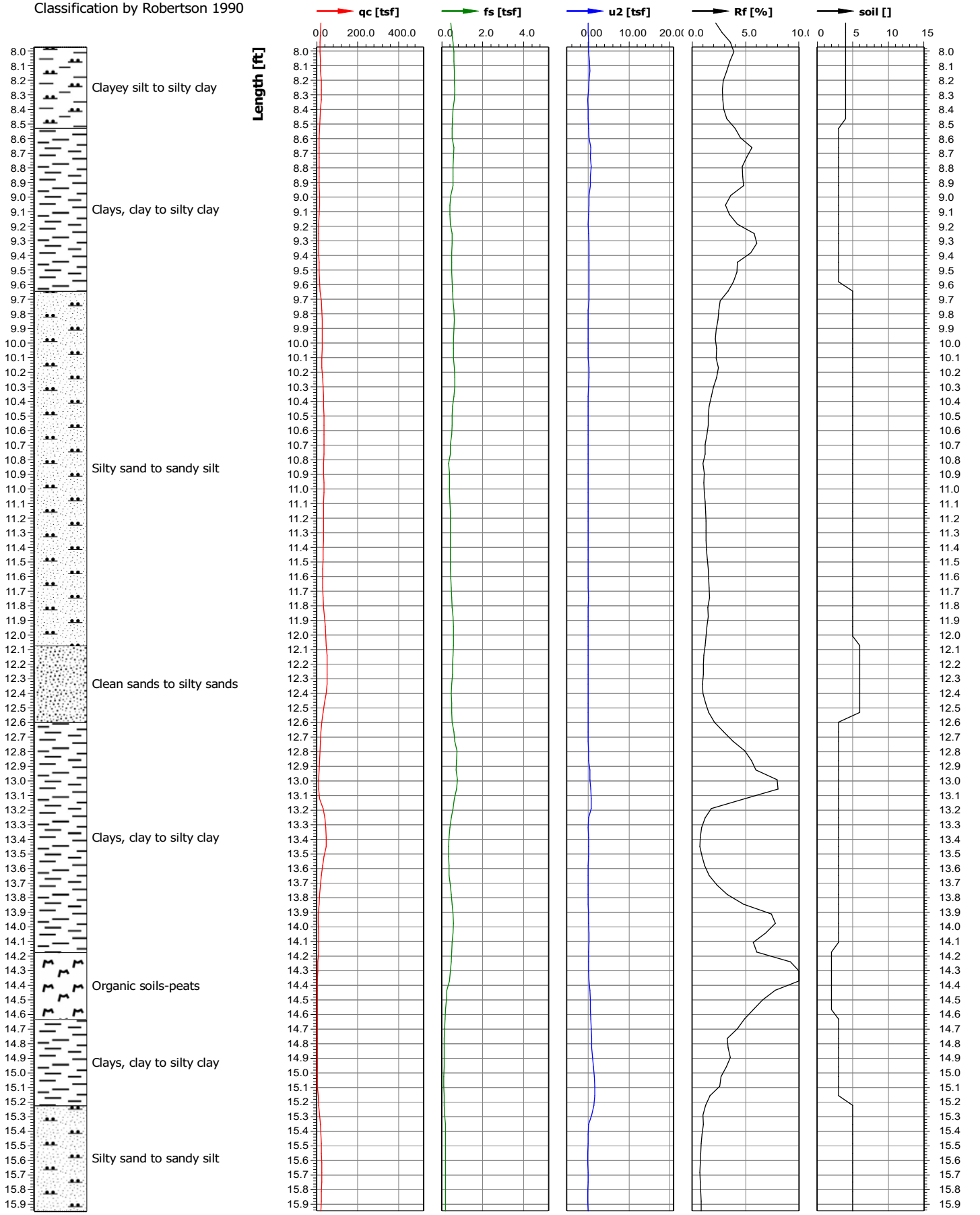
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		1/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



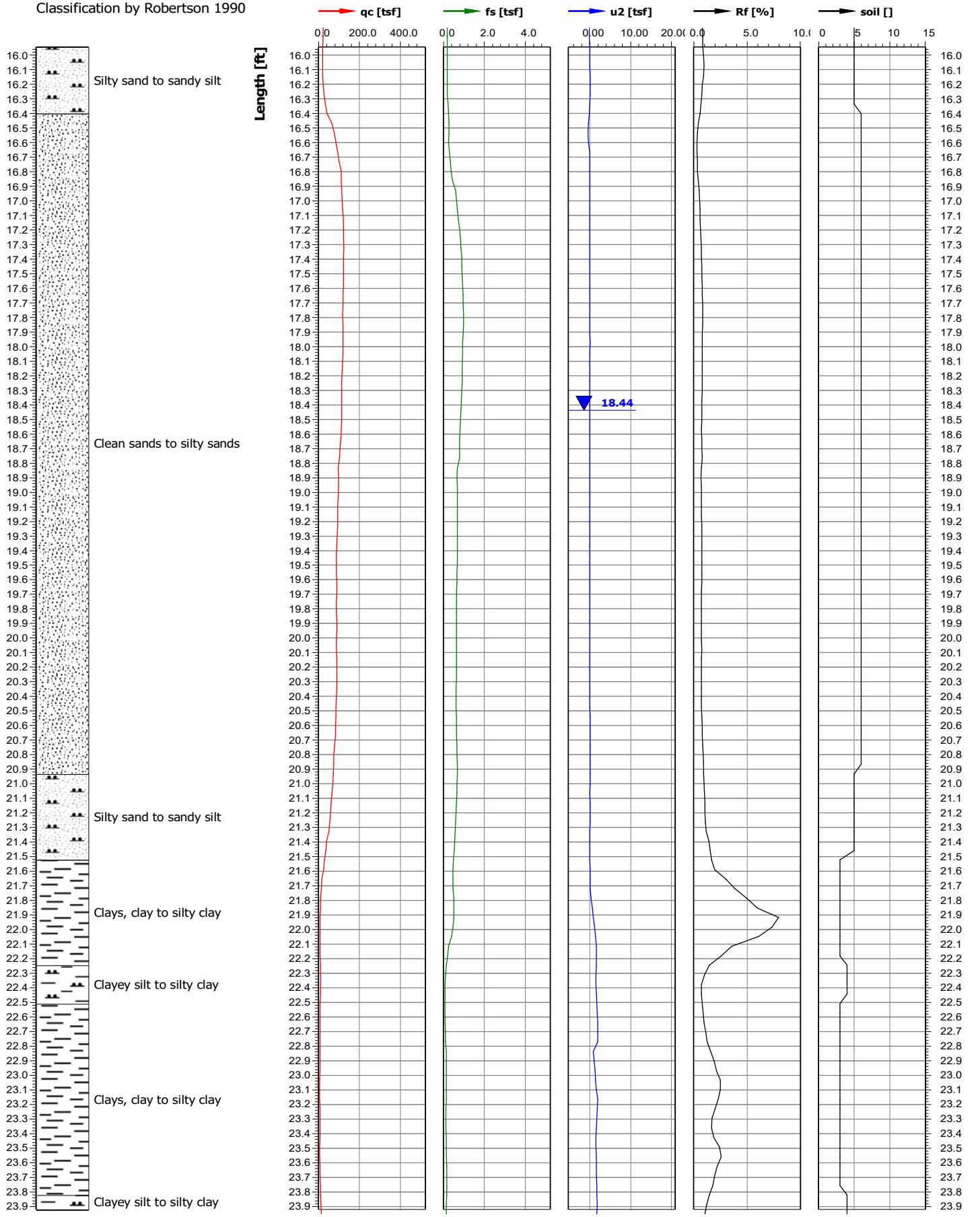
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		2/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



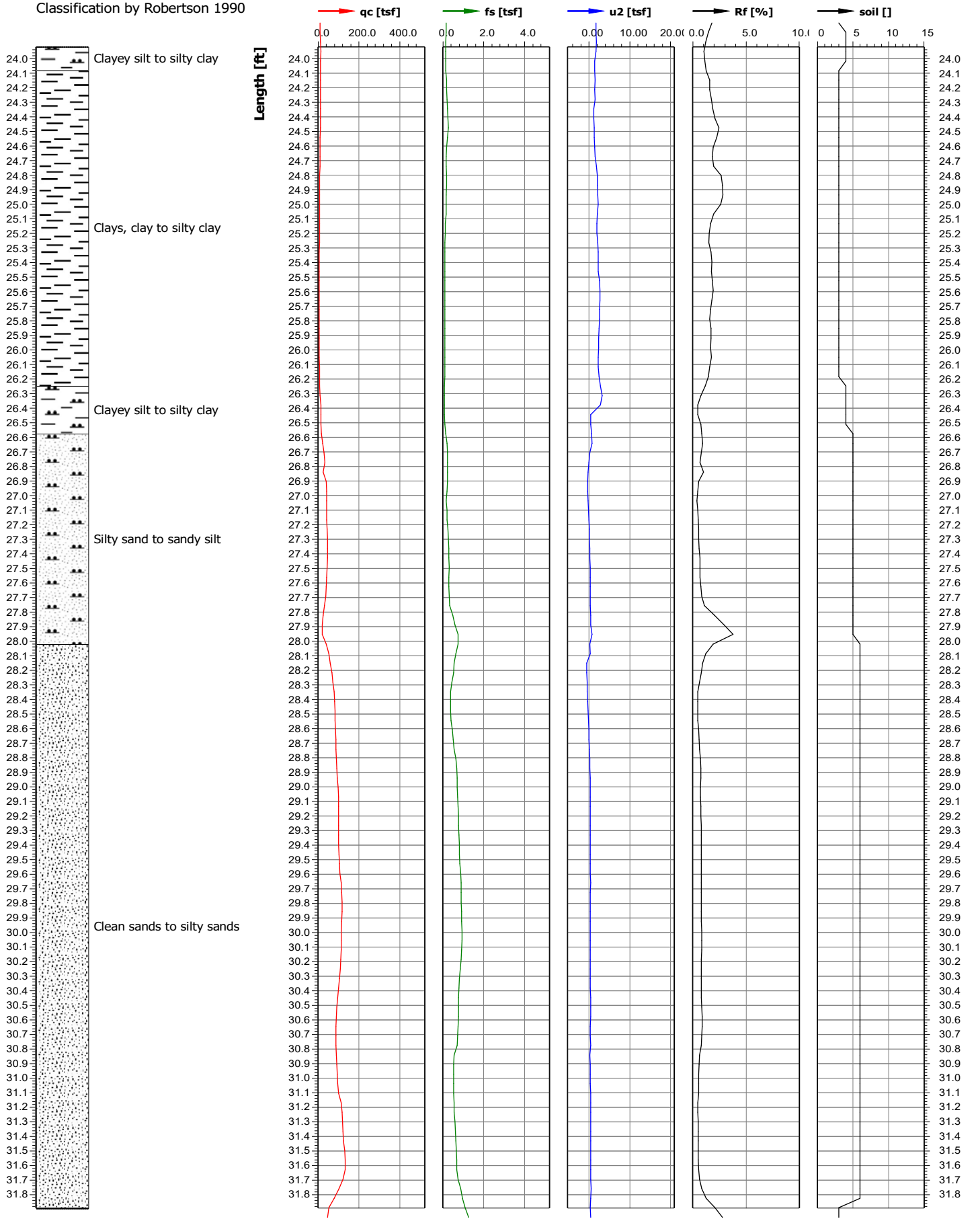
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		3/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



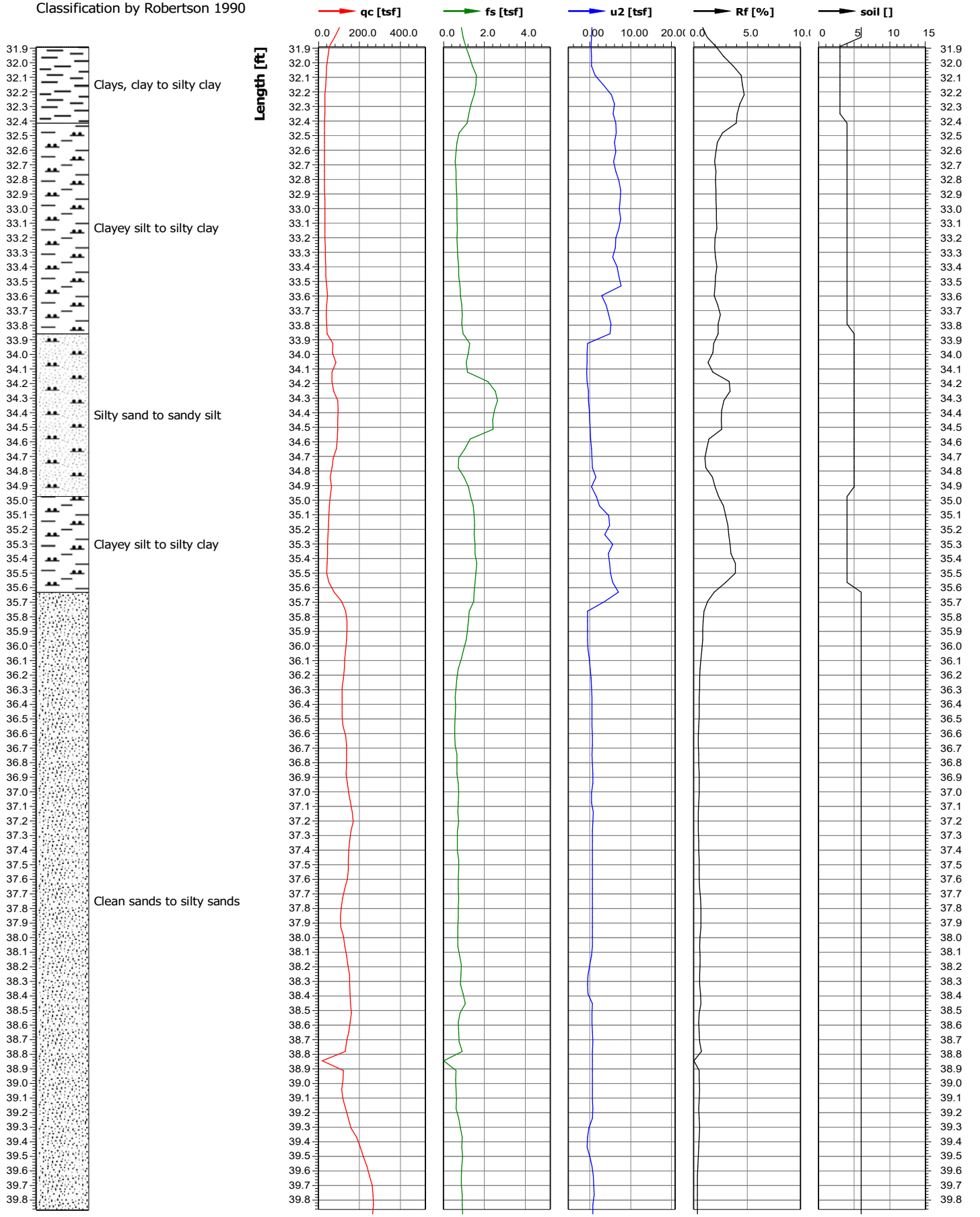
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		4/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



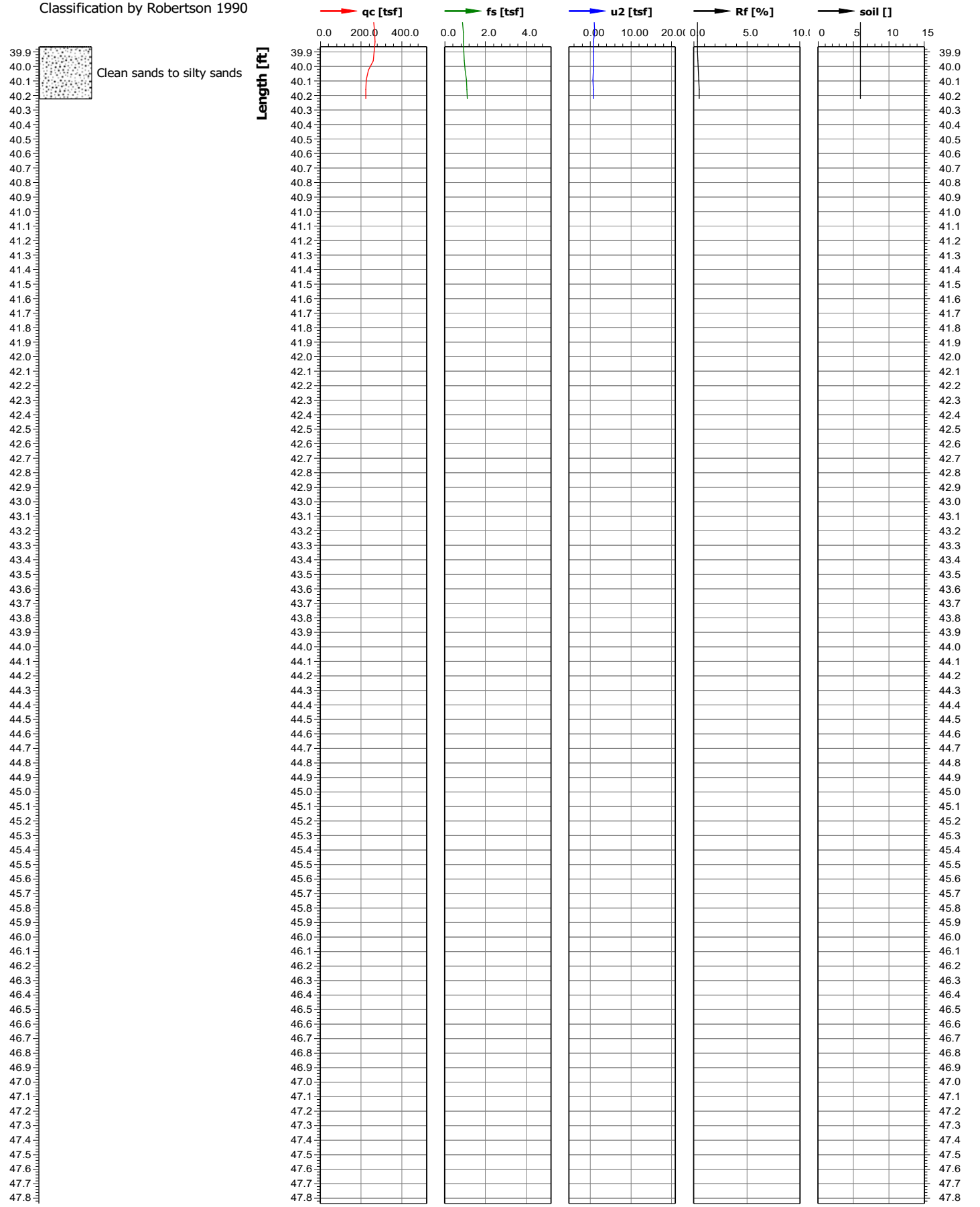
Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		5/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



Test location name	X coordinate [m]/Y coordinate [m]	Z value [ft]	Test name	Cone serial number
Knife River Indian Villages Historic Site	0.00/0.00	0.00	KN-FY21-CP12	
Project ID	Client	Investigation start ...	Standard/Standar...	Nominal surface area of...
KN-FY21-FY22	USACE - NPS	12/3/2021	/	10.0/150.0
Project name		Page	Scale	Net surface area quotie...
Knife River Elbee Bend Bank Stabilization		6/6	1:10	0.840/0.000
Remarks1		Coordinate system used		U
				u2

Classification by Robertson 1990



DRILLING LOG

DIVISION: Northwestern		INSTALLATION	Sheet 1 of 1
1. PROJECT: Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site		10. COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 613629.88 E: 1748769.83	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: KN-FY21-BH01	3. DRILLING AGENCY: NWO Drill Crew	11. DATE BORING: STARTED Dec 09 2021	COMPLETED Dec 09 2021
4. NAME OF DRILLER: Chris Miner		12. HAMMER TYPE	EFFICIENCY (%)
5. EQUIPMENT		13. SIZE AND TYPE OF BIT: 4.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING: 0	14. ELEVATION SURFACE: 1668.0'
			15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 4.5'			16. TOTAL NUMBER CORE BOXES
8. DEPTH DRILLED INTO ROCK			17. SIGNATURE AND TITLE OF INSPECTOR: Tyler Anderson, Geologist
9. TOTAL DEPTH OF BORING: 4.5'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
		2				POORLY GRADED SAND (SP) fine to medium, subrounded; brown, wet, loose, trace silt			
		2	4				87	D-1	
1663.5	4.50	2							
						Borehole finished at 4.5			

1663

DRILLING LOG

DIVISION: Northwestern		INSTALLATION	Sheet 1 of 1
1. PROJECT: Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site		10. COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 613517.45 E: 1748833.94	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: KN-FY21-BH03	3. DRILLING AGENCY: NWO Drill Crew	11. DATE BORING: STARTED Dec 09 2021	COMPLETED Dec 09 2021
4. NAME OF DRILLER: Chris Miner		12. HAMMER TYPE	EFFICIENCY (%)
5. EQUIPMENT		13. SIZE AND TYPE OF BIT: 4.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING: 0	14. ELEVATION SURFACE: 1674.0'
			15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 7.5'			16. TOTAL NUMBER CORE BOXES
8. DEPTH DRILLED INTO ROCK			17. SIGNATURE AND TITLE OF INSPECTOR: Tyler Anderson, Geologist
9. TOTAL DEPTH OF BORING: 7.5'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
1667.5	6.50	2	5			SANDY LEAN CLAY (CL) subrounded; grayish brown, moist, soft, little fine to medium sand, few silt	93	D-1	
1666.5	7.50	3 2				POORLY GRADED SAND (SP) subrounded; grayish brown, moist, soft, trace silt		D-2	
						Borehole finished at 7.5			

1669

DRILLING LOG

DIVISION: Northwestern		INSTALLATION	Sheet 1 of 1
1. PROJECT: Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site		10. COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 613327.94 E: 1748948.33	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: KN-FY21-BH04	3. DRILLING AGENCY: NWO Drill Crew	11. DATE BORING: STARTED Dec 09 2021	COMPLETED Dec 09 2021
4. NAME OF DRILLER: Chris Miner		12. HAMMER TYPE	EFFICIENCY (%)
5. EQUIPMENT		13. SIZE AND TYPE OF BIT: 4.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING: 0	14. ELEVATION SURFACE: 1663.0'
			15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 7.5'			16. TOTAL NUMBER CORE BOXES
8. DEPTH DRILLED INTO ROCK			17. SIGNATURE AND TITLE OF INSPECTOR: Tyler Anderson, Geologist
9. TOTAL DEPTH OF BORING: 7.5'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
		1				SILTY SAND (SM) fine to medium, subrounded; gray to black, moist, soft, little silt, possible organics		D-1	
1656.4	6.60	0	1			SANDY LEAN CLAY (CL-ML) black, moist, soft, possible organics	87	D-2	
		1							
1655.5	7.50					Borehole finished at 7.5			

1658

DRILLING LOG

DIVISION: Northwestern		INSTALLATION	Sheet 1 of 1
1. PROJECT: Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site		10. COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 613723.51 E: 1748904.62	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: KN-FY21-BH05	3. DRILLING AGENCY: NWO Drill Crew	11. DATE BORING	STARTED: Dec 09 2021 / COMPLETED: Dec 09 2021
4. NAME OF DRILLER: Chris Miner		12. HAMMER TYPE	EFFICIENCY (%)
5. EQUIPMENT		13. SIZE AND TYPE OF BIT: 4.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING: 0	14. ELEVATION SURFACE: 1664.0'
			15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 5.5'			16. TOTAL NUMBER CORE BOXES
8. DEPTH DRILLED INTO ROCK			17. SIGNATURE AND TITLE OF INSPECTOR: Tyler Anderson, Geologist
9. TOTAL DEPTH OF BORING: 5.5'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
		1	1			POORLY GRADED SAND (SM) fine to medium, subrounded; brown, moist, soft	73	D-1	
1659.4	4.60	0				LEAN CLAY (CL) gray, moist, soft, trace sand		D-2	1659
		1							
1658.5	5.50					Borehole finished at 5.5			

DRILLING LOG

DIVISION: Northwestern		INSTALLATION	Sheet 1 of 5
1. PROJECT: Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site		10. COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 613493.99 E: 1748592.12	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: KN-FY21-BH10	3. DRILLING AGENCY: NWO Drill Crew	11. DATE BORING	STARTED: Dec 08 2021 / COMPLETED: Dec 08 2021
4. NAME OF DRILLER: Chris Miner		12. HAMMER TYPE	EFFICIENCY (%)
5. EQUIPMENT		13. SIZE AND TYPE OF BIT: 4.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING: 0	14. ELEVATION SURFACE: 1688.0'
			15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 39.5'			16. TOTAL NUMBER CORE BOXES
8. DEPTH DRILLED INTO ROCK			17. SIGNATURE AND TITLE OF INSPECTOR: Tyler Anderson, Geologist
9. TOTAL DEPTH OF BORING: 39.5'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS

1683

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 2 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613493.99 E: 1748592.12	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
			0			LEAN CLAY (CL) brown to grayish brown, moist, little fine to medium sand, Iron staining, possibly Fat Clay (CH)	70	UD-1	
1678.0	10.00								

1678

1673

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 3 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613493.99 E: 1748592.12	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
			0			LEAN CLAY (CL) gray brownish gray, moist, trace fine sand, trace silt, possibly fat clay	70	UD-2	
1667.0	21.00								

1668

1663

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 4 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613493.99 E: 1748592.12	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS	
										1658
			0			SANDY LEAN CLAY (CL-ML) fine to medium, subrounded; gray, wet, organic material present, black specs lignite?	35	UD-3		1653
1652.0	36.00									

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 5 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613493.99 E: 1748592.12	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
		0				FAT CLAY (CH) gray, soft, trace fine sand, trace silt			
		0	3				93	D-1	
1648.5	39.50	3							
						Borehole finished at 39.5			

1648

1643

DRILLING LOG

DIVISION: Northwestern		INSTALLATION	Sheet 1 of 5
1. PROJECT: Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site		10. COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL: NAVD88
		LOCATION COORDINATES: N: 613857.86 E: 1748671.97	LOCATION METHOD: Handheld GPS
2. HOLE NUMBER: KN-FY21-BH11	3. DRILLING AGENCY: NWO Drill Crew	11. DATE BORING: STARTED Dec 07 2021	COMPLETED Dec 07 2021
4. NAME OF DRILLER: Chris Miner		12. HAMMER TYPE	EFFICIENCY (%)
5. EQUIPMENT		13. SIZE AND TYPE OF BIT: 4.25" HSA	
6. DIRECTION OF BORING: Vertical	DEG FROM VERTICAL:	BEARING: 0	14. ELEVATION SURFACE: 1688.0'
			15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN: 46.5'			16. TOTAL NUMBER CORE BOXES
8. DEPTH DRILLED INTO ROCK			17. SIGNATURE AND TITLE OF INSPECTOR: Tyler Anderson, Geologist
9. TOTAL DEPTH OF BORING: 46.5'			

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
						LEAN CLAY (CL) brown to grayish brown, few fine sand, possible iron staining			

1683

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 2 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613857.86 E: 1748671.97	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
			0			LEAN CLAY (CL) brown to grayish brown, few fine sand, possible iron staining	95	UD-1	
1679.0	9.00								
						LEAN CLAY (CL) brown to gray, moist, fine to medium sand lenses in bottom of shelby mixed with clay	85	UD-2	
			0						
1672.0	16.00								

1678

1673

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 3 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613857.86 E: 1748671.97	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
1669.0	19.00		0			POORLY GRADED SAND (SP) subrounded; yellowish brown, moist	200	UD-3	

1668

1663

(continued on next page)

DRILLING LOG (Cont Sheet)

INSTALLATION		Sheet 4 of 5
PROJECT Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	COORDINATE SYSTEM NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	VERTICAL NAVD88
	LOCATION COORDINATES N: 613857.86 E: 1748671.97	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS

1658

1653

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DRILLING LOG (Cont Sheet)

INSTALLATION	Sheet 5 of 5

PROJECT	COORDINATE SYSTEM	VERTICAL
Elbee Bend Bank Stabilization Knife River Indian Villages Historical Site	NAD 1983 StatePlane North Dakota South FIPS 3302 Feet	NAVD88
	LOCATION COORDINATES N: 613857.86 E: 1748671.97	LOCATION METHOD: Handheld GPS

ELEV	DEPTH	BLOWS/ 0.5ft	N	N60	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	REMARKS
									1648
									1643
		0				FAT CLAY (CH) subrounded; gray, moist, soft, trace coarse sand, possible organics			
		4	10				133	D-1	
		6							
1641.5	46.50								
						Borehole finished at 46.5			