Morphologic Map Unit Properties Table: Knife River Indian Villages National Historic Site

Gray-shaded map units are not mapped within Knife River Indian Villages National Historic Site.

Age	Map Unit (Symbol)	Geologic Description	Geologic Features and Processes	Geologic Resource Management Issues	Geologic History
		Bedrock surface (without terraces) mantled with a thin layer of Paleocene sediments, till, and loess. Rolling hills with generally less than 15° slopes interspersed with closed depressions and sloughs. The 600-m (2,000-ft) contour marks the lower contact with **Qtr** or **Qsl**.	Rolling hills, closed depressions, and till.	None reported.	**The Past 12 Thousand Years (Cenozoic Era): Holocene Thaw**—This region above the Missouri River and Knife River valleys is north of the historic site and records the effects of erosion on the topography carved from the last Pleistocene ice age.
	Slopes (Qsl)	Breaks between terraces or between the uplands and the highest terrace present. Includes rugged badlands (15°–90° slopes) cut into Paleocene sediments and smooth breaks between fluvial terraces (< 10° slopes). Most slopes are at least partially covered with colluvium.	Rugged badlands; smooth breaks in slopes.	**Slope Movement**—Steep slopes may be subject to sheetwash. Potential slope failure.	**The Past 12 Thousand Years (Cenozoic Era): Holocene Thaw**—The age of the slopes is variable, but they are younger than the terrace immediately above them.
		Areas altered by anthropogenic activities such as construction and coal mining. Includes unfilled pits, spoil piles, and reclaimed land associated with coal mining.	None reported.	**Impacts Resulting from the Garrison Dam**—Includes areas disturbed during the construction of Garrison Dam. **Disturbed Land**—Mandans and Hidatsas cultivated much of the area, which was seeded with perennial grass prior to NPS ownership.	**The Past 12 Thousand Years (Cenozoic Era): Holocene Thaw**—Recent construction activities. Not mapped within the historic site at the scale of the enclosed GIS map.
	B terrace (Qtb)	Current terrace forming adjacent to the Knife and Missouri rivers. A composite of two, relatively flat terraces (**B1** and **B2**) up to 6 m (20 ft) above the Knife and Missouri rivers at elevations from 509–520 m (1,670–1,710 ft). Floodplain sand dunes, partially filled channels, and the present channel cause up to 6 m (20 ft) of relief. **B2 terrace**. Light-colored lower unit of pale-brown to very light brown, silty sand, which contains vertical iron stains, iron-stained siltstone nodules, and carbonate nodules. **B1 terrace**. Light-colored, sandy, upper part overlying 1–3 m (3–10 ft) of dark colored silty clay, which contains carbonate nodules. Darker colors are the result of soil development.	**Terraces as Landscape Features**—Meander scars are easily identifiable from the air. **B2 terrace:** Surface ranges up to 5 m (16 ft) above river level and includes the modern floodplain. The terrace fill is inset into either **Qta** or **B1**. Outcrop characteristics are similar to **Qta**. Contains climbing ripple cross-beds, small-scale cross-beds, flat beds, and convoluted beds. **B1 terrace:** Relatively flat surface from 4–6 m (13–20 ft) above river level. Uncomformably overlies **Qta**. **Paleontological Resources**—**B2 terrace** contains terrestrial and aquatic gastropod shells, bivalve shells, large mammal bones, wood, and charcoal. Fossils used as cultural artifacts may be found. Dark-gray silty clay of **B1 terrace** contains bones of large mammals, unidentified organic material, terrestrial gastropods, and thin bands of charcoal.	**Impacts Resulting from the Garrison Dam**—Narrow active channel is confined between banks of **Qo7**, which forms **Qtb**. **Flooding on the Knife River**—Inundation due to overbank flooding caused by ice jams, rapid ice melt, and/or seasonal flood events. **Bank Erosion on the Knife River**—Erosion caused by ice gouging, precipitation, Missouri River backflow, and lateral migration of the channel. **Impacts of Bank Erosion on Archeological Sites and Infrastructure**—Erosion threatens archeological sites (Elbee and Taylor bends) and Mercer County Road 18 (Taylor Bend), the Two River hiking trail (Loop Bend), and the historic site boundary (Noname Bend). **Paleontological Resource Inventory and Monitoring**—Field-based, park-specific survey, inventory, and identification of fossils in museum collection should be considered. Combined archeological and paleontological projects will collect fossils with little disturbance to cultural material.	**The Past 12 Thousand Years (Cenozoic Era): Holocene Thaw**—**B2 terrace** began forming approximately 500 years BP when the climate began fluctuating between cool, moist conditions and warm, dry conditions. **B1 terrace** began forming about 2,500 years BP in a warm, dry climate. Vegetation density decreased and hillslopes became less stable. Flooding and lateral erosion resulted in overbank (vertical accretion) and point bar (lateral accretion) deposits.

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Age	Map Unit (Symbol)	Geologic Description	Geologic Features and Processes	Geologic Resource Management Issues	Geologic History
QUATERNARY (Holocene)	A terrace (Qta)	Fill terrace found between the 515-m (1,690-ft) and 522-m (1,710-ft) contours, 6–8 m (20–26 ft) above river level. Restricted to the Knife River valley. Divided into lower and upper units. *Upper unit*. Pale-brown, clayey silt and dark-grayish-brown silty clay containing several paleosols. Capped by up to 1 m (3.3 ft) of grayish-brown loess. Vertical accretion deposits that accumulated as sediments settled out of overbank flood waters. *Lower unit*. Light-brown to gray, fine- to medium-grained, silty sand and clay. Sand, which can be > 5 m (16 ft) thick, mostly accumulated by lateral accretion in point bars.	**Terraces as Landscape Features**—Identified by its elevation limits, escarpments between upper and lower units, characteristic stratigraphy of each unit, and lack of meander scars on the surface. *Upper unit*. No distinct bedding. Contains discontinuous layers of charcoal, terrestrial gastropods, carbonate nodules, bones of large mammals, and artifacts. The dark-colored bands (paleosols) contain disseminated organic materials. *Lower unit*. High- and low-angle, small-scale cross-beds, climbing ripple cross-beds, and horizontal beds. **Paleontological Resources**—Fossils used as cultural artifacts may be found in **Qta**. *Upper unit*. Terrestrial gastropods, bones of large mammals, discontinuous charcoal layers, and disseminated organic material.	**Flooding on the Knife River**—Potential inundation due to overbank flooding caused by ice jams, rapid ice melt, and/or seasonal flood events. **Bank Erosion on the Knife River**—Potential erosion caused by ice gouging, precipitation, Missouri River backflow, and lateral migration of the channel. **Impacts of Bank Erosion on Archeological Sites and Infrastructure**—Erosion threatens archeological sites (Elbee and Taylor bends) and Mercer County Road 18 (Taylor Bend), which are in the area of **Qta**. **Paleontological Resource Inventory and Monitoring**—Field-based, park-specific survey, inventory, and identification of fossils in museum collection should be considered. Combined archeological and paleontological projects will collect fossils with little disturbance to cultural material. **Slope Movement**—Reworked by slopewash.	**The Past 12 Thousand Years (Cenozoic Era): Holocene Thaw**—The upper part of **Qta** formed from about 4,500 to 2,500 years BP in a cool, moist climate that increased vegetation density, stabilized hillslopes, and caused the Knife River to have a meandering channel pattern. Overbank deposits predominate. Floodplain forest fires produced charcoal layers. Radiocarbon dates from charcoal range from 3,900 years BP to 2,900 years BP. The lower part of **Qta** began forming about 8,500 years BP when a warm, dry climate decreased vegetation density, allowing more sediment to erode into the Knife River. Decreased precipitation, lower water levels, and an increase in sediment load led to lateral accretion (point bars) and aggradation. Without the stabilizing effect of vegetation, sand dunes became active.
QUATERNARY (Pleistocene)	Sakakawea Terrace (Qtsa)	Named after Lake Sakakawea because it forms a level surface at about the same elevation (560–570 m [1,840–1,870 ft]) as the maximum pool level of the lake. Stratigraphy similar to **Qtr**.	**Terraces as Landscape Features**—Cut terrace 51–61 m (170–200 ft) above river level with slopes of < 5°. Flat to gently undulating, well-drained surface.	Not mapped in the historic site.	**From 2 Million to 12 Thousand Years Ago (Cenozoic Era): Pleistocene Deep Freeze**—This pre-Wisconsinan former river floodplain was modified by glacial deposition and stream and slopewash erosion. Younger than **Qtr** and older than lower elevation terraces.
	Riverdale Terrace (Qtr)	Highest terrace mapped in the vicinity of the historic site. Cut terrace at elevations between 579–600 m (1,900–1,970 ft), which is 67–90 m (220–290 ft) above river level. Typically consists of Paleocene fluvial sediment overlain by 1 m (3.3 ft) of gravel, which is overlain by 1–2 m (3.3–6.6 ft) of till. Capped by < 1 m (3.3 ft) of loess.	**Terraces as Landscape Features**—Flat to gently undulating, well-drained surface with slopes of <5°. Less relief, better drainages, and more surface and near-surface fluvial sand and gravel than **Qup**. An arbitrary upper limit of the 600-m (2,000-ft) contour marks the highest contact between **Qtr** and **Qup**. Identified by elevation. Slopes generally form escarpments between terraces.	Not mapped in the historic site.	**From 2 Million to 12 Thousand Years Ago (Cenozoic Era): Pleistocene Deep Freeze**—The oldest terrace identified in the area, **Qtr** is probably pre-Wisconsinan and post-Pliocene. Vertical incision transformed this former fluvial floodplain into a terrace. Subsequent deposition of till and erosion by streams and slope wash modified the original terrace surface, making **Qtr** more difficult to identify than the lower terraces.
	Stanton Terrace (Qtst)	Lowest Pleistocene terrace identified in the area. Fill terrace between elevations of 517–524 m (1,700–1,720 ft). It is 8–15 m (26–49 ft) above river level. Composed of more than 2 m (6.6 ft) of poorly sorted, flat-bedded to massive sand and gravel and capped by up to 5 m (16 ft) of aeolian silt or sand that grades into and is interbedded with overbank silt and clay near tributaries. Where the surface is overlain by deposits of younger alluvial silt and clay, **Qtst** is difficult to differentiate from **Qta**.	**Features that Connect Geology and Archeology**—Flat surface provided locations for the Hidatsa villages in the historic site. **Terraces as Landscape Features**—Identified by its elevation limits and flat, well-drained surface with slopes < 5°. Tributary terraces grading into **Qtst** commonly have steeper slopes and extend to higher elevation.	**Bank Erosion on the Knife River**—Potential erosion caused by ice gouging, precipitation, Missouri River backflow, and lateral migration of the channel. **Slope Movement**—Potential slope movement due to bluff collapse.	**From 2 Million to 12 Thousand Years Ago (Cenozoic Era): Pleistocene Deep Freeze**—**Qtst** formed as the last glacier was retreating from North Dakota, from 13,000 to 8,500 years BP. The climate was cool and moist, allowing vegetation density to increase and hillslopes to become more stable. Forests were replaced by grasslands about 10,000 years BP.
	Hensler Terrace (Qth)	Fill terrace 527–542 m (1,730–1,780 ft) above sea level and between 17–31 m (56–100 ft) above river level. Composed of up to 16 m (52 ft) of fluvial sand and gravel and capped by up to 10 m (33 ft) of aeolian sand or up to 5 m (16 ft) of loess.	**Terraces as Landscape Features**—Flat, gently undulating, well-drained surface with slopes < 5°. Identified by its relatively flat surface between specific elevation limits.	**Slope Movement**—Potential slope movement due to bluff collapse.	**From 2 Million to 12 Thousand Years Ago (Cenozoic Era): Pleistocene Deep Freeze**—**Qth** formed at two different times. The original **Qth** floodplain formed during late Wisconsinan time, but the terrace was drowned when glacial Lake McKenzie formed. When the ice dam breached and Lake McKenzie drained, the river returned to approximately the original **Qth** surface.
	McKenzie Terrace (Qtm)	Mean elevation of 548 m (1,800 ft). Parts of this terrace are present between 33–42 m (110–140 ft) above river level. Surface is preserved either as a terrace cut into Paleocene sediments or till, or as a fill terrace underlain by sand or gravel. Much of the surface is overlain by up to 10 m (33 ft) of aeolian sand or up to 5 m (16 ft) of loess.	**Terraces as Landscape Features**—Flat to gently sloping, well-drained surface with slopes < 5°. **Qtm** was once the shore of glacial Lake McKenzie. About 500 m (1,600 ft) north of the historic site, the terrace is composed of 2 m (6.6 ft) of large-scale, high-angle, cross-bedded gravel, which are backbeach (backshore) deposits. Identified by its flat surface within its specific elevation limits.	**Slope Movement**—Potential slope movement due to bluff collapse.	**From 2 Million to 12 Thousand Years Ago (Cenozoic Era): Pleistocene Deep Freeze**—Glacial Lake McKenzie filled during the late Wisconsinan glaciation and occupied parts of south-central North Dakota east of the present location of Bismarck, near the town of McKenzie. Lake silts indicate a minimum lake level of 533 m (1,750 ft) above sea level. The cross-bedded gravels within **Qtm** are backbeach (backshore) deposits.

Based on Reiten (1983). Pleistocene terraces are listed in the order they appear in the knri_geology.pdf (see GRI GIS data) and on the geomorphic map. Terraces are not listed in chronological order.