R. 20 W. R. 19 W. R. 19 W. R. 18 W. R. 18 W. R. 17 W.

T. 41 N.

T. 40 N.

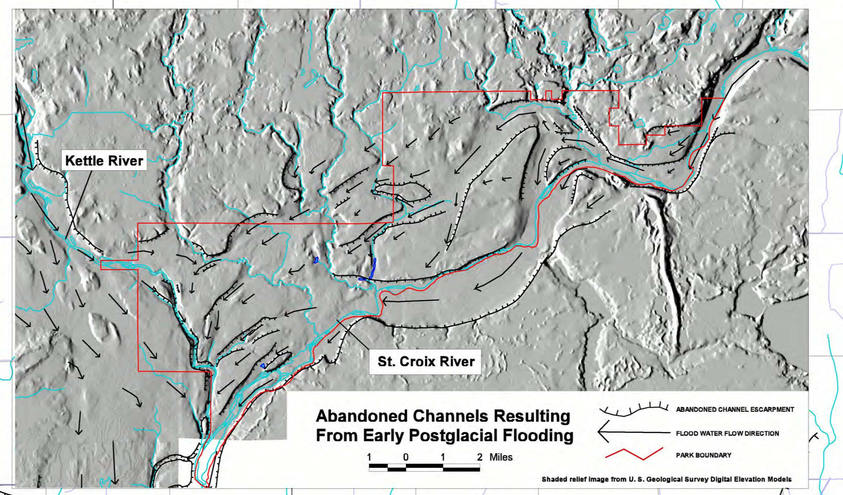
T. 40 N.

T. 39 N.

R. 20 W. R. 19 W. R. 18 W. R. 18 W.

T. 41 N.

T. 40 N.



Abandoned Channels Resulting From Early Postglacial Flooding

1 0 1 2 Miles

ABANDONED CHANNEL ESCARPMENT

FLOOD WATER FLOW DIRECTION

PARK BOUNDARY

Shaded relief image from U. S. Geological Survey Digital Elevation Models

"High Banks"

Surficial Geology of St. Croix State Park

By
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1997

DESCRIPTION OF MAP UNITS

HOLOCENE (POST ICE AGE)

LAKES AND STREAMS

ORGANIC DEPOSITS: Peat and organic rich soils; commonly filling abandoned stream channels.

ALLUVIUM: Silty clay to fine sand containing variable amounts of organic material, silty sand, sand and sandy pebble-gravel.

CHANNEL BAR DEPOSITS: An elongate deposit of alluvium located in or along the course of a river.

POINT BAR DEPOSITS (meander scroll): A series of low, arcuate ridges of alluvium deposited on the inside of a growing meander loop; delineates the migration of the channel towards the outer bank (arcuate ridges best observed on airphotos).

ALLUVIUM MANTLED DEPOSITS: Alluvium deposited over bedrock, till or earlier fluvial deposits.

PLEISTOCENE (ICE AGE) DEPOSITS - LATE WISCONSINAN

Deposits Modified by Flood Waters from Glacial Lake Duluth, or Glacial Lakes Koochiching, Upham and Aitkin

BOULDER STREWN TERRACE: Boulder strewn terraces; interpreted to be abandoned channel floors that formed during catastrophic flooding from Glacial Lake Duluth, or Glacial Lakes Koochiching, Upham and Aitkin.

CHANNEL SIDE BOULDER LAG DEPOSITS: An accumulation of boulders produced by the eroding action of past floods that transported the finer materials away. The larger boulder lag areas are located near abandoned channel escarpments. Boulder lag areas too small to map were also observed in both map units of the Flood Scoured Outwash and Fluvial Deposits (large abandoned channels, and numerous small abandoned channels).

FLOOD SCOURED OUTWASH AND FLUVIAL DEPOSITS WITH LARGE ABANDONED CHANNELS: Sand, gravelly sand, and bouldery, cobbly gravel; often silty; moderate to poorly sorted, locally well sorted. Clasts are primarily of Superior lobe provenance. Deposit thickness varies greatly; poorly exposed Superior lobe till is locally observed within this unit (generally mantled by a thin veneer of sand to cobbly gravel, or boulder lag). Contains local boulder lag areas that are too small to map separately. The land surface is generally level to gently rolling, but includes large abandoned channels with steep escarpments. The abandoned channels appear to be cut into an older outwash plain, this suggests that the flooding from Glacial Lakes Duluth, Koochiching, Upham and Aitkin (which created the channels) was primarily an erosional event. The map unit contains preflood deposits that were scoured during the flooding and fluvial deposits associated with the actual flooding.

FLOOD SCOURED SANDY OUTWASH: Large areas primarily consisting of sand with minor mounts of fine to medium gravel; moderate to well sorted. The land surface is generally level to gently sloping; this map unit is commonly seperated from other units by a steep escarpment.

FLOOD SCOURED OUTWASH AND FLUVIAL DEPOSITS WITH NUMEROUS SMALL ABANDONED CHANNELS: Sand, gravelly sand, and bouldery, cobbly gravel: often silty; moderate to poorly sorted, locally well sorted. Clasts are primarily of Superior lobe provenance. Deposit thickness varies greatly; poorly exposed Superior lobe till is locally observed within this unit (generally mantled by a thin veneer of sand to cobbly gravel, or boulder lag). Contains local areas of boulder lag too small to map separately. This unit differs from the previous unit (Flood Scoured Outwash and Fluvial Deposits With Large Abandoned Channels) in that it does not contain extensive areas of sandy outwash and it exhibits a different topographic character. The land surface is generally level to gently rolling, and contains numerous small abandoned channels (commonly peat filled), and generally lacks large abandoned channels with steep escarpments.

ESKER AND KAME-LIKE LANDFORMS: Sand and gravel, ranging from silty sand to sandy pebble-gravel with cobbles; The steep sided, elongate ridges may represent eskers (deposits left by past streams that flowed through tunnels or open channels within the glacier ice). A small conical shaped hill (possibly a kame) is located just to the south of the esker-like ridges. A small depression on top of the hill may represent where a small block of ice had melted out. It is also possible that these landforms may have been shaped when Glacial Lake Duluth overflowed it's basin, sending tremendous amounts of flood water down the St. Croix valley.

FLOOD SCOURED ICE-STAGNATION MORAINE: Supraglacial sediments (materials deposited at the upper surface of the glacier) associated with ice stagnation of the Superior lobe; composed primarily of red, sandy till with numerous cobbles and boulders. The land surface is a small, somewhat circlar hill. A concentration of boulders at the top of the hill may be the result of flood waters carrying away the finer grained materials. A small, peat filled kettle is located near the crest of this hill. The lower slopes of the hillside are mantled by poorly sorted, silty sand containing scattered pebbles and cobbles.

FLOOD SCOURED SUPERIOR LOBE TILL: Reddish brown, unsorted sediment; primarily sandy loam in texture with varying amounts of pebbles, cobbles and boulders. Poorly exposed at the surface, where observed it is generally mantled by a thin veneer of sand to cobbly gravel, or boulder lag. Thinly mantled exposures of till are present in both map units of Flood Scoured Outwash and Fluvial Deposits (large abandoned channels, and small numerous abandoned channels). Due to it's limited surface expression only a small exposure along the east bank of the Kettle River near the south end of "High Banks" was mapped.

STREAMLINED EROSIONAL LANDFORMS: Streamlined landforms found within the Kettle River spillway; the landforms were probably shaped during catastrophic flooding from Glacial Lakes Koochiching, Upham and Aitkin (these landforms are outside of the park).

VARVED LAKE CLAYS: Lacustrine sediments of Glacial Lake Lind; consisting of alternating layers of red clay and brown silty clay presumably deposited in seasonal pairs (varves). Glacial lake varves represent seasonally deposited sediment which normally include a coarser-grained "summer layer" (brown silty clay) and a finer-grained "winter layer" (red clay). The exposures of varved lacustrine sediments are overlain by a thick sand deposit and are exposed where flowing springs occur along the banks of the St. Croix River.

Deposits Minimumly Effected by Flood Waters From Glacial Lakes Duluth, Koochiching, Upham and Aitkin

OUTWASH (SILT MANTLED): Primarily sand with lesser amounts of gravel, ranging from silty, fine sand to sandy pebble-gravel; generally moderate to well sorted. Deposited by meltwater streams flowing from the Superior lobe. A silt mantle of approximately six inches to three feet covers this deposit. The exact origin of the silt mantle is difficult to determine. It may have possibly been deposited as wind blown sediments (loess), or as silts from Glacial Lake Grantsburg, or as silts from overbank flooding when Glacial Lake Duluth drained.

PITTED OUTWASH (SILT MANTLED): Primarily sand with lesser amounts of gravel, ranging from silty, fine sand to sandy pebble-gravel; generally moderate to well sorted. Deposited by meltwater streams flowing from the Superior lobe across areas containing small detached blocks of glacial ice. When the ice blocks melted the overlying sediments collapsed into the areas once occupied by the ice, resulting in a pitted appearance to the outwash plain. The land surface is gently sloping with scattered small depressions or pits (best observed on airphotos). A silt mantle of approximately six inches to three feet covers this deposit.

COLLAPSED OUTWASH: Sand and gravel, ranging from silty, fine sand to sandy pebble-gravel; moderate to well sorted. Deposited by meltwater steams flowing from the Superior lobe across areas containing large detached blocks of glacial ice. When the ice blocks melted the overlying sediments collapsed into the areas once occupied by the ice. The land surface is characterized as hummocky.

ICE-CONTACT SAND AND GRAVEL DEPOSITS: Sandy pebble-gravel with numerous cobbles and boulders; poorly sorted. Deposited in contact with glacial ice of the Superior lobe. Melting of the supporting ice resulted in slumping and collapse of sediments. The land surface very hummocky. This deposit appears to be associated with a north-south trending tunnel valley that extends north of the park. The tunnel valley now contains a string of lakes.

ESKER: Sand and gravel with varying amounts of silts, cobbles and boulders. Deposited by former streams flowing through tunnels or open channels within glacial ice of the Superior lobe; occurs as a narrow, steep sided ridge (found outside of park boundary).

PRE-WISCONSINAN AGE DEPOSITS

PRE-WISCONSINAN AGE TILL: Dark gray, fine textured silt loam with few pebble size clasts; unsorted. The age of this till is unknown, but it is probably pre-Wisconsinan in age (greater than 75,000 years old). A small exposure of this "old" till is located at the north end of "High Banks", a few feet above the river level of the Kettle River.

MIDDLE PROTEROZOIC ROCKS

Volcanic and Sedimentary Rocks of the Chengwatana Volcanic Group of the Keweenawan Super Group

CONGLOMERATE/SANDSTONE: Reddish brown conglomerate with minor amounts of sandstone. The conglomerate consists of pebble to boulder sized clasts of varying lithologies set in a matrix of lithic sandstone; clasts are subangular to rounded. Clast lithologies include: mafic and felsic volcanics, granitoids, and quartzite. Locally interbedded with reddish brown, fine- to coarse-grained lithic sandstone. These deposits probably represent interflow sediments that were deposited between lava flows. Outcrops are locally exposed along the Kettle River and, to a lesser extent, the St. Croix River.

BASALT: Fine-grained, dark gray basalt; commonly weathering purplish gray and locally greenish blue. White calcite veins are locally present. Individual basalt flows are characterized by a central massive zone and an upper amygdaloidal (gas cavities filled with secondary minerals) zone. Outcrops are locally exposed along the Kettle River and, to a lesser extent, the St. Croix River. An exposure, at the north side of "High Banks" on the east side of the Kettle River, displays the basalt weathering directly to a yellow-brown "toothpaste consistency" clay (saprolite).

ABANDONED CHANNEL ESCARPMENT

SHAFT OR TEST PIT (IN BASALT)

FLOOD WATER FLOW DIRECTION

PARK BOUNDARY

TUNNEL VALLEY: Trench-like feature that formed as a drainage channel at the base of a glacier.

ROADS

Scale 1:30,000

1 0 1 2 Miles

Draft copy Minnesota Department of Natural Resources - Division of Minerals