North Dakota Geological Survey
24K: Lnrd - sg

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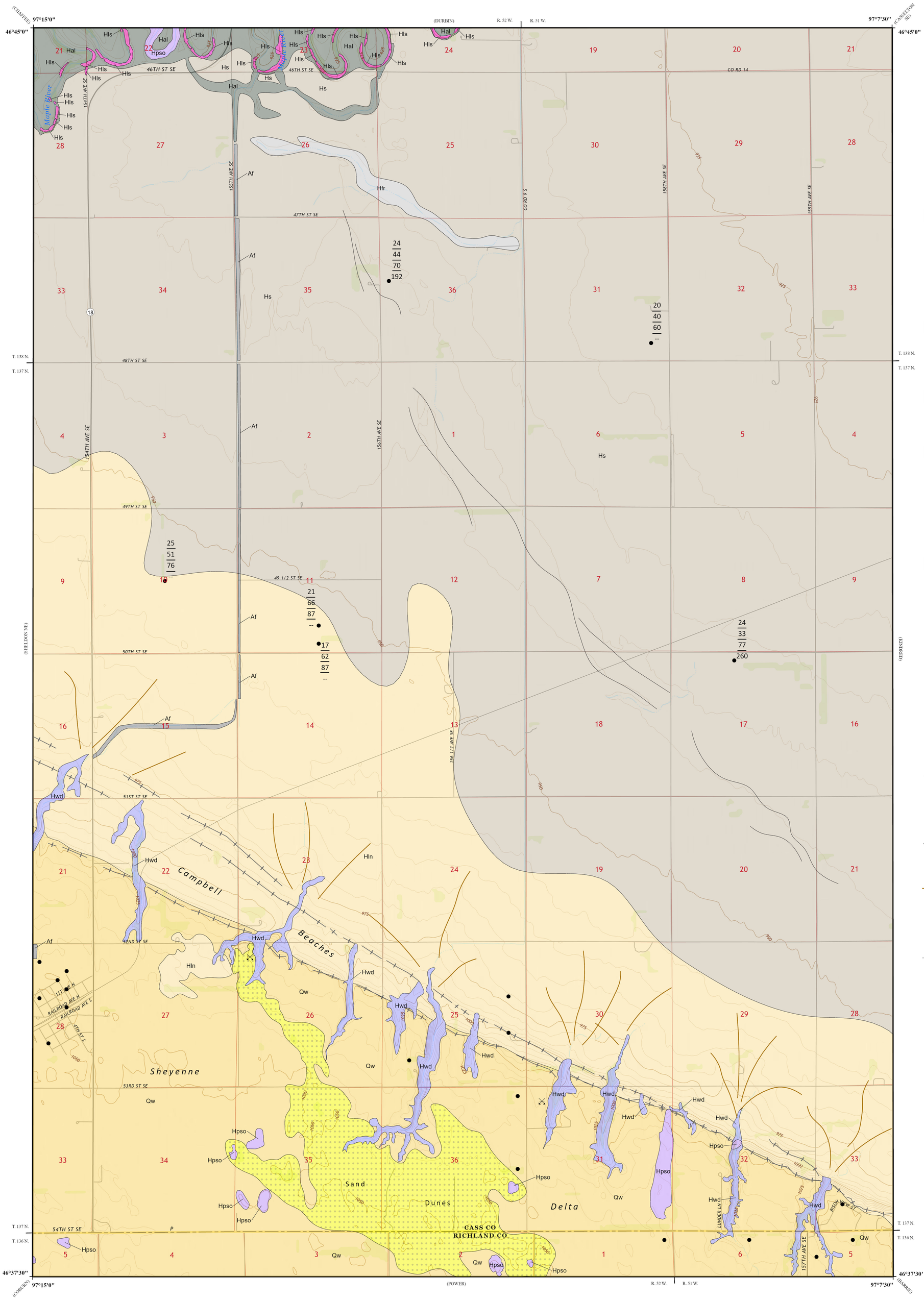
Surface Geology
Leonard Quadrangle, North Dakota



Fred J. Anderson

2025

EXPLANATION

ANTHROPOCENE

Af — **FILL DEPOSITS**
Cut and fill materials consisting dominantly of silts, clays, and sands from adjacent near surface formation placed by artificial means. Found along wastewater treatment impoundments.

QUATERNARY PERIOD

HOLOCENE EPOCH

Hls — **LANDSLIDE DEPOSITS**
A mass of material that has moved downslope. Includes earth flows, slumps along riverbanks, and areas of soil creep. Found along cutbank meanders of the Maple River.

Qw — **WIND BLOWN DEPOSITS**
Tan to brown sand and silt; fine grained; well sorted; eolian deposits on the Sheyenne Delta. Sand dunes of low-relief from 0 to 10 feet (3 meters) delineated as dotted pattern.

Hpso — **POND AND SLOUGH SEDIMENTS**
Dark brown to black obscurely bedded clay, silt, sand, and organic debris generally one to three feet thick (0.9 meters); Modern pond and slough sediments in oxbow lakes and cutoff meanders within the Maple River meander belt.

Hwd — **SLOPE WASHED ALLUVIUM**
Brown to gray sand, silt, and clay deposited as slope wash within remnant drainages into glacial Lake Agassiz terminating along Campbell beaches.

Hfr — **FLUVIAL SEDIMENT (Recent)**
Black to brown, clay, silt, and sand, with organics; commonly less than three feet (0.9 meters) thick. Swale washed sediment along modern drainages.

Hal — **ALLUVIUM**
Brown to gray, bedded to massive, sands, silts, gravels, and clays; deposited as reworked and recent channel alluvium and overbank deposits along the Maple River.

Hln — **GLACIOLACUSTRINE NEARSHORE SEDIMENT**
Silt, sand and gravel; moderately to well-sorted; planar to cross-bedded; deposited along the shoreline of glacial Lake Agassiz; ranging in thickness from 0 to 15 feet (4.6 meters). Occasional gastropod shells and shell fragments; shallow water deposits. Sand and gravel deposits may occur in washed beach ridges along with spits, sand bars, and small deltaic like landforms. Reworked surficial deposits.

SHERACK FORMATION

Hs — **GLACIOLACUSTRINE OFFSHORE SEDIMENT**
Yellow-gray, laminated to obscurely bedded, silt, clay and silty clay; cohesive. Ranges in thickness between 17 and 39 feet (5.2 to 12 m) within the quadrangle. Glaciolacustrine sediments deposited in offshore environments of glacial Lake Agassiz.

SAND DUNES

BEACH RIDGES (Upper and Lower Campbell Beach)
Established from LiDAR maps; line indicates the crest of the ridge or high-water line; interpreted to be a beach ridge along the margin of a lake or high-water level; discernable on LiDAR maps and aerial imagery. Difficult to identify on the ground.

STRANDLINES
Lineations on the Lake Agassiz plain. shaped by fluctuating water levels either above or below the shallow water surface.

DELTAIC DEPOSITS
Localized deltaic like landforms of fluvial silt and sand deposits at the margins of the Sheyenne Delta; sediments washed from the Sheyenne Delta at the mouths of shallow lakeward drainages.

GEOLOGIC SYMBOLS

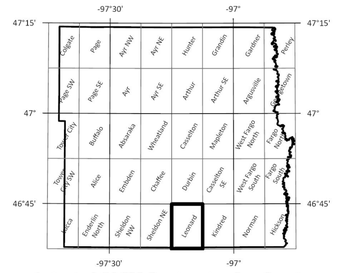
Geologic contact (Known)

Drillholes

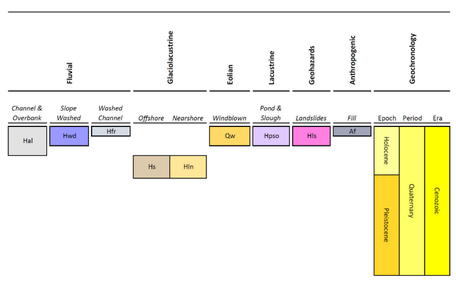
Abandoned Sand and Gravel Pits

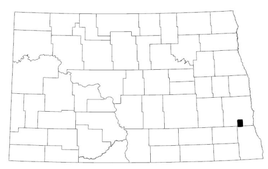
DRILLHOLE EXPLANATION

	24	BRENNA	Depth (ft)
	44	FORMATION	Thickness (ft)
Location ●	70	IST GLACIAL TILL	
Depth (ft)	192	BEDROCK	
	--	No data available	



Index to 1:24,000 Quadrangles, Cass County





Leonard Quadrangle, North Dakota

Scale 1:24,000

0 0.3 0.5 0.8 1 Miles
0 1,000 2,000 3,000 4,000 Feet
0 0.3 0.5 0.8 1 Kilometers

Lambert Conformal Conic Projection
North American 1983 Datum
USGS 7.5 Minute Topo Map

Standard Parallels 46°37'30"N, 46°45'0"N

LiDAR Data Originator:
International Water Institute, 2010.
Red River Basin Mapping Initiative 2008-2010.
NRCS-Bismarck and ND State Water Commission, 2020,
James River Basin LiDAR Qs2.

3°8' MN

2019 Magnetic North
Declination at Center of Sheet

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program