Minnesota Department of Natural Resources
Division of Lands and Minerals
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AGGREGATE RESOURCES
RENVILLE COUNTY, MINNESOTA

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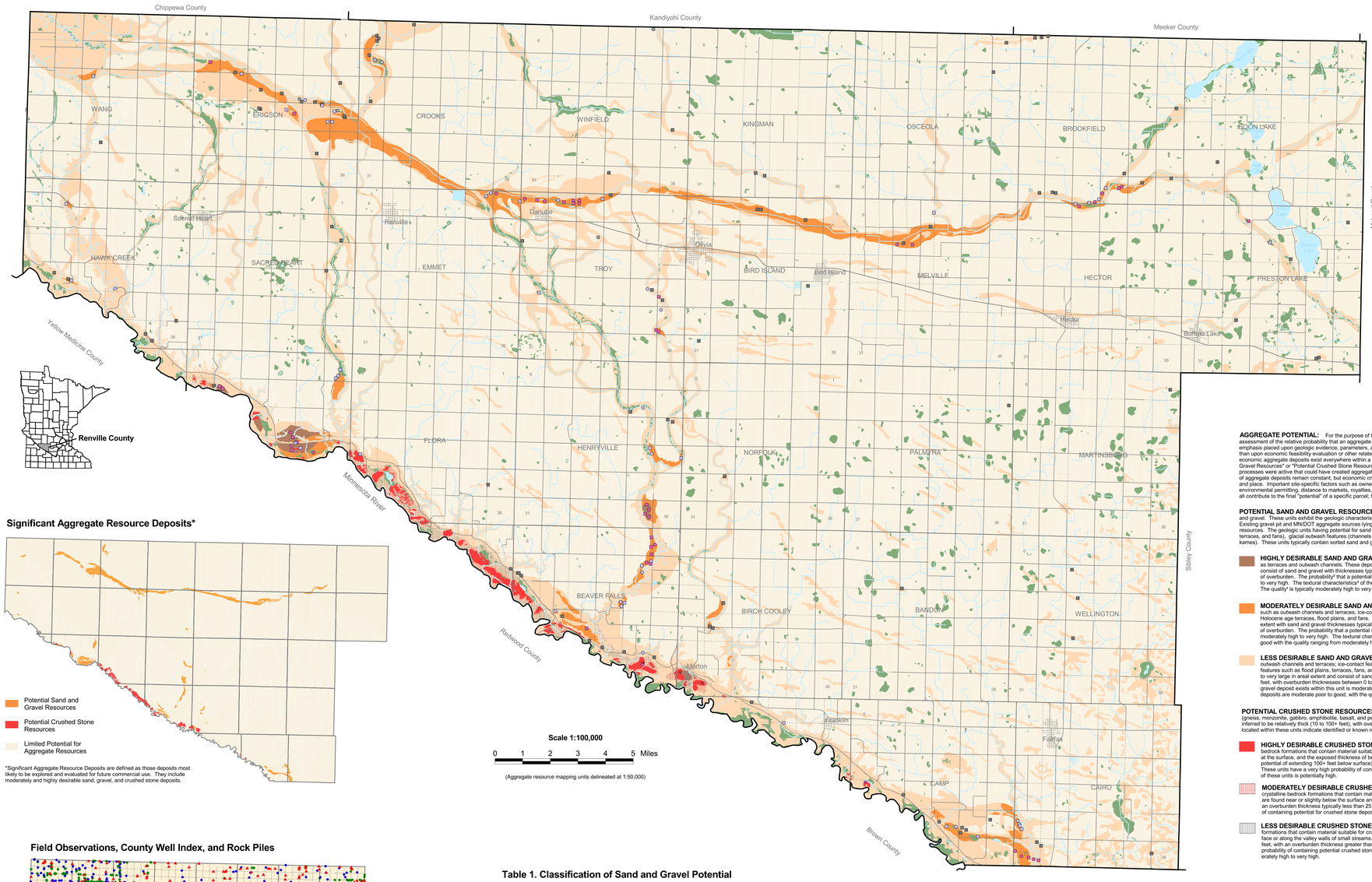
Department of Natural Resources
Lands and Minerals Division

The purpose of this project is to identify and classify potential construction aggregate resources (sand, gravel, and crushed stone) in Renville County, Minnesota. Having locally available, low-cost construction aggregates is fundamental to building and maintaining public infrastructure and private sector development. This information is intended to assist local planners and others in making comprehensive land-use and zoning decisions regarding aggregate resources, introduce aggregate resource protection, spread the burden of development, and promote orderly and environmentally sound development of the resource. To accomplish these goals, two map plates and a comprehensive data set on a CD-ROM were created. Plate A shows a detailed breakdown of all identified and potential aggregate resource deposits. Plate B shows surficial geology and includes a description of the methodologies used for mapping. The maps and digital data are designed to provide information to support land used decisions, such as zoning ordinances, permitting decisions, and protection of aggregate resources.

There are several factors related to aggregate resources that affect their availability, usability, and supply. These factors include the transportation costs, the quality of the material, and land-use conflicts. Aggregate materials are high-bulk, low-value commodities, which means transportation costs can account for a considerable amount of the delivered price. Having a local supply of aggregate means lower costs for public and private projects. Aggregate products, such as concrete and asphalt, have specific quality requirements depending on the end use.

Therefore aggregate deposits must be evaluated in relation to quality standards. At the same time, land-use conflicts between aggregate mining and urban developments are becoming more common. Land-use conflicts can be caused by cities expanding into adjacent rural areas, aggregate resource deposits being covered by new developments, or new development occurring adjacent to aggregate resources. As a result, the distance from the aggregate source to its consumers is increasing. Due to the increased use of aggregate material in and around urban areas, aggregate resources are being depleted rapidly.

With these and other issues in mind, the 1984 Minnesota Legislature passed a law (Minn. Stat. sec 84.94, Aggregate Planning and Protection) that directs the Minnesota Department of Natural Resources, in cooperation with the Minnesota Geological Survey and the Minnesota Department of Transportation, to identify and classify potential aggregate resources. When the mapping is completed, the information is provided to local governments and the public. Since this is a reconnaissance-level survey of aggregate resources, site-specific evaluations are still necessary prior to any development of the resource, especially in regards to aggregate quality or environmental review. Factors such as ownership, zoning, protected waters and wetlands, environmental permitting, and other individual site characteristics are not part of the geological resource data summarized here.



Significant Aggregate Resource Deposits*

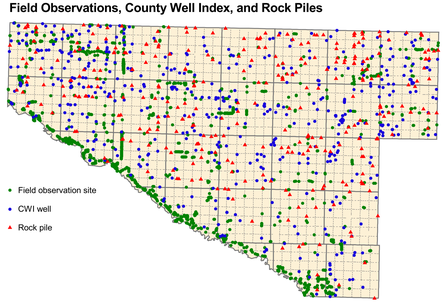
*Significant Aggregate Resource Deposits are defined as those deposits most likely to be explored and evaluated for future commercial use. They include moderately and highly desirable sand, gravel, and crushed stone deposits.

Scale 1:100,000

0 1 2 3 4 5 Miles

(Aggregate resource mapping units delineated at 1:50,000)

Field Observations, County Well Index, and Rock Piles



Cartography by Matt Oberhelman. GIS database design by Renee Johnson. Database assistance by Jason Barnum and Erika Rowe. Field and drilling assistance by Ricco Rihiluoma, Doug Rosnau, Pat Geiselman, and Mike Ellett.

Table 1. Classification of Sand and Gravel Potential

Characteristics	Desirability Rating			
	Highly	Moderately	Less	Limited
Surficial Geology Features	Glaciofluvial outwash channels and terraces	Outwash channels and terraces; kames and eskers; alluvial terraces, fans, bars, floodplains	Outwash channels and terraces; kames and eskers; alluvial terraces, fans, bars, flood plains	Moraines; collapsed channels; glacial lake beds; colluvial slopes; small alluvial features
Sediment Description	Sand and gravel	Sand and gravel	Sand with occasional sand and gravel	Clay/silt/sand with occasional sand with gravel
Probability[2]	High to very high	Moderately high to very high	Moderate to very high	Very low to moderate
Sand and Gravel Thickness (in feet)	15-40+	10-20+	0-15+	0-10+
Overburden Thickness (in feet)	0-5	0-10	0-50+	0-100+
Sand and Gravel Deposit Size (areal extent)	Large to very large (+40 acres)	Moderately small to large (+10 acres)	Moderately small to very large (+10 acres)	Very small to moderately small (<10 acres)
Sand and Gravel Textural Characteristics	Good to very good	Moderate to very good	Moderately poor to good	Poor to moderately poor
Sand and Gravel Quality[4]	Moderately high to very high	Moderate to moderately high	Moderately low to high	Low to moderate

[2]Probability is the degree of certainty that sand and gravel exists within a unit.
[4]Quality is defined in terms of soundness, durability, and mineral make-up.

Note: The colors are associated with aggregate desirability class (i.e., highly desirable, moderately desirable, less desirable, limited potential for aggregate deposits).

AGGREGATE RESOURCE POTENTIAL: SAND, GRAVEL AND CRUSHED STONE

The aggregate resources of Renville County were divided into seven categories: 1) highly desirable sand and gravel deposits, 2) moderately desirable sand and gravel deposits, 3) less desirable sand and gravel deposits, 4) highly desirable crushed stone deposits, 5) moderately desirable crushed stone deposits, 6) less desirable crushed stone deposits, and 7) limited potential for aggregate deposits.

The sand and gravel resources were divided into these categories based on the host geological feature, probability (certainty), sand and gravel thickness, overburden thickness, deposit size (areal extent), textural characteristics (sieve analysis), quality (soundness and durability), and the sediment description as observed in the field (Table 1). For example, a flood plain deposit typically hosts sand and gravel, thus the feature may have potential. If the deposit has a gravel pit located on or adjacent to it, and sand and gravel were encountered by drilling during fieldwork, it has a very high probability. If that deposit is 30 feet thick with 2 feet of overburden and covers 40 acres in areal extent, the aggregate thickness, overburden thickness, and deposit size are all in the high to very high category. If the texture indicates a high percentage of gravel and the quality meets MN/DOT specifications, then this flood plain deposit is categorized as a highly desirable sand and gravel deposit. Even if a deposit has good geological characteristics for sand and gravel, one economic factor, such as haul distance costs, could make a deposit less economically desirable, but economic factors were not considered in this study.

Crushed stone resources were divided into three categories: 1) highly desirable, 2) moderately desirable, and 3) less desirable. These resources were divided into their respective categories based on overburden thickness, bedrock exposure, and crystalline vs. non-crystalline bedrock lithologies. Highly desirable crushed stone resources consist of exposed crystalline bedrock knobs with minimal overburden. Moderately desirable crushed stone resources consist of crystalline bedrock near the surface with less than 25 feet of overburden. Less desirable crushed stone resources consist of non-crystalline bedrock at the surface and crystalline bedrock with overburden thicknesses greater than 25 feet. This unit was inferred by the distribution of exposed bedrock knobs. If the overburden was less than 25 feet, the unit was considered accessible. The probability, deposit size, and quality were determined similarly to that of the sand and gravel category.

The areas identified as limited aggregate potential did not meet the above-mentioned criteria. The deposits may have been too small in areal extent, not thick enough, have too much overburden, may not have met the quality specifications, or contained material too fine in size.

Along with aggregate potential, all known identified sources of aggregate were mapped. This included gravel pits and quarries ranging in size from less than an acre to more than 50 acres. These gravel pits and quarries may be active, inactive, depleted, or reclaimed, but represent an area where aggregate is or has been mined.

AGGREGATE POTENTIAL: For the purpose of this study, aggregate potential is defined as an assessment of the relative probability that an aggregate deposit exists within a given area, with almost all emphasis placed upon geologic evidence, parameters, and interpretation at the reconnaissance level, rather than upon economic feasibility evaluation or other related parameters. This assessment does not imply that economic aggregate deposits exist everywhere within a given map unit designated as "Potential Sand and Gravel Resources" or "Potential Crushed Stone Resources." Rather, that within such a map unit, geologic processes were active that could have created aggregate deposits at specific sites. Geologic measurements of aggregate deposits remain constant, but economic criteria and environmental permitting vary across time and place. Important site-specific factors such as ownership, zoning, protected waters and wetlands, environmental permitting, distance to markets, royalties, and individual site characteristics, such as access, all contribute to the final "potential" of a specific parcel; however, these factors were not considered in this study.

POTENTIAL SAND AND GRAVEL RESOURCES: Geologic units that are inferred to contain sand and gravel. These units exhibit the geologic characteristics that typically produce sand and gravel deposits. Existing gravel pit and MN/DOT aggregate sources lying within these units indicate identified or known resources. The geologic units having potential for sand and gravel include alluvial features (flood plains, terraces, and fans), glacial outwash features (channels and terraces), and ice-contact features (eskers and kames). These units typically contain sorted sand and gravel with little silt or clay.

HIGHLY DESIRABLE SAND AND GRAVEL DEPOSITS: Glaciofluvial features, such as terraces and outwash channels. These deposits are very large in areal extent[1]. These deposits consist of sand and gravel with thicknesses typically ranging from 15 to 40+ feet with less than 5 feet of overburden. The probability[2] that a potential sand and gravel deposit exists within this unit is high to very high. The textural characteristics[3] of these deposits are classified as good to very good. The quality[4] is typically moderately high to very high relative to all deposits within Renville County.

MODERATELY DESIRABLE SAND AND GRAVEL DEPOSITS: Glaciofluvial features, such as outwash channels and terraces; ice-contact features, such as eskers and kames; as well as Holocene age terraces, flood plains, and fans. These deposits are moderately small to large in areal extent with sand and gravel thicknesses typically ranging from 10 to 20+ feet with less than 10 feet of overburden. The probability that a potential sand and gravel deposit exists within this unit is moderately high to very high. The textural characteristics of these deposits are moderate to very good with the quality ranging from moderately high to high.

LESS DESIRABLE SAND AND GRAVEL DEPOSITS: Glaciofluvial features, such as outwash channels and terraces; ice-contact features, such as eskers and kames; and alluvial features such as flood plains, terraces, fans, and sand bars. These deposits are moderately small to very large in areal extent and consist of sand and fine sand with thicknesses ranging from 0 to 15+ feet, with overburden thicknesses between 0 to 50+ feet. The probability that a potential sand and gravel deposit exists within this unit is moderate to very high. The textural characteristics of these deposits are moderate poor to good, with the quality ranging from moderately low to high.

POTENTIAL CRUSHED STONE RESOURCES: Granite and other crystalline bedrock formations, (gneiss, monzonite, gabbro, amphibolite, basalt, and peridotite) that are suitable for crushing. These units are inferred to be relatively thick (10 to 100+ feet), with overburden thicknesses ranging from 0 to 25+ feet. Quarries located within these units indicate identified or known resources.

HIGHLY DESIRABLE CRUSHED STONE DEPOSITS: Granite and other crystalline bedrock formations that contain material suitable for crushed aggregate. These units are exposed at the surface, and the exposed thickness of bedrock knobs can range from 10 to 70+ feet (with the potential of extending 100+ feet below surface). Overburden thickness is typically less than 10 feet. These units have a very high probability of containing potential for crushed stone deposits. The quality of these units is potentially high.

MODERATELY DESIRABLE CRUSHED STONE DEPOSITS: Granite and other crystalline bedrock formations that contain material suitable for crushed aggregate. These units are found near or slightly below the surface and can have thicknesses greater than 100+ feet, with an overburden thickness typically less than 25 feet. These units have a high to very high probability of containing potential for crushed stone deposits. The quality of these units is potentially high.

LESS DESIRABLE CRUSHED STONE DEPOSITS: Granite and other crystalline bedrock formations that contain material suitable for crushed aggregate. These units are found below the surface or along the valley walls of small streams. The thickness of the unit is probably greater than 100+ feet, with an overburden thickness greater than 25 feet. These units have a moderately high to very high probability of containing potential crushed stone deposits. The quality of these units is potentially moderately high to very high.

LIMITED POTENTIAL FOR AGGREGATE RESOURCES: Units that generally have little or no potential for significant aggregate resources. These units exhibit geologic characteristics that are typically not consistent with significant aggregate deposits. The geologic units having limited potential include collapsed glaciofluvial channels, glacial lake plains, ground moraines, colluvial slopes, small alluvial deposits, or bedrock with overburden thicknesses typically greater than 25 feet. These units typically contain clay, silt, fine sand, unsorted sediments (till), or very thin layers of sand and gravel. These units may include aggregate deposits that are too small to map.

LIMITED POTENTIAL FOR AGGREGATE DEPOSITS: Units that include glacial features such as collapsed glaciofluvial channels, ground moraines, end moraines, collulvial slopes, and small alluvial features such as flood plains and streams. The probability that a significant aggregate deposit exists within this unit is very low to moderate. The aggregate deposits occurring in this unit are very small to moderately small in areal extent and typically consist of finer material (sand with some gravel). The thicknesses of these aggregate deposits are typically less than 10 feet, with overburden thicknesses sometimes reaching over 100 feet. The textural characteristics are poor to moderately poor with the quality ranging from low to moderate. These units also contain granitic bedrock units with an overburden thickness of greater than 25 feet (however, a dotted pattern on top of this color indicates crushed stone potential but limited sand and gravel potential).

IDENTIFIED AGGREGATE RESOURCES: Areas where aggregate resources (sand, gravel, and/or crushed stone) have been or are currently being mined. Pit and quarry locations have been gathered from several different sources, including topographic maps, aerial photographs, county records, county highway department maps, soil surveys, MN/DOT files, fieldwork, gravel operators, and other miscellaneous sources. The pits and quarries range in size from less than 1 acre to greater than 50 acres and may be active, inactive, depleted, or reclaimed. The aggregate quality of the pits varies.

Gravel Pits: Locations were gathered from several different reference sources. Any given pit may be active, inactive, depleted, or reclaimed. The color indicates the relative size of the pit.

- Large - larger than 15 acres.
- Medium - approximately 5 to 15 acres.
- Small - less than 5 acres.

Gravel Pits - MN/DOT files: Locations gathered from ASIS, the Minnesota Department of Transportation's Aggregate Source Information System listing of aggregate sources. Test hole logs, sieve, and quality test data are available. The color indicates the relative size of the pit.

- Large - larger than 15 acres.
- Medium - approximately 5 to 15 acres.
- Small - less than 5 acres.

Quarries: Granitic and gneiss quarries used for either crushed stone or dimension stone. Any given unit may be active, inactive, depleted, or reclaimed.

- Large - larger than 15 acres.
- Medium - approximately 5 to 15 acres.
- Small - approximately < 5 acres.

OTHER FEATURES:

WETLANDS: Wetland area.

WATER: Lakes or rivers.

[1] Areal Extent - the size, horizontal extent, or distribution of a unit (e.g., area in acres).
[2] Probability - the degree of certainty that aggregate exists within a mapping unit.
[3] Textural Characteristics - particle size distribution - the percent of gravel or sand vs. silt or clay (e.g., sieve analysis).
[4] Quality - the characteristics of the material - soundness (e.g., magnesium sulfate test), durability (Los Angeles rattler test), and mineral makeup (percent deleterious material such as shale, iron oxide, and unsound chert).

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Aggregate Resources:
Aerial photograph interpretation, field work, and delineation of mapping units by Heather Anderson, 2003, County Aggregate Mapping Program, Division of Lands and Minerals, Minnesota Department of Natural Resources. Source information included aerial photographs from NAPP (National Aerial Photography Program), 1991-1992, 9" x 9" color infared photos at 1:40,000; DOQs (Digital Orthophoto Quadrangles) at 1:12,000 from USGS (United States Geological Survey); ORQs (Digital Raster Graphics) at 1:24,000 from USGS; 7.5-minute USGS topographic quadrangles at 1:24,000 (dating from 1964-1992); the Soil Survey of Renville County, 1998 from the USDA-NRCS (United States Department of Agriculture - Natural Resource Conservation Service); and CWI (County Well Index) database from the Minnesota Geological Survey, downloaded in 2002.

Base map data sources:
Lakes, wetlands, and rivers from National Wetland Inventory, U.S. Fish and Wildlife Service, Compiled at 1:24,000 from aerial photography (1979-1988) and spot field checked. Public Land Survey - PLS Project, 2001, Minnesota Department of Natural Resources, Division of Lands and Minerals. Roads from MN/DOT Basemap 2001 -Roads, Minnesota Department of Transportation, BaseMap Development Group, Surveying and Mapping Section. Civil Townships and Municipal Boundaries from MN/DOT Basemap 2001 - Civilhwy and Muni, Minnesota Department of Transportation, BaseMap Development Group, Surveying and Mapping Section

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Mineral Diversification projects are determined by a committee composed of Governor-appointed members from the public and private sectors.

Products of this project include a CD/ROM of maps, data, and metadata in a digital format and the following plates:
Plate A, Report 363, Aggregate Resources Plate B, Report 363, Surficial Geology