AGGREGATE RESOURCES
CRUSHED STONE POTENTIAL
Olmsted County, MN

Produced by the Aggregate Resource Mapping Program
Division of Lands and Minerals

Minnesota Department of Natural Resources
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Map Scale 1 : 63,360

Crushed Stone Potential Mapped at 1:100,000

INTRODUCTION: The purpose of this plate is to display the distribution of crushed stone (aggregate) potential of bedrock within 50 feet of the earth's surface in Olmsted County, Minnesota. Crushed stone is produced by mechanically reducing dolostone or limestone bedrock into desired sized particles that have a consistent composition, angular shape, and can meet specifications for aggregate used in building roads, bridges and airport runways. Unfortunately, crushed stone resources are not evenly distributed across the state or within a single county. The usefulness of a crushed stone resource depends on the physical and compositional characteristics of the bedrock as well as the overburden thickness. For example, in Olmsted County, dolostone is a hard, fine-grained rock that has the potential to be a durable aggregate source, while shale is soft and flaky and is unacceptable as an aggregate source. Overburden refers to glacial sediment, or shale, on top of a desired resource, that must be removed to access the underlying resource.

Geologic data, such as exposed bedrock outcrops, subsurface water well data, previous geologic studies, and verbal communication with local aggregate producers, provide the basis for the interpretations used to define the crushed stone potential of bedrock in Olmsted County. This is a reconnaissance-level analysis (1:100,000), which offers an overview of the distribution of crushed stone potential in Olmsted County. To determine the economic suitability of a crushed stone quarry site, additional site-specific information is required. Site-specific factors can include land ownership, the owner's preference, environmental criteria, royalty rates, distance to market, permitting requirements, and/or cultural and historical significance of the location. Additionally, the crushed stone potential associated with a map unit does not imply that aggregate resources exist everywhere within a given map unit. Crushed stone potential defines an area where there is geologic evidence to support a particular map unit designation, but the variability of geologic processes cannot be fully characterized at the scale of this map. The map was created at a scale of 1:100,000 but is presented at a scale of 1:63,360. A larger scale was used to display the printed map in order to show more detail for those choosing to use a paper copy of the map to locate areas of crushed stone potential.

METHODOLOGY: Aggregate resources are mined from the earth, which dictates that geologic evaluations are used to determine the location, distribution, and quality of a potential aggregate source. Because the crushed stone potential of a bedrock unit is partially dependent on the thickness of material that must be removed to access the rock, a simple geologic model is used to identify bedrock within 50 feet of the earth's surface. The model combines bedrock information from field observations, the County Well Index (CWI), exploratory drilling logs, bedrock data from Natural Resource Conservation Service (NRCS) soil surveys, Minnesota Geological Survey (MGS) outcrop data and MGS bedrock geology maps. The computer model uses data from these sources to estimate the depth to bedrock and interpret crushed stone potential where durable, high-quality bedrock is located within 50 feet of the ground surface.

CWI is an important data source and accounts for most of the subsurface information used to model depth to bedrock. The CWI is an online database (www.health.state.mn.us/divs/eh/cwi) developed and maintained by the MGS and the Minnesota Department of Health that contains basic information for over 300,000 drilled wells throughout Minnesota and has two levels of data accuracy: *located* and *unlocated*. *Located* CWI data are used as a source only if the address information on the well log can be verified and located using a number of general information sources: parcel data from the county tax records, address information, and online address location web sites. The well locations are further refined using published county parcel maps, plat maps, air photographs, and road maps. Once the address and parcel location of a well is confirmed, the well is placed near a residential dwelling within the parcel. This method of locating wells is not as accurate as field checking locations using 7.5 Minute USGS Quadrangle maps and/or a Global Positioning System (GPS), but is acceptable for delineating reconnaissance-level crushed stone potential. Overburden thickness is estimated using ESRI's ArcGIS® to develop a bedrock elevation model using 4,943 depth-to-bedrock data points. This number includes 1181 field observations of bedrock outcrops, 601 SSURGO Soil Survey bedrock outcrops, and 2734 wells within Olmsted County that contain depth to bedrock values, and 427 wells from the surrounding counties, that help to more accurately model the bedrock surface elevation in the area of the Olmsted County border. The overburden thickness is determined by subtracting the modeled bedrock elevation from the surface elevation.

Like other types of models, a bedrock surface elevation model is only as good as the data used to create it. In Olmsted County, some CWI reports contain over-simplified geologic information, which make it difficult to accurately define the depth to bedrock at that location. In other instances, a bedrock exposure may have been artificially created by removing the overburden during road building or other construction activities. This situation can artificially decrease the modeled overburden thickness in the area because there is no simple way to account for the missing overburden. The number of data points used in the model also affects the ability of the model to accurately represent the overburden thickness. In Olmsted County there are areas that do not have an abundance of information about the depth to bedrock. Fortunately these areas are not as large, nor as numerous, as found in less densely populated counties.

Crushed stone potential is based on a 1:100,000-scale bedrock map of Olmsted County constructed for this project. Bedrock contacts in the Rochester area are mapped on two-foot contour intervals based on surface elevation and bedrock elevation data provided by the Olmsted County Environmental Resource Services Department. The remainder of the county is mapped using ten-foot contour intervals because higher resolution elevation data were not available for the entire county at the time the bedrock map was constructed. The high-resolution elevation data area is identified on the map on this plate by the heavy dashed line surrounding the Rochester area. The bedrock information that serves as the basis for the crushed stone potential map is based, in part, on data from the Minnesota Geological Survey, including the state map series, S-20: "Geologic map of Minnesota, bedrock geology," (1:1,000,000, Morey and Meints, 2000), the county atlas series, C-3: "Geologic Atlas of Olmsted County, Minnesota," (1:100,000, N.H. Balaban, ed., 1988), report of investigation number 36, RI-36: "Paleozoic Lithostratigraphic Nomenclature for Minnesota," (Mossler, 1987), report of investigation number 65, RI-65: "Paleozoic Lithostratigraphic Nomenclature for Minnesota," (Mossler, 2008), and a digital bedrock geologic map for Olmsted County as part of open file report OF07-07: "Bedrock geology, topography and karst feature inventory of Steele, Dodge, Olmsted and Winona counties, (Tipping and others, 2004).

The final determination of crushed stone potential integrates the existing geologic maps and interpretations, the physical characteristics of the bedrock units and the overburden thickness. The crushed stone potential of map units are classified as high, moderate, low, or limited. Mapping units that have been classified as either high or moderate potential are defined as having significant potential for crushed stone resources while areas classified as low or limited potential are considered nonsignificant resources. The implementation of this classification system is described in the **Crushed Stone Resource Potential** section and is illustrated in Table 1.

An example of how the lack of data creates uncertainty in defining crushed stone potential can be seen in the geologic cross-section in Figure 1. Bedrock elevation trends can be seen along the length of the cross-section, but the lack of additional well points forces us to estimate the change of the bedrock surface between the well points. We must assume that the bedrock surface elevation changes only enough to reach the bedrock elevation defined at the next well point along the line. This creates a series of straight lines that are an unlikely estimation of the actual elevation of the bedrock surface between data points. This is especially significant as the distance between well points increases. While there are areas within Olmsted County where few well points are available, there are not enough of these areas to affect the crushed stone potential value assigned to individual polygons when mapped at a scale of 1:100,000.

CRUSHED STONE RESOURCE POTENTIAL: In Olmsted County, the interpretation of geologic evidence at the reconnaissance level is the basis for defining crushed stone potential, not economic feasibility nor cultural considerations. This assessment does not imply that economic crushed stone resources exist everywhere within a given map unit designated as "Potential Crushed Stone Resources." Rather, that within a map unit similar geologic processes were responsible for producing the bedrock, but over time erosion has removed more bedrock in some areas than in others. In most instances, the bedrock surface is buried by sediment that obscures our view of the rock and creates some uncertainty about the crushed stone potential within an entire map unit. There are areas within Olmsted County where few well points are available, but not enough of these areas exist to affect the crushed stone potential value assigned to individual polygons when mapped at a scale of 1:100,000. While geologic measurements of aggregate deposits remain relatively constant, economic criteria and environmental standards can vary across time and place. Important site-specific factors such as ownership, zoning, protected waters and wetlands, distance to markets, and access, are important to the decision-making process for locating a new quarry, but they are outside the scope of this study.

SIGNIFICANT POTENTIAL FOR CRUSHED STONE RESOURCES: Bedrock geologic units of dolostone and limestone having the necessary quality to produce crushed stone aggregate and are buried by limited overburden. The quality information is derived from Aggregate Source Information System (ASIS) test data as well as through existing crushed stone industry use in Olmsted County. The geologic units are the Oneota Dolomite, Shakopee Formation, Stewartville Formation, and the Prosser Formation. Where classified as having significant potential for crushed stone resources, these bedrock units are buried by less than 30 feet of overburden. Though each of the above mentioned bedrock formations can be used for producing crushed stone aggregate, all of the units contain layers of lower quality rock that are not suitable for crushed stone aggregate. Crushed stone quarries located within these map polygons are classified as identified resources. A brief description of each formation is included below.

Hp — **High Potential for Crushed Stone Resources:** Dolostone and limestone bedrock units exposed at the land surface or buried by less than 15 feet of overburden. Based on the rock types observed in this study, the Oneota Dolomite, Shakopee Formation, and the Stewartville Formation are classified as having high potential for crushed stone aggregate resources.

Stewartville Formation: Medium- to thickly-bedded dolomite or dolomitic limestone; may also occur as thinly-bedded limestone similar in appearance to the Prosser Limestone. The Stewartville Formation is typically 70 to 80 feet thick and primarily occurs in the south-central and southwestern areas of the county.

Shakopee Formation: Thinly-bedded dolomite with minor sandstone and shale beds throughout the upper 100 feet. The Shakopee is approximately 120 to 150 feet thick. The Shakopee Formation is the upper-most bedrock unit in much of the northern part of the county and is normally limited in exposure to road cuts or along river valleys. The sequences of sandstone and shale reduce the quality of the bedrock within these intervals.

Oneota Dolomite: Massive, thickly-bedded dolomite occurs in the upper portion of the formation while the lower part is dominantly dolomite with inter-bedded sandstone, sandy dolostone, and minor amounts of shale. The Oneota is typically 150 to 185 feet thick. Limited exposures of the Oneota Formation are located in the extreme northeastern corner of the county in the Whitewater River valley. The sequences of sandstone and shale reduce the quality of the bedrock within these intervals.

Mp — **Moderate Potential for Crushed Stone Resources:** Dolostone and limestone bedrock units buried by 0 to 30 feet of overburden. The bedrock units mentioned above (with 16 to 30 feet of overburden), as well as the Prosser Formation (with 0 to 15 feet of overburden), are classified as having moderate potential for crushed stone aggregate resources.

Prosser Formation: Thinly-bedded limestone with thin layers of shale. Limestone beds vary in thickness from an inch to several inches. The Prosser Formation is typically 50 to 70 feet thick and is primarily limited to the eastern and southern portions of the county.

NONSIGNIFICANT POTENTIAL FOR CRUSHED STONE RESOURCES: Bedrock geologic units of dolostone, limestone, shaly limestone, sandstone, and shale that have low, limited, or no potential for crushing because of low rock quality or excessive overburden thickness. The units having nonsignificant potential are found as part of the following bedrock geologic formations: Oneota, Shakopee, Stewartville, Prosser, Platteville, Cummingsville, Dubuque, St. Peter, Glenwood, Decorah, and Jordan. These formations have varying bedrock and overburden thicknesses.

Lp — **Low Potential for Crushed Stone Resources:** Dolostone, limestone, and shaly limestone bedrock units buried by 0 to >50 feet of overburden. These map units include the following bedrock formations: Oneota, Shakopee, Stewartville (with more than 30 feet of overburden), Prosser Formation (with more than 15 feet of overburden), and the Platteville, Cummingsville, and Dubuque Formations. Based on the characteristics of the rock types in this study, the Platteville, Cummingsville, and Dubuque Formations (with 0 to 15 feet of overburden) are designated "Low Potential" for crushed stone resources. Quarries are found throughout the county where the Platteville Formation and Cummingsville Formation limestone have been mined, but many of the quarries are abandoned because they are either too small or the crushed stone produced from these formations cannot meet current construction aggregate quality specifications. The Dubuque, Cummingsville, and Platteville Formations are briefly discussed below.

Dubuque Formation: Medium-bedded limestone with alternating thinly bedded shale. The Dubuque Formation is typically from 20 to 30 feet thick and is limited in occurrence to the southwestern portion of the county where it is typically buried.

Cummingsville Formation: Inter-bedded limestone and shale. Limestone beds typically alternate with successions of thin beds of green/gray shale. The Cummingsville Formation ranges from 60 to 70 feet thick and is generally found in the southern half of Olmsted County.

Platteville Formation: Thin- to medium-bedded limestone with very thin shale layers. Shale is more prominent in the upper portion of the formation while sandy limestone is more prevalent in the lower portion. The Platteville is approximately 20 feet thick throughout the county but can be as thick as 25 feet. The Platteville Formation is present throughout Olmsted County, occurring in natural exposures, roadcuts, and commonly capping small buttes and plateaus.

Ld — **Limited Potential for Crushed Stone Resources:** Dolostone, limestone, shale, sandstone, and shaly limestone units buried by 0 to >50 feet of overburden. These map units include all of the previously mentioned bedrock formations found in Olmsted County, as well the Maquoketa Formation (limestone), sandstones of the St. Peter and Jordan formations, and shale of the Glenwood and Decorah formations. The sandstone and shale formations lack the necessary durability required of an aggregate resource, regardless of the overburden thickness. General descriptions of these formations are given below.

Maquoketa Formation: Thinly bedded fossiliferous limestone with thin beds of dolostone and shale; chert nodules are common. The Maquoketa Formation is approximately 70 feet thick and has a gradational contact with the underlying Dubuque Formation. Limited in occurrence to the southwestern portion of the county and is typically buried.

Sandstones

St. Peter Sandstone: Fine- to medium-grained, poorly cemented, quartzose sandstone. The St. Peter Sandstone ranges in thickness from 80 to 100 feet. It is present throughout the county and can be easily recognized by its white/orange color, lack of major structure, and slope-forming tendency. In Olmsted County, the St. Peter Sandstone is a significant source of industrial sand.

Jordan Sandstone: Medium- to coarse-grained, cross-stratified quartzose sandstone. The Jordan Sandstone is approximately 80 feet thick and is limited in exposure to the Dry Run Creek valley in the north and the Whitewater River valley in the northeast.

Shales

Decorah Shale: Large successions of thinly-bedded shale with thin beds of limestone identifiable by its stark green/gray color and lack of structure. The Decorah Formation is approximately 40 feet thick, but can be as thick as 60 feet. It is exposed throughout the county, usually heavily vegetated, and is generally limited to locations where overlying Cummingsville Formation limestone still exists.

Glenwood Formation: Thinly-bedded shale with thinly-bedded, intermittent sandstone beds. Upper portion of the formation is predominantly green shale, with sandstone inter-beds occurring in the lower portion of the formation. The Glenwood Formation is typically 6 feet thick, but can range from 2 to 8 feet thick. The Glenwood Formation is present throughout the county and is typically associated with the Platteville Formation.

General References

Anderson, H.E., 2002, Aggregate Resources, Dodge County, Minnesota Department of Natural Resources, Division of Lands and Minerals, Report 357, Plates I, II, III, and IV.

Morey, G.B. and Meints, J.P., 2000, Geologic map of Minnesota bedrock geology, Minnesota Geological Survey, State Map Series S-20, scale 1:1,000,000.

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Mossler, J. H., 2008, Paleozoic lithostratigraphic nomenclature for Minnesota, Minnesota Geological Survey, Report of Investigations 65.

Olsen, B.M., 1988, Bedrock geology of Olmsted County, *in* Geologic atlas Olmsted County, Minnesota. (N.H. Balaban, ed.), Minnesota Geological Survey County Atlas Series Atlas C-3, scale 1:100,000.

R.G. Tipping, J.H. Mossler, E.C. Alexander, Jr., Y. Gao, L. Green, and S.C. Alexander, 2004, Bedrock geology, topography and karst feature inventory of Steele, Dodge, Olmsted and Winona counties, Open File Report O F07-07.

Mapping Sources

Bedrock geology and bedrock model interpretation, fieldwork, and delineation of mapping units by Steve Kostka, 2007-2009 and Jon Ellingson and Ross Hoffman 2003-2006. Bedrock geology cross-section delineated by Steve Kostka with cartographic design assistance by Kevin Hanson. Overburden modeling, bedrock geology geoprocessing, and locating the County Well Index *unlocated* points by Kevin Hanson, 2006-2008. Remote sensing sources were; NAPP (National Aerial Photography Program), 1991-1992, 9" x 9" color infrared photos at 1:40,000; 1991 DOQs (Digital Orthophoto Quadrangles) at 1:12,000 from USGS (United States Geological Survey); FSA (Farm Se rvices Administration) Color Orthophotos collected from the following years; 2003–04, 2005, 2006, 2008; FSA CIR (Color Infrared) Imagery collected in 2008; DRGs (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 Geographic Database for Olmsted County, published November 20th, 2006 from the USDA-NRCS (United States Department of Agriculture - Natural Resource Conservation Service); USGS (United State Geological Survey) National Elevation Dataset's 1-arc second (30m) DEM, and where available 2-foot contour elevation data obtained from Olmsted County and then converted to 1/9-arc second (3M) DEM., and MGS Minnesota aeromagnetic grid (+/- 50 Metera horizontal accuracy) with micro-leveling (dating from 1961-1991).

GIS and **Cartography** by Kevin J. Hanson, MN DNR, Division of Lands and Minerals. Copy edited by Nick Kroska, MN DNR Division of Waters.

Products of this project include a CD/ROM of maps, data, and metadata in a digital format and the following maps:

Plate A, Report 375, Olmsted County Aggregate Resources, Sand and Gravel Potential & Plate B, Report 375, Olmsted County Aggregate Resources, Crushed Stone Potential

Map Scale 1:63,360

The map was created at a scale of 1:100,000 but is presented at a scale of 1:63,360 to display more detail for those choosing to use a paper copy of the map to locate areas of crushed stone potential.

1 inch equals ~1 mile

0 1 2 3 4 Miles
0 1 2 3 4 5 6 Kilometers

1 centimeter equals ~0.63 kilometers

This map was prepared from publicly available information. Every reasonable effort has been made to ensure the accuracy of the factual data on which this map interpretation is based. However, the Department of Natural Resources does not warrant the accuracy, completeness, or any implied uses of these data. Users may wish to verify critical information; sources include both the references here and information on file in the offices of the Minnesota Geological Survey and the Minnesota Department of Natural Resources. Every effort has been made to structure the interpretation shown conforms to sound geologic and cartographic principles. This map should not be used to establish legal title, boundaries, or locations of improvements.

Table 1: Classification Matrix of Crushed Stone Potential

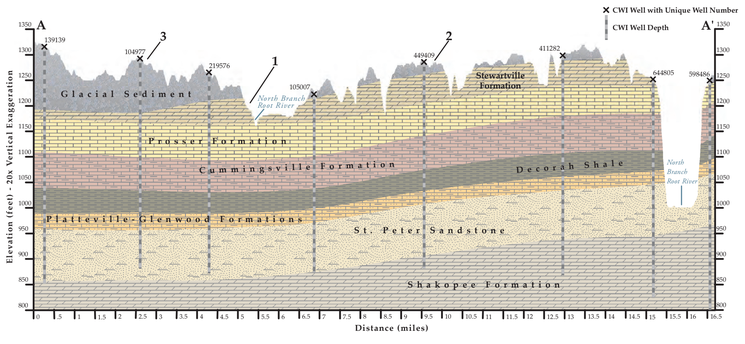
Formation	Description	Quality	Overburden Thickness (ft.)	Crushed Stone Potential
Maquoketa	Shaly Limestone	Low	> 50	Limited
Dubuque	Shaly Limestone	Low	0 - 15	Low
			16 - 30	Limited
Stewartville	Dolostone	High	0 - 15	High
			16 - 30	Moderate
			31 - 50	Low
			> 50	Limited
Prosser	Limestone	Moderate	0 - 15	Moderate
			16 - 30	Low
			> 30	Limited
Cummingsville	Shaly Limestone	Low	0 - 15	Low
			16 - 30	Limited
Decorah	Shale	Very Low	0 - 15	Limited
Platteville	Limestone	Moderately Low	0 - 15	Low
			16 - 30	Limited
Glenwood	Shale	Very Low	0 - 15	Limited
St. Peter	Sandstone	Very Low	0 - 15	Limited
Shakopee	Dolostone	High	0 - 15	High
			16 - 30	Moderate
			31 - 50	Low
			> 50	Limited
Oneota	Dolostone	High	0 - 15	High
			16 - 30	Moderate
			31 - 50	Low
			> 50	Limited
Jordan	Sandstone	Very Low	0 - 15	Limited

Base Map Data Sources:

Lakes, rivers, and streams from National Wetland Inventory, Mn/DOT Base map, MN DNR 24K Streams, compiled at 1:24,000 from aerial photography (1979–1988) and USGS quadrangle maps (1980-1990); *PLS (Public Land Survey) townships and sections* layers extracted from PLS Project, 2001, MN DNR; *Populated places* were derived from the GNIS (Geographic Name Information System) by pulling out the features that were coded as populated places, 2003; *County boundaries* from MN DNR, 1993. *High resolution boundary* from Olmsted County; *Roads* from Mn/DOT Base map, Fall of 2006; *Railroad Tracks* from Mn/DOT Base map, 2001; *Contour Intervals* created by smoothing the 30 Meter Digital Elevation Model (see topographic relief) and then applying ArcGIS 9.3 Spatial Analyst to create the contours; *Topographic relief* from a 3-meter digital elevation models (DEM) by the MN DNR in 2009 from LiDAR data flown in November, 2008 by Aero-Metrics

Figure 1: Bedrock Geology Cross-Section

The cross-section in Figure 1 helps illustrate the crushed stone classification scheme for Olmsted County as well as some of the issues associated with limited geologic control points. At point "1," the Stewartville Formation is exposed at the surface and would be easily accessible for quarrying. The Stewartville Formation is a durable dolostone and would be designated as having high potential for crushed stone resources at this location. At point "2," the Stewartville Formation is covered by more than 15 feet of glacial till. Based on the matrix in Table 1, the Stewartville Formation in the vicinity of Point "2" would be assigned a value of moderate or low potential depending on the thickness of glacial till. Finally, the area indicated at point "3," shows the Stewartville Formation beneath more than 50 feet of glacial till. At this location, the overburden atop the Stewartville Formation is so thick that quarrying would be difficult. Consequently, the Formation would be considered to have "limited potential." The crushed stone potential assigned to the Stewartville Formation at each of the three locations only considers the quality of the bedrock and the overburden thickness. In Olmsted County, the sediment deposited on top of the eroded bedrock obscures our view of the rock, creating some uncertainty about the crushed stone potential within an entire map unit. The bedrock surface elevation trend can be seen along the length of the cross-section, but the lack of additional well points forces us to assume that the bedrock surface between the points changes only enough to reach the bedrock surface elevation defined at the next well point along the line. This creates a series of straight lines that we presume to reflect the actual elevation of the bedrock surface between data points. While there are areas within Olmsted County where few well points are available, there are not enough of these areas to affect the crushed stone potential value assigned to individual polygons when mapped at a scale of 1:100,000.



IDENTIFIED CRUSHED STONE RESOURCES: Sites where crushed stone resources have been, or are currently, being mined. Crushed stone 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, quarry operators, and other miscellaneous sources. The crushed stone quarries range in size from less than 1 acre to greater than 50 acres and may be active, inactive, depleted, or reclaimed. The size of the points indicates the relative areal extent of the quarry.

Small	Medium	Large	Size in Acres
< 5	5-15	> 15	
○	○	○	**Crushed Stone Quarries:** Sites that have been or are currently being mined.
⊘	⊘	⊘	**Mn/DOT Identified Crushed Stone Sites:** Sites were identified by Mn/DOT as part of the Aggregate Source Information System (ASIS). Most sites are located on private property and leases are not necessarily active. Some locations were modified to better correlate to present quarry boundaries.
⊡	⊡	⊡	**Gravel Pits Above Crushed Stone Quarries:** Sites that have been, or are currently being mined. These sites contain sand and gravel pits on top of limestone or dolostone bedrock.
⊠	⊠	⊠	**Mn/DOT Identified Gravel Sites Above Crushed Stone Sites:** Sites were identified by Mn/DOT as part of the Aggregate Source Information System (ASIS). These sites contain sand and gravel deposits on top of limestone or dolostone bedrock. Most pit-quarries with this designation have been or are currently being mined and some sites are located on private property and leases are not necessarily active.

GEOLOGIC DATA SOURCES FOR MAP UNIT INTERPRETATION: Field observations and the County Well Index (CWI) database were data sources used in the interpretation of aggregate potential.

- **Field Observations:** A total of 1695 field observations, including 207 gravel pits and quarries, were logged during the fall of 2003 and spring of 2004. Surficial geologic sediment, glacial stratigraphy, and bedrock formations were observed in road cuts, stream exposures, excavations, judicial ditches, construction projects, trenches (cable, pipe, tiling), and even animal burrows.
- × **County Well Index Locations:** The County Well Index (CWI) is an online database maintained by the Minnesota Geological Survey and the Minnesota Department of Health containing approximately 4063 (as of 2007) wells located in Olmsted County. Approximately 1900 wells in Olmsted County are considered to have geological descriptions that are appropriate for the crushed stone potential part of this project.

Transportation Features
- Interstate Highway
- US Highway
- MN Highway
- County Highway
- County Road
- Township and Other Roads
- Municipal Roads
- Railroad Tracks

Bounding Features
- County Boundaries
- High-Resolution Area Boundary
- PLS Township Boundaries
- Section Boundaries *Sections 1,6,31, & 36 labeled*
- Geologic Cross-Section Line (see Figure 1)

Populated Places
- Byron
- Genoa

(Size of font type indicates relative populations)

Physical Features
- *Lakes*
- *Rivers & Streams*
- 100 Ft. Elevation Contours
- 25 Ft. Elevation Contours

Shaded Topographic Relief (Azimuth = 315, Altitude = 45)