

THE MINERAL INDUSTRY OF MICHIGAN

This chapter has been prepared under a Memorandum of Understanding between the U.S. Geological Survey and the Michigan Department of Environmental Quality, Geological Survey Division, for collecting information on all nonfuel minerals.

In 2000, the estimated value¹ of nonfuel mineral production for Michigan was \$1.67 billion, based upon preliminary U.S. Geological Survey (USGS) data. This was a 5.7% increase from that of 1999² and followed a 5.4% decrease in 1999 from 1998. The State rose to sixth from seventh in rank among the 50 States in total nonfuel mineral production value, of which Michigan accounted for more than 4% of the U.S. total.

Michigan continued to be the Nation's second leading iron ore-producing State in 2000. Although usable iron ore production represented a very significant percent of the State's nonfuel mineral economy, portland cement (for the second consecutive year) was Michigan's leading nonfuel mineral commodity. Iron ore was second, followed by construction sand and gravel, crushed stone, magnesium compounds, and salt. In 2000, cement (masonry and portland) represented almost 30% of the State's total nonfuel mineral production value. When cement is combined with the values of Michigan's other major construction materials—construction sand and gravel, crushed stone, and gypsum (in descending order of value)—the total accounted for about 56% of the State's total value as shown in table 1.

In 1999, a more than \$100 million drop in the value of iron ore alongside a \$21 million decrease in the value of crushed stone was only somewhat offset by a more than \$20 million increase in salt, a more than \$4 million rise in cement (masonry and portland), and smaller yet significant increases in the values of lime and industrial sand and gravel. All other changes were small and had little effect on the net results.

Compared with USGS estimates of the quantities produced in the other 49 States in 2000, Michigan remained first in magnesium compounds; second in iron ore, industrial sand and gravel, and peat, as well as second of two bromine-producing States; third in construction sand and gravel, gypsum, and iron

¹The terms "nonfuel mineral production" and related "values" encompass variations in meaning, depending upon the minerals or mineral products. Production may be measured by mine shipments, mineral commodity sales, or marketable production (including consumption by producers) as is applicable to the individual mineral commodity.

All 2000 USGS mineral production data published in this chapter are preliminary estimates as of July 2001 and are expected to change. For some mineral commodities, such as construction sand and gravel, crushed stone, and portland cement, estimates are updated periodically. To obtain the most current information, please contact the appropriate USGS mineral commodity specialist. A telephone listing of the specialists may be retrieved over the Internet at URL <http://minerals.usgs.gov/minerals/contacts/comdir.html>, by using MINES FaxBack at (703) 648-4999 from a fax machine with a touch-tone handset (request Document #1000 for a telephone listing of all mineral commodity specialists), or by calling USGS information at (703) 648-4000 for the specialist's name and number. All Mineral Industry Surveys—mineral commodity, State, and country—also may be retrieved over the Internet at URL <http://minerals.usgs.gov/minerals>; facsimile copies may be obtained from MINES FaxBack.

²Values, percentage calculations, and rankings for 1999 may vary from the Minerals Yearbook, Area Reports: Domestic 1999, Volume II, owing to the revision of preliminary 1999 to final 1999 data. Data for 2000 are preliminary and are expected to change; related rankings may also change.

oxide pigments and third of three States that produce potash; fourth in portland cement; and seventh in masonry cement. Additionally, the State was a significant producer of crushed stone, lime, and common clays (listed in descending order of value). Michigan rose to fourth from fifth in the Nation in the manufacture of raw steel with an estimated output of nearly 6.5 million metric tons (Mt), as reported by the American Iron and Steel Institute.

The following narrative information was provided by Michigan's Department of Environmental Quality, Geological Survey Division, and the State's Department of Natural Resources (DNR), Forestry, Mineral, and Fire Management Division.³ The Cleveland-Cliffs Iron Co. managed Michigan's two iron ore mines, the Empire Mine and the Tilden Mine, both in Marquette County in the Upper Peninsula. The Empire Mine at Palmer employed about 1,000 people. The mine is owned by the Empire Iron Mining Partnership, which early in 2000 was owned 40% by Ispat Inland Inc., 25% by LTV Steel Co., 22.5% by Cleveland-Cliffs Iron Co., and 12.5% by Wheeling-Pittsburgh Steel Corp. In the fall of 2000, Cleveland-Cliffs bought the 12.5% owned by Wheeling-Pittsburgh, raising Cleveland-Cliff's share to 35%. Early production goals for 2000 were to meet the annual rated capacity of 8.51 Mt (8.375 million long tons) of pellets. In mid-November, it was announced that the Wheeling-Pittsburgh Steel Corp. had filed for Chapter 11 bankruptcy and had sold its 12.5% of the mine to Cleveland Cliffs, Inc. In early April, Empire produced its 200 millionth metric ton of iron ore pellets, having started production in 1963 (Skillings Mining Review, 2000a, b).

The Tilden Mine, near Ishpeming, is owned by the Tilden Mining Company L.C., which is owned 40% by Cleveland-Cliffs, 45% by Algoma Steel, Inc., and 15% by Stelco, Inc. The mine had more than 800 employees in 2000 and initially planned on producing more than 7.87 Mt (7.75 million long tons) of iron ore pellets. In September, Algoma Steel announced a reduction in its steelmaking, resulting in needing fewer pellets from Tilden. In October, Tilden announced a 2-week shutdown for November and a reduction in annual production to 7.4 Mt of pellets. The Tilden Mine processes both hematite and magnetite iron ores from different locations within the mine at different times of the year (Skillings Mining Review, 2000c, g, h).

Factors affecting the U.S. iron and steel industry, including the mining of iron ore in Michigan, were delineated in a number of news articles in 2000. Steel company bankruptcies and financial problems cut ore demand. The U.S. International

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Trade Commission and the U.S. Department of Commerce took action on some steel product imports from countries with falling economies dumping steel at low prices or subsidizing production costs, which made U.S. material noncompetitive in the United States. Also, the increasing number of minimills using scrap iron and steel has cut into the market for iron ore. The lack of cheap fuel to convert ore to direct-reduced iron or hot-briquetted iron that can be used in minimills near the mines has resulted in increases in the cost of producing iron ore pellets, making the industry less competitive with scrap iron and steel. The U.S. companies and workers are working to reduce costs to keep iron ore pellets competitive (Kakela, 2000; Skillings Mining Review, 2000f, j, k).

BHP Copper Co. North America sold its electrolytic copper refinery at White Pine, MI, to Considar White Pine Acquisition Corp. in June 2000. Its new name is White Pine Copper Refinery, Inc. The White Pine refinery continues to refine about 75,000 metric tons per year of anode copper to purer cathode copper. The copper anodes are shipped 2,000 kilometers (km) by rail from the Hudson Bay Mining and Smelting Co. Ltd's smelter at Flin Flon, Manitoba, Canada. The refinery was built to serve the White Pine Copper Mine and smelter, which ceased production a number of years ago.

Michigan's only copper mine is the Caledonia Mine, near Mass City in Ontonagon County. Red Metal Minerals Co. operates this mine and produces a very limited quantity of copper, silver, and other mineral specimens sold around the world to museums and mineral collectors.

While the White Pine Copper Mine no longer produces copper, a new use has been found for part of the mine openings. Sub Terra LLC, partially owned by Prairie Plant Systems Inc. of Saskatoon, Saskatchewan, Canada, has a pilot biotechnology operation within some of the upper mine openings. They are growing special tobacco plants for a Health Canada bone marrow cancer treatment protein ingredient and other plants used in making other pharmaceuticals. While only a few workers are involved now, the company plans to expand its facilities and operations and to employ 200 or more sometime in the future.

Industrial Minerals

Georgia-Pacific Corp. closed its last gypsum processing plant in the Grand Rapids area, Kent County, in November. They had closed the last Michigan underground gypsum mine in Kent County in late 1999. Gypsum mining and processing was the Grand Rapids area's oldest industry, starting in the 1840s.

Open pit mining of gypsum continued in Iosco County. The U.S. Gypsum Co. quarry at Alabaster planned to reduce its number of employees by 39 from about 90 by yearend and reduce its production during the next 3 years. It will move the crushing operation from near the shore of Lake Huron into a nearby quarry. The quarry's aerial tram ship loading facility suffered storm damage earlier in the year, and product was being trucked 8 km to National Gypsum Co.'s ship loading facility. The company has decided not to spend the \$7 to \$8 million to repair the tram and rock loading system. The quarry was started in the Civil War days and has about 10 years of reserves left at the current production rate.

Nugent Sand Co.'s permit to mine industrial sand from sand dunes along Lake Michigan near Norton Shores, Muskegon County, and Construction Aggregate Corp.'s permit to mine

sand in Ferrysburg, Ottawa County, were renewed for 5 years in early 2000. A group opposed the Nugent Sand permit extension. Another group asked a Berrien County judge to block TechniSand Inc. from mining dune sand near Bridgeman. Some State lawmakers considered legislation to ban all sand dune mining by 2006. Several companies together produce more than 2.3 Mt of dune sand each year; the sand is mainly used for metal casting, such as for the Michigan automobile industry. Some inland sand deposits are used for foundry work too. Ford Motor Co. reportedly uses about three-fourths inland sand to one-fourth dune sand in its casting operations (Aggregates Manager, 2000a, p. 19).

Oglebay Norton Co. completed the purchase of Michigan Limestone Operation's Cedarville and Rogers City limestone and dolomite quarries. The announced price was \$53 million in cash at closing, plus certain payments during the next decade. The quarries became part of Oglebay's Global Stone Corp. The Cedarville quarry, near Cedarville, Mackinac County, ships material out of Port Dolomite. The Rogers City quarry is near Rogers City, Presque Isle County, and ships out of Port Calcite. Both ports are on northern Lake Huron. Global Stone purchased J.M. Huber Corp.'s limestone processing facility in northern Indiana, renaming it Global Stone Portage, and planned on supplying the facility with limestone from its Michigan quarries via Oglebay Norton's Marine Services vessels on the Great Lakes (Rock Products, 2000a, b, Skillings Mining Review; 2000i).

Lafarge Corp. announced in July that it purchased the Presque Isle Corp., Lake Huron, for about \$56 million. Presque Isle was owned by LTV Steel Co., National Steel Corp., and Bethlehem Steel Corp. As part of the deal, LTV has agreed to continue purchasing limestone from the quarry for 3 years at market prices. The quarry produces about 8.1 million metric tons per year (8 million long tons) of metallurgical and construction material. At the current production rate, the reserves will last about 50 years (Skillings Mining Review, 2000d).

Vulcan Materials Co. agreed to supply agricultural lime and limestone to a grain terminal in White Pigeon, in the southwestern corner of the State. The material will be transported into Michigan from Vulcan's operations elsewhere (Rock Products, 2000c).

Aggregate Industries, Inc., a United Kingdom-based aggregate and construction materials company, announced that its name would replace the name of all of its operating businesses in the United Kingdom and the United States. This includes its Michigan operation, the former Bill Smith Sand & Gravel Co. at Otsego, which it purchased in 1999. Later in the year, it announced the purchase of Klett Construction Co. at Hartford and Michigan Colprovia Co. at Grand Rapids. Both companies are suppliers of asphalt materials (Aggregates Manager, 2000b).

The Lowell Township Planning Commission, Kent County, approved a 10-year mining permit renewal for a sand and gravel operation located across the road from the Lowell Township Hall. The renewed permit requires the pit operator to: establish a mine reclamation plan; deposit money with the township to ensure reclamation; have a \$1 million liability insurance policy; fence and sign the pit; control dust and erosion of the entrance road; and construct acceleration and deceleration lanes on the road near the entrance.

The shipping of bulk mineral materials on the Great Lakes was affected by the fourth consecutive year of declining lake levels. Cargo loads, including iron ore pellets and limestone-dolomite, were reduced by U.S. carriers. In early 2000, large cargo carriers had to reduce their loads more than 1,016 metric tons (t) per load as compared with May 1999, which was nearly 10,000 t per load less than in May 1997. Thus more trips were required to haul the same amount of materials. The mild winter allowed an early start of shipping. The loading of iron ore pellets at the Escanaba dock on Lake Michigan began on March 13, 2000. The wet spring lessened demand for limestone from the construction industry so that those loads could be delayed and iron ore could be hauled to meet the early demand (Skillings Mining Review, 2000e).

Exploration

During 2000, metallic mineral exploration consisted of limited fieldwork in search of nonferrous and precious metals on Federal, State, and private lands. Exploration activities were expected to continue in 2001.

Two companies were reported by the Department of Environmental Quality/Geologic Survey Division (DEQ/GSD) to have drilled 14 metallic mineral exploration drill holes totaling nearly 1,640 meters in two counties on private leases in fiscal year (FY) 2000, October 1, 1999, through September 30, 2000. Drilling was expected to continue periodically as exploration took place in FY 2000 on the direct leased State land and on surrounding Federal and private lands. Generally, low metal prices continued to adversely affect metallic mineral exploration worldwide, especially in North America, including Michigan.

While no nonmetallic mineral exploration was reported in 2000, Michigan has a vast potential for many nonmetallic mineral resources. One commodity with a high potential is dimension stone. The privately produced report entitled "Dimension Stone Feasibility Study—Development Potential in Michigan's Upper Peninsula" was again available to the public on the DEQ/GSD website in 2000, at URL www.deq.state.mi.us/gsd/dsfs/index.html. The Michigan Economic Development Corporation funded the report, which was completed in mid-1999. Ninety-six rock outcrop locations listed in an early 1970s report by Michigan Technological University and other sources were field reviewed for quarry stone characteristics. A number of sites were test drilled, and 11 locations were selected as having dimension stone quarry potential. Speculation was made that up to 200 quarry and related jobs could be developed.

The Geological Core and Sample Repository of the DEQ/GSD continues to be an aid to mineral exploration. The repository houses thousands of metallic and nonmetallic mineral exploration drill cores, rock samples, old mine maps, information from former State mineral leases, and other geological records in Marquette. Materials are available to review and study at the facility by appointment. These materials continue to be useful in understanding the State's geologic history and mineral deposit potential.

Government Programs

The State of Michigan owns more than 1.5 million hectares of combined surface and mineral rights within the State, plus an additional 850,000 hectares (ha) of only mineral rights. The State also owns surface-only lands and 10 million hectares of Great Lakes bottomlands. The leasing of State-owned metallic and nonmetallic mineral rights for exploration and production of minerals is a function of the Department of Natural Resources' Land and Mineral Services Division (DNR/LMSD). The income from lease bonus and rental fees, along with production royalty fees, are deposited into the Michigan Natural Resources Trust Fund (MNRTF). Local and State governments use the fund for the purchase of public recreational property.

Eleven direct leases were issued in FY 2000 for State-owned metallic minerals in the western part of the Upper Peninsula. An additional group of leases was nearing final approval and will be issued in FY 2001. A total of six applications to direct lease metallic minerals were received in FY 2000. Field reviews and further processing of these lease requests will continue in FY 2001. One full metallic minerals lease was released, and there were 2,300 ha under 34 State metallic minerals leases at the end of FY 2000. The total income from the metallic minerals activities on State lands in 2000 was \$43,663 and was placed into the MNRTF.

Leasing for nonmetallic minerals is done under both the sealed bid lease method and under special circumstances by the direct lease method. In early FY 2000, one lease was issued for limestone-dolomite in Mackinac County at the old Hendricks Quarry location. This property was nominated in late 1998; the review and the bid lease sale were held in 1999.

One direct lease, nominated by DNR staff in 1998, was in final preparation during FY 2000. This was for the conversion from an old sand and gravel permit to a construction sand, gravel, cobble, boulder, and clay lease. The lease is for the expansion of a pond and cleanup of an old pit within the 7 Lakes State Park in Oakland County. The lease should be issued in early FY 2001.

One sand and gravel pit production lease in Lapeer County expired in 2000, with reclamation due to be completed in 2001. The DNR continued to review which State-owned sand and gravel pits to keep active and which to convert from annual permits to multiyear leases. There were 270 ha under seven-State nonmetallic minerals leases at the end of FY 2000, producing a total income to the MNRTF of \$723,477.

The owners of unrecorded severed metallic mineral rights in Michigan were to record their interests with the County by December 22, 2000. Public Act 154 of 1997, the Act To Reduce the (Metallic) Mineral Rights Title Period, reduced the marketable record title for metallic minerals to 20 years from 40 years. Hereafter, they must be recorded every 20 years.

The Department of Environmental Quality, Geological Survey Division, continued to implement the open pit metallic mine reclamation regulations and to administer the sand dune mining regulations. The sand dune mining activities required an increased effort by Geologic Survey Division during 2000, largely in response to public concerns about the environmental impacts of coastal sand dune mining.

The DNR extended its review of its State-owned sand and gravel mining program. It held discussions about which pit locations to close or to keep open and which to convert from annual permits to multiyear leases. Leases issued by

DNR/LMSD are issued to one responsible party and are complete with bonding, insurance, and mining and reclamation plans.

The DNR/LMSD selected 11 abandoned mine sites where the State owns the mineral rights for needed safety repair; they were chosen from the Report on Mines Requiring Attention in 1999. Repairs during 2000 included mine capping, installing bat cages on openings where needed, backfilling of openings, and installing fencing and warning signs. The Report on Mines Requiring Attention was based upon the Michigan Abandoned Underground Mine Inventory, completed in late 1998. These are aids to public safety in areas of old mines on private and public property. The inventory includes information on about 800 mine locations with nearly 2,000 openings to the surface. Copies of the reports were limited to the DNR and the County Mine Inspectors, or related agencies, for the counties containing the old mines. The limiting of distribution was done to prevent the materials from becoming guides to potentially dangerous locations for adventurous people who may enter unsafe areas and be hurt or killed.

The replacement mine cap for the one that subsided in July 1999 at the abandoned Ludington C Shaft, Chapin Mine, City of Iron Mountain, was nearly completed by yearend of 2000. A Governor's emergency order allowed State funds to be transferred to Dickinson County to hire a consulting company to repair the unsafe conditions. The building immediately adjacent to the hole is the local mine history association's museum, and many homes with children are nearby.

New mineral processing methods and development of mining byproducts are two of the services offered to the mineral industry by Michigan Technological University's (MTU) Institute of Materials Processing (IMP). The IMP at Houghton offers its services for worldwide projects and is funded by private industry contracts, grants, and royalties. It has worked on many projects covering a wide range of mineral commodities and products.

The A.E. Seaman Mineral Museum, MTU, Houghton, MI, received a Michigan Department of Environmental Quality permit in late 2000 to remove a 10-ton native copper boulder from the bottom of Lake Superior offshore of Keweenaw

County (Barron, 2001). In late 1999, the Michigan DNR and MTU signed a formal loan agreement allowing MTU to take the copper boulder, which is a State-owned mineral resource, and to place it on public display in or next to their museum in adjacent Houghton County. In December, 2000, Keweenaw County and one of the townships publicly stated that they want the copper boulder so that they can display it in a facility to be built at Copper Harbor.

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TABLE 1
NONFUEL RAW MINERAL PRODUCTION IN MICHIGAN 1/ 2/

(Thousand metric tons and thousand dollars)

Mineral	1998		1999		2000 p/	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement:						
Masonry	294	28,000 e/	283	28,100 e/	300	29,700 e/
Portland	5,710	435,000 e/	5,810	439,000 e/	6,300	471,000 e/
Clays, common	644	4,520	615	3,550	615	3,560
Gemstones	NA	1	NA	1	NA	1
Gypsum, crude	1,830	15,000	2,170	15,700	2,280	16,500
Lime	761	40,300	781	43,900	W	W
Peat	190	5,500	195	4,520	185	4,510
Sand and gravel:						
Construction	66,900	245,000	70,200	245,000	75,400	270,000
Industrial	2,390	25,700	2,550	28,100	2,730	29,300
Stone, crushed 3/	43,700	167,000	42,500	146,000	44,000	155,000
Combined values of bromine, iron ore (usable), iron oxide pigments (crude), magnesium compounds, potash, salt, stone (crushed marl and miscellaneous, dimension dolomite and sandstone), and value indicated by symbol W	XX	706,000	XX	625,000	XX	694,000
Total	XX	1,670,000	XX	1,580,000	XX	1,670,000

e/ Estimated. p/ Preliminary. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined values" data. XX Not applicable.

1/ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

2/ Data are rounded to no more than three significant digits; may not add to totals shown.

3/ Excludes certain stones; kind and value included with "Combined values" data.

TABLE 2
MICHIGAN: CRUSHED STONE SOLD OR USED, BY KIND 1/ 2/

Kind	1998				1999			
	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Unit value	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Unit value
Limestone	23	34,800 r/	\$135,000 r/	\$3.87 r/	22	32,700	\$110,000	\$3.36
Dolomite	6	8,900 r/	32,000 r/	3.59 r/	6	9,710	35,500	3.65
Calcareous marl	1	W	W	W	1	W	W	W
Sandstone	1	7	113	16.14	1	12	195	16.25
Miscellaneous stone	2 r/	W	W	W	1	W	W	W
Total or average	XX	43,700	167,000	3.82	XX	42,500	146,000	3.43

r/ Revised. W Withheld to avoid disclosing company proprietary data. XX Not applicable.

1/ Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.

2/ Traprock for 1998 was revised to zero.

TABLE 3
MICHIGAN: CRUSHED STONE SOLD OR USED BY PRODUCERS
IN 1999, BY USE 1/ 2/

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Construction:			
Coarse aggregate (+1 1/2 inch):			
Riprap and jetty stone	77	\$1,290	\$16.73
Filter stone	W	W	W
Other coarse aggregate	687	2,580	3.76
Coarse aggregate, graded:			
Concrete aggregate, coarse	2,960	12,200	4.14
Bituminous aggregate, coarse	725	3,110	4.29
Bituminous surface-treatment aggregate	97	658	6.78
Railroad ballast	W	W	W
Other graded coarse aggregate	1,720	6,810	3.97
Fine aggregate (-3/8 inch):			
Stone sand, bituminous mix or seal	498	1,820	3.65
Screening, undesignated	527	1,770	3.35
Coarse and fine aggregates:			
Graded road base or subbase	2,820	10,900	3.86
Unpaved road surfacing	W	W	W
Crusher run or fill or waste	142	543	3.82
Other coarse and fine aggregates	1,360	5,890	4.35
Other construction materials	(3/)	(3/)	(3/)
Agricultural:			
Agricultural limestone	W	W	W
Other agricultural uses	100	842	8.42
Chemical and metallurgical:			
Cement manufacture	6,360	11,700	1.84
Lime manufacture	(3/)	(3/)	(3/)
Flux stone	6,200	25,200	4.06
Unspecified: 4/			
Reported	16,300	54,300	3.33
Estimated	1,300	4,000	3.09
Total or average	42,500	146,000	3.43

W Withheld to avoid disclosing company proprietary data; included with "Other."

1/ Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.

2/ Includes dolomite, limestone, and sandstone; excludes calcareous marl and miscellaneous stone to avoid disclosing company proprietary data.

3/ Withheld to avoid disclosing company proprietary data; included in "Total."

4/ Reported and estimated production without a breakdown by end use.

TABLE 4
MICHIGAN: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 1999, BY USE AND DISTRICT 1/ 2/

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction:						
Coarse aggregate (+1 1/2 inch) 3/	W	W	W	W	74	1,250
Coarse aggregate, graded 4/	W	W	2,500	10,100	W	W
Fine aggregate (-3/8 inch) 5/	W	W	548	1,900	W	W
Coarse and fine aggregate 6/	--	--	2,570	9,390	1,750	7,900
Other construction materials	--	--	W	W	--	--
Agricultural 7/	W	W	W	W	93	812
Chemical and metallurgical 8/	W	W	8,500	19,700	W	W
Unspecified: 9/						
Reported	W	W	W	W	5,230	17,700
Estimated	120	360	11	35	1,200	3,600
Total	10,600	38,800	21,400	65,400	10,500	41,500

W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ Includes dolomite, limestone, and sandstone, excludes calcareous marl and miscellaneous stone to avoid disclosing company proprietary data.

3/ Includes filter stone, riprap and jetty stone and other coarse aggregate.

4/ Includes bituminous aggregate (coarse), bituminous surface-treatment aggregate, concrete aggregate (coarse), railroad ballast, and other graded coarse aggregate.

5/ Includes screening (undesignated) and stone sand (bituminous mix or seal).

6/ Includes crusher run (select material or fill), graded road base or subbase, unpaved road surfacing, and other coarse and fine aggregates.

7/ Includes agricultural limestone and other agricultural uses.

8/ Includes cement manufacture, flux stone, and lime manufacture.

9/ Reported and estimated production without a breakdown by end use.

TABLE 5
MICHIGAN: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 1999,
BY MAJOR USE CATEGORY 1/

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Concrete aggregate (including concrete sand)	6,380	\$24,200	\$3.80
Plaster and gunite sands	65	388	5.97
Concrete products (blocks, bricks, pipe, decorative, etc.)	147	702	4.78
Asphaltic concrete aggregates and other bituminous mixtures	6,960	25,800	3.70
Road base and coverings 2/	12,200	35,300	2.90
Fill	9,000	16,900	1.88
Snow and ice control	394	936	2.38
Filtration	97	725	7.47
Other miscellaneous uses 3/	496	3,020	6.09
Unspecified: 4/			
Reported	16,100	67,700	4.22
Estimated	18,000	69,000	3.74
Total or average	70,200	245,000	3.48

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ Includes road and other stabilization (cement and lime).

3/ Includes railroad ballast.

4/ Reported and estimated production without a breakdown by end use.

TABLE 6
MICHIGAN: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 1999,
BY USE AND DISTRICT 1/

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3		Unspecified districts	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate and concrete products 2/	244	1,790	987	4,370	5,170	18,200	--	--
Asphaltic concrete aggregates and other bituminous mixtures	121	309	1,400	5,700	5,350	19,600	77	171
Road base and coverings 3/	675	2,010	1,900	4,960	9,430	28,000	181	400
Fill	271	471	928	2,170	7,810	14,300	--	--
Snow and ice control	97	164	189	456	108	315	--	--
Other miscellaneous uses 4/	2	8	103	719	488	3,020	--	--
Unspecified: 5/								
Reported	97	161	74	148	15,600	66,900	325	537
Estimated	2,200	7,800	3,700	12,000	13,000	49,000	--	--
Total	3,650	12,700	9,270	30,900	56,700	200,000	584	1,110

-- Zero.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ Includes gunite and plaster sands.

3/ Includes road and other stabilization (cement and lime).

4/ Includes filtration and railroad ballast.

5/ Reported and estimated production without a breakdown by end use.