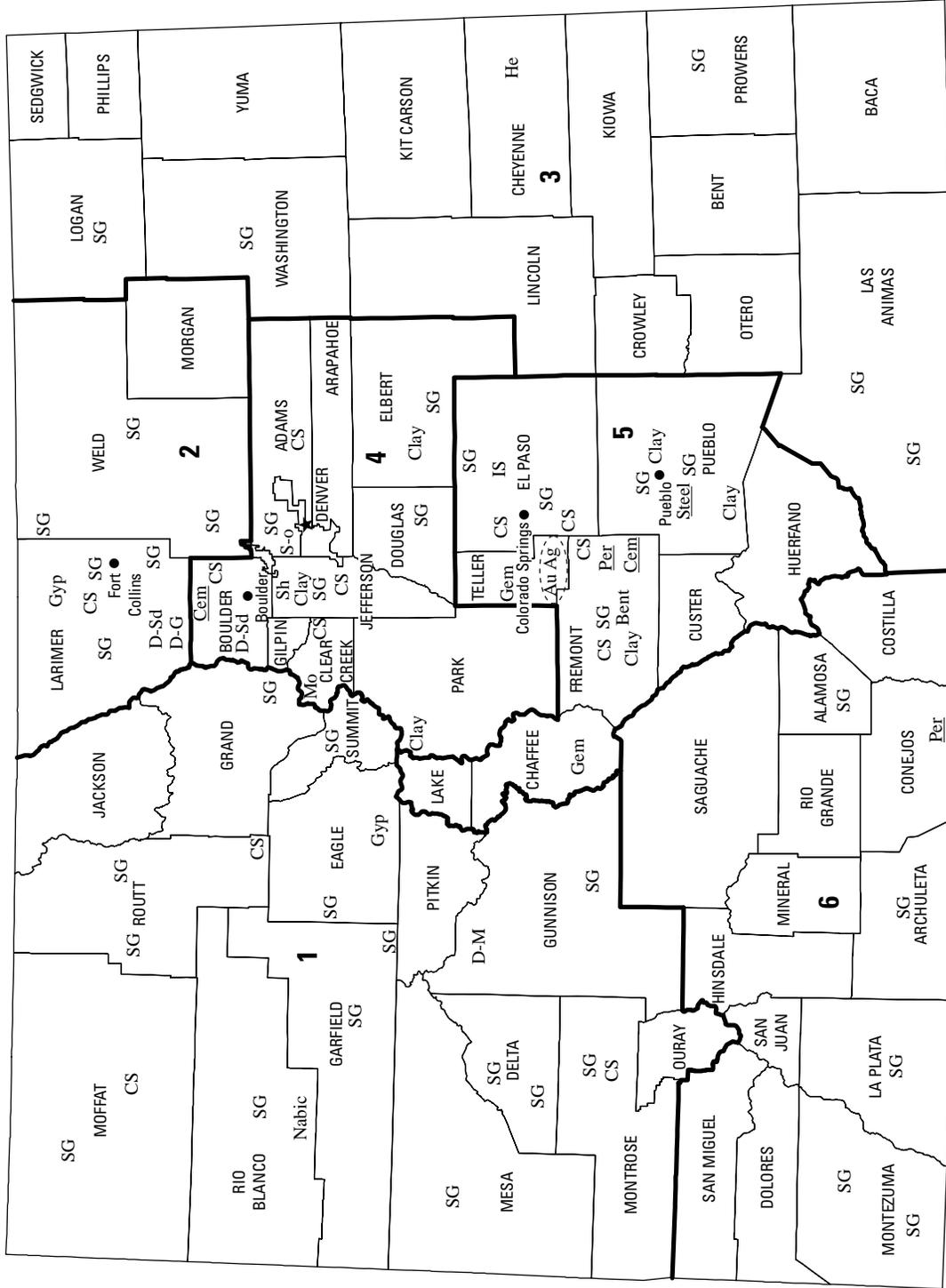




2007 Minerals Yearbook

COLORADO [ADVANCE RELEASE]

COLORADO

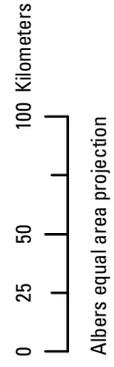


LEGEND

- County boundary
- ★ Capital
- City
- 1— Crushed stone/sand and gravel district boundary

MINERAL SYMBOLS (Major producing areas)

- Ag Silver
- Au Gold
- Bent Bentonite
- Cem Cement plant
- Clay Common clay
- CS Crushed stone
- D-G Dimension granite
- D-M Dimension marble
- D-Sd Dimension sandstone
- Gem Gemstones
- Gyp Gypsum
- He Helium
- IS Industrial sand
- Mo Molybdenum
- Nabic Sodium bicarbonate
- Per Perlite plant
- S-o Sulfur (oil)
- SG Construction sand and gravel
- Sh Shale
- Steel Steel plant
- Concentration of mineral operations



Source: Colorado Geological Survey/U.S. Geological Survey (2007).

THE MINERAL INDUSTRY OF COLORADO

This chapter has been prepared under a Memorandum of Understanding between the U.S. Geological Survey and the Colorado Geological Survey for collecting information on all nonfuel minerals.

In 2007, Colorado's nonfuel raw mineral production¹ was valued at \$2.04 billion, based upon annual U.S. Geological Survey (USGS) data. This was a 21.4% increase from the State's total nonfuel mineral production value of 2006, following a 4% decrease from 2005 to 2006. Colorado rose in rank to 11th from 13th among the 50 States in nonfuel mineral production value, while accounting for about 2.9% of the U.S. total.

The State's first- and second-leading nonfuel mineral commodities in 2007 were, by value, molybdenum and construction sand and gravel, followed by cement (portland and masonry), gold, and crushed stone. These five commodities accounted for more than 98% of Colorado's total nonfuel raw mineral production value. The largest increases in value took place in molybdenum, construction sand and gravel, gold, and portland cement. With an 8% increase in molybdenum production in 2007, the mineral commodity's value rose by more than \$300 million, and in spite of a small decrease in construction sand and gravel production, its value rose by 11.5%, up by \$38 million. Relatively small decreases took place in the production of gold and portland cement, but the values of each were up by more than \$10 million. Smaller yet significant increases also took place in the values of industrial sand and gravel (substantial increase in unit value), Grade-A helium, and dimension stone (table 1). The largest decrease in a nonfuel mineral commodity value was in the production value of crushed stone, down by \$9.5 million.

About 67% of Colorado's nonfuel mineral production value in 2007 resulted from the production of metals—molybdenum concentrates, gold, and silver—in descending order of value; this established a high of recent years following a 62% share in 2006, 65% in 2005, 52% in 2004, 30% in 2003, and 23% in 2002. Although gold, in particular, also has shared in the increased percentage of metals value, the largest share of the increases from 2003–07 (as compared with recent years past) mainly resulted from the significantly higher increases in the average annual prices of molybdenum.

In 2007, Colorado continued to be 4th in the quantity of gold produced among 10 producing States and rose to 1st from 2d in the production of molybdenum, to 6th from 7th in construction sand and gravel, and to 11th from 12th in gemstone production (gemstones based upon value). The State continued to produce significant quantities (in descending order of value) of portland cement, crushed stone, and crude gypsum.

¹The terms "nonfuel mineral production" and related "values" encompass variations in meaning, depending upon the 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 2007 USGS mineral production data published in this chapter are those available as of June 2009. All USGS Mineral Industry Surveys and USGS Minerals Yearbook chapters—mineral commodity, State, and country—can be retrieved over the Internet at URL <http://minerals.usgs.gov/minerals>.

The following narrative information was provided by the Colorado Geological Survey² (CGS), and much of the data are based on its own surveys, estimates, and information gathered from company annual reports.

Exploration and Development Activities

Mineral exploration and development activity continued at a steady pace in 2007. New mining claims filed pertaining to mineral resources on Federal land in the State totaled 10,628, nearly doubling the 5,693 of 2006. Most of these claims were filed for uranium resources, but numerous other resources provided targets for nonfuel minerals, especially those of copper, gold, molybdenum, and silver.

Metals

Copper.—Constellation Copper Corp.'s Cashin deposit was a sandstone-hosted copper prospect near the Colorado-Utah border. Planned as a satellite operation to Constellation's Lisbon Valley Mine, located about 24 kilometers (km) (15 miles) to the southwest in Utah, the closing of that Utah facility resulted in the development of the Cashin Mine being placed on inactive status. The Cashin deposit contained an estimated 5.2 million metric tons (Mt) of proven and probable ore grading 0.55% copper and containing slightly more than 28,000 t (more than 62 million pounds) of copper in the Triassic Age Wingate Sandstone.

Gold and Silver.—Development and permitting activities continued on several small gold and silver properties. The Bates-Hunter Mine in Gilpin County was a gold project being developed by Wits Basin Precious Metals, Inc. of Minneapolis, MN. The company controlled the mine and mill and had active mining and water discharge permits to cover an operation of 63,500 metric tons per year (t/yr) (70,000 short tons) of gold ore. Northwest of Denver, Calais Resources, Inc.'s Caribou Consolidated Project near Nederland, Boulder County, was focused on defining a large gold/silver deposit on a property assembled from various patented and unpatented claims and operational rights totaling more than 890 hectares (ha) (more than 2,200 acres). Results of nearly 42,700 meters (m) (140,000 feet) of core drilling have indicated an estimated 12,400 kilograms (kg) (400,000 troy ounces) of gold and 390,000 kg (12.5 million troy ounces) of silver to be contained in the Caribou Consolidated property. Fairburn Mining & Exploration Co. (the owners of the Fairburn Mine) which was west of Denver in Gilpin County, began refurbishing those workings in preparation for a silver mining operation.

²James Burnell, Geologist and Minerals Program Director, Mineral Resources and Mapping, Colorado Geological Survey, authored the text of the State mineral industry information provided by that agency.

Molybdenum.—In the west central portion of the State, Kobex Corp.'s Lucky Jack molybdenum deposit consisted of 25 patented and 520 unpatented mining claims covering about 2,190 ha [5,400 acres (8 square miles)], 8 km northwest of Crested Butte, Gunnison County. Lucky Jack was discovered in the 1970s beneath the Keystone Mine, a silver-lead-zinc mine that operated until the late 1970s. Core drilling has identified an estimated 200 Mt of molybdenum ore grading at 0.336% molybdenum disulfide, potentially making this a world-class deposit according to the company. In 2007, Kobex was in the process of preparing permit applications and operation plans to continue development of the project. However, Kobex was facing some resistance from the community regarding the development of the mine because also under consideration was the possibility of extending the 10-year high-grade molybdenum operation further into a 50-year low-grade ore operation if the economics then were favorable. This introduced the factor of the potential environmental impact of a 60-year mine life rather than just one of 10 years (Salter, 2008).

Another large deposit was located at the old southwestern Colorado mining town of Rico, Dolores County. Drilling by The Anaconda Company in the early 1980s identified an estimated resource of about 120,000 metric tons (t) of molybdenum. Interest in further exploration and project evaluation was considered by the exploration firm, Bolero Resources Inc., and some landowners made inquiries regarding the possibility of marketing their properties for their mineral potential during the year, but at yearend no plans had been put in place regarding the deposit (Levin, 2008).

The most significant news in molybdenum was that Freeport-McMoran Copper and Gold, Inc.'s (FCX) Climax Mine, which took steps to reopen and resume production in 2007. Climax, located on the Continental Divide at Fremont Pass between Leadville and Copper Mountain in central Colorado, was the first major molybdenum mine in the United States. The mine has been on care-and-maintenance status since 1995, but the recent high price of molybdenum and the recognition of a large reserve of molybdenum resources at the mine, interested the company enough to invest more than \$500 million to completely refurbish and rebuild the facilities for reopening the mine, with production scheduled to begin in 2010. A recent prefeasibility study showed that the mine potentially could produce between about 9,000 t/yr and 13,000 t/yr (about 20 million to 30 million pounds) of molybdenum and employ 300 workers. The most current reserve estimates were that the Climax deposit contained 140 Mt of molybdenum ore grading at 0.19% molybdenum, containing 227,000 t of recoverable molybdenum. Estimates of additional resources indicated more than 510 Mt of molybdenum ore at 0.16% molybdenum. The old facilities were being demolished and replaced with new buildings including a mill capable of processing more than 27,000 t per day of molybdenum ore. Starting in 2010, the Climax Mine was expected to produce about 13,600 t/yr of molybdenum in concentrate.

Commodity Review

Industrial Minerals

Sand and Gravel, Construction and Stone, Crushed.—Colorado produced a total of about 57 Mt of construction aggregate in 2007, down about 4.7% from 2006 (table 1). Leading aggregate producers in the State included Lafarge North America Inc., Oldcastle Materials, Inc., and Holcim/Aggregate Industries. The total value of Colorado aggregate was about \$442 million, up about \$28 million from that of the 2006. Construction sand and gravel production was 46.1 Mt, down 4% from 2006 production total of 48 Mt. The average price per ton of sand and gravel in 2007 was \$7.91. Crushed stone production decreased by about 7.4% from 12.1 Mt in 2006 to 11.2 Mt in 2007. The average unit value for crushed stone was \$6.93 per ton. Forty-eight new sand, gravel, and crushed stone mining permits were issued in the State during 2007.

Stone, Dimension and Decorative Stone.—Colorado produced approximately 18,000 t of dimension and decorative stone in 2007. The most abundant stone produced was sandstone from the Lyons Formation in Boulder and Larimer Counties, east of the Front Range, the first mountain range of the Rocky Mountains west of the Great Plains along the 40th parallel of latitude north. Granite, marble, rhyolite, and tuff were also produced as part of the State's industry. The Yule Marble quarry in Gunnison County produced a pure, white marble that has been used in such memorials as the Tomb of the Unknowns in the Arlington National Cemetery and the Lincoln Memorial in Washington, DC. There were 28 different quarries that operated in 2007, including 14 in Larimer County and 9 in Boulder County.

Cement.—CEMEX, Inc. produced portland and masonry cement at its Boulder County mine and processing facility in Boulder County, and Holcim (US), Inc. operated its Portland Plant near Florence in Fremont County. GCC Rio Grande, Inc. (a subsidiary of Grupo Cementos de Chihuahua) permitted a new state-of-the-art cement plant in Pueblo. The plant, scheduled to open in 2008, was being built to produce about one million tons of cement per year, using limestone from the Fort Hays member of the Niobrara Formation.

Common Clays and Shale.—In 2007, Colorado mines produced more than 170,000 t of common clay and shale with a value of \$1.1 million; this represented an 18% decrease in production from that of 2006 (table 1). Much of the clay mined in the State was common clay, used mainly to produce bricks and tiles or for use in the manufacture of cement and lightweight aggregate. In eastern Colorado, clay was mined principally from three geologic formations: the Laramie Formation (Upper Cretaceous Age), the Dakota Sandstone (Lower Cretaceous Age), and the Dawson Formation (Upper Cretaceous Age to Tertiary Age). Elsewhere in the State, clay deposits have been mined from within the Benton, Lykins, Mesaverde, Morrison,

Niobrara, and Vermejo Formations (ranging in age from Triassic to Cretaceous). Principal producers of clay products were Robinson Brick Co., Denver Brick Co., Summit Brick and Tile Co., and TXI Operations (Texas Industries).

Gypsum.—American Gypsum Co. in Eagle County and Colorado Lein Co. in Larimer County produced gypsum in 2007. American Gypsum operated a wallboard plant adjacent to its mine in the town of Gypsum, where the commodity was excavated from evaporite deposits using a surface grinder. Colorado Lein in LaPort produced gypsum from the Permian Age Lykins Formation for use within the State in the cement industry.

Sodium Bicarbonate.—Natural Soda, Inc. solution mined naturally occurring sodium bicarbonate from nahcolite deposits on leases in the Piceance Basin of Rio Blanco County. The two principal markets for Natural Soda, Inc. were the food industry and the animal feed industry, both of which largely avoided the economic downturn of 2007.

Metals

Gold and Silver.—The CGS estimated that total gold production for the State in 2007 was more than 8,700 kg (280,000 troy ounces), down by about 8% from that of 2006, at an approximate value of more than \$180 million. The two main producers were the Cresson Mine, run by the Cripple Creek and Victor Gold Mining Co. (a subsidiary of AngloGold Ashanti, Ltd., of South Africa) and the Cash Mine, a small underground mine in Boulder County operated by Mont Royal Ventures, Inc. The Cash Mine began producing from the Gold Hill District west of the city of Boulder at yearend 2006. The Cash property

consisted of about 190 ha that contained 18 former producing mines. Additional small amounts of gold were produced from small placer mines that do not publically disclose their production data. Silver was produced in 2007 as a byproduct of gold mining.

Molybdenum.—Colorado led in molybdenum production in 2007 with more than one-fourth of U.S. production coming from the Henderson Mine in Clear Creek County, operated by the FCX. The increased production of molybdenum in recent years largely has been motivated by its continued high prices, that peaked at nearly \$73 per kilogram (\$33 per pound) in 2007. Molybdenum ore at the Henderson Mine was transported beneath the Continental Divide to the company's mill in Grand County by a 24-km-long (15-mile-long) conveyer. Historically, from the Henderson Mine, more than 154 Mt of molybdenum ore have been extracted with a production of more than 370,000 t (about 830 million pounds) of molybdenum. Reserves have been estimated to be more than 135 Mt of molybdenum ore containing more than 225,000 t (about 500 million pounds) of recoverable molybdenum. The company continued to increase production through aggressive reengineering and efficiency improvements to the operation.

References Cited

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- Salter, Bob, 2008, A persistent pattern—Red lady still threatened: Crested Butte, CO, High Country Citizens' Alliance, 3 p. (Accessed October 15, 2009, at <http://www.hccaonline.org/page.cfm?pageid=5538>.)

TABLE 1
NONFUEL RAW MINERAL PRODUCTION IN COLORADO^{1,2}

(Thousand metric tons and thousand dollars)

Mineral	2005		2006		2007	
	Quantity	Value	Quantity	Value	Quantity	Value
Clays, common	255	1,610	211	1,300	174	1,100
Gemstones	NA	358	NA	261	NA	261
Lime	29	3,900	50	5,750	W	W
Sand and gravel, construction	44,700	280,000	48,000	327,000	46,100	364,000
Stone:						
Crushed	13,200	90,500	12,100	87,400 ^r	11,200	77,900
Dimension	18	2,400	18	2,400	W	W
Combined values of cement, clays (bentonite), gold, gypsum (crude), helium (Grade-A), molybdenum concentrates, sand and gravel (industrial), silver, and values indicated by symbol W	XX	1,380,000	XX	1,250,000	XX	1,590,000
Total	XX	1,750,000	XX	1,680,000	XX	2,040,000

^rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data. Withheld values included in "Combined value" data.

XX Not applicable.

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

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

TABLE 2
 COLORADO: CRUSHED STONE SOLD OR USED, BY TYPE¹

Type	2006			2007		
	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Number of quarries	Quantity (thousand metric tons)	Value (thousands)
Limestone	7	1,250 ^r	\$11,000 ^r	5	1,200	\$9,420
Marble	1	79	555	1	96	676
Granite	10	5,630	38,900	11	6,200	39,300
Traprock	1	2	15	1	5	22
Sandstone and quartzite	8	3,990	29,200	7	2,630	19,400
Miscellaneous stone	20 ^r	1,140 ^r	7,720 ^r	19	1,110	9,010
Total	XX	12,100	87,400 ^r	XX	11,200	77,900

^rRevised. XX Not applicable.

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

TABLE 3
 COLORADO: CRUSHED STONE SOLD OR USED BY PRODUCERS
 IN 2007, BY USE¹

(Thousand metric tons and thousand dollars)

Use	Quantity	Value
Construction:		
Coarse aggregate (+1½ inch):		
Riprap and jetty stone	W	W
Filter stone	W	W
Other coarse aggregate	W	W
Coarse aggregate, graded:		
Concrete aggregate, coarse	W	W
Bituminous aggregate, coarse	1,290	10,500
Bituminous surface-treatment aggregate	W	W
Railroad ballast	W	W
Other graded coarse aggregate	1,120	11,500
Fine aggregate (-3/8 inch):		
Stone sand, concrete	W	W
Stone sand, bituminous mix or seal	W	W
Screening, undesignated	W	W
Other fine aggregate	448	2,190
Coarse and fine aggregates:		
Graded road base or subbase	W	W
Unpaved road surfacing	W	W
Terrazzo and exposed aggregate	W	W
Crusher run or fill or waste	1,060	836
Other coarse and fine aggregates	62	298
Chemical and metallurgical:		
Cement manufacture	W	W
Sulfur oxide removal	W	W
Special, mine dusting or acid water treatment	W	W
Unspecified:²		
Reported	670	4,920
Estimated	3,500	24,000
Total	11,200	77,900

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

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

²Reported and estimated production without a breakdown by end use.

TABLE 4
 COLORADO: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 2007, BY USE AND DISTRICT^{1,2}

(Thousand metric tons and thousand dollars)

Use	Districts 1, 4, and 5 ³		District 2		District 6	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction:						
Coarse aggregate (+1½ inch) ⁴	777	9,110	--	--	3	23
Coarse aggregate, graded ⁵	2,910	27,500	--	--	--	--
Fine aggregate (-¾ inch) ⁶	1,280	5,490	--	--	--	--
Coarse and fine aggregates ⁷	2,000	4,860	--	--	10	60
Chemical and metallurgical ⁸	W	W	--	--	--	--
Special ⁹	W	W	--	--	--	--
Unspecified:¹⁰						
Reported	578	4,830	--	--	--	--
Estimated	3,300	23,000	123	861	--	--
Total	11,000	76,900	123	861	13	83
Unspecified districts						
	Quantity	Value				
Construction:						
Coarse aggregate (+1½ inch) ⁴	--	--				
Coarse aggregate, graded ⁵	--	--				
Fine aggregate (-¾ inch) ⁶	--	--				
Coarse and fine aggregates ⁷	--	--				
Chemical and metallurgical ⁸	--	--				
Special ⁹	--	--				
Unspecified:¹⁰						
Reported	92	91				
Estimated	--	--				
Total	92	91				

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

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

²No production for District 3.

³Districts 1, 4, and 5 are combined to avoid disclosing company proprietary data.

⁴Includes filter stone, riprap and jetty stone, and other coarse aggregate.

⁵Includes bituminous aggregate (coarse), bituminous surface-treatment aggregate, concrete aggregate (coarse), railroad ballast, and other graded coarse aggregate.

⁶Includes stone sand (concrete), stone sand (bituminous mix or seal), screening (undesignated), and other fine aggregate.

⁷Includes crusher run or fill or waste, graded road base or subbase, terrazzo and exposed aggregate, unpaved road surfacing, and other coarse and fine aggregates.

⁸Includes cement manufacture and sulfur oxide removal.

⁹Includes mine dusting or acid water treatment.

¹⁰Reported and estimated production without a breakdown by end use.

TABLE 5
 COLORADO: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2007,
 BY MAJOR USE CATEGORY¹

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Concrete aggregate (including concrete sand)	8,620	\$63,400	\$7.36
Plaster and gunite sands	121	1,670	13.81
Concrete products (blocks, bricks, pipe, decorative, etc.)	113	549	4.88
Asphaltic concrete aggregates and other bituminous mixtures	2,820	41,600	14.74
Road base and coverings	7,470	48,400	6.47
Road and other stabilization (cement)	59	172	2.91
Fill	1,380	6,270	4.54
Snow and ice control	249	3,200	12.82
Other miscellaneous uses ²	549	5,260	9.58
Unspecified: ³			
Reported	7,140	60,300	8.44
Estimated	17,600	134,000	7.61
Total or average	46,100	364,000	7.91

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

²Includes filtration, golf course, and railroad ballast.

³Reported and estimated production without a breakdown by end use.

TABLE 6
 COLORADO: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2007, BY USE AND DISTRICT¹

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate and concrete products ²	1,250	14,600	2,460	18,500	260	2,330
Asphaltic concrete aggregates and road base materials ³	2,640	25,600	1,650	11,600	952	4,710
Fill	338	1,970	502	1,970	43	195
Other miscellaneous uses ⁴	451	3,610	155	1,640	5	27
Unspecified: ⁵						
Reported	1,280	11,800	1,170	11,000	--	--
Estimated	3,380	25,700	8,190	63,200	901	6,890
Total or average	9,340	83,400	14,100	108,000	2,160	14,100
Use	District 4		District 5		District 6	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate and concrete products ²	2,810	17,300	1,780	10,100	298	2,810
Asphaltic concrete aggregates and road base materials ³	573	3,420	2,090	26,900	2,450	17,800
Fill	370	1,700	119	393	11	51
Other miscellaneous uses ⁴	140	2,580	28	378	19	222
Unspecified: ⁵						
Reported	2,580	25,400	309	674	1,470	10,700
Estimated	769	5,110	3,370	25,700	955	6,970
Total or average	7,240	55,500	7,690	64,100	5,200	38,600
Use	Unspecified districts					
	Quantity	Value				
Concrete aggregate and concrete products ²	--	--				
Asphaltic concrete aggregates and road base materials ³	--	--				
Fill	--	--				
Other miscellaneous uses ⁴	--	--				
Unspecified: ⁵						
Reported	344	682				
Estimated	--	--				
Total or average	344	682				

-- Zero.

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

²Includes plaster and gunite sands.

³Includes road and other stabilization (cement).

⁴Includes filtration, golf course, railroad ballast, and snow and ice control.

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