

The Impact of the Crushed Stone and Sand and Gravel Industry on the U.S. Economy

Executive Summary

The crushed stone and sand and gravel industries (the aggregates industry) are important to the economic health of the nation and constitute a major source of employment and income nationally and in the producing states. This industry produces major and essential inputs to many other industries across the breadth of the national economy. It makes a significant contribution to Gross Domestic Product and the economies of many states. As basic inputs to the nation's goods-producing industries—agriculture, manufacturing and construction—the aggregates industry provides the foundation for the nation's economic vitality. The importance of this industry can be measured by the value of its outputs and their contribution to the intermediate and final products of industries that use aggregates in their production processes.

While these monetary values and related employment and income impacts are significant, they do not account for all of the benefits that flow to the national and state economies from the aggregates industry. The final products that incorporate the output of the aggregates industry define the cities and communities where the nation's citizens live and work and the infrastructure that supports their high quality of living and their high and growing levels of productivity. These contributions can be seen in all facets of our daily lives, in the achievements of our society, in the strength and durability of the nation and in its ability to protect and preserve our achievements as a nation for future generations. The impacts reported herein are the benefits that are easy to measure—the dollars and cents of the industry. While these impacts are impressive, they are not the entire story.

Industry Impacts at the National Level

In 2003, output of the aggregates industry totaled \$14.63 billion. The crushed stone sector generated \$8.625 billion in total sales while the sand and gravel sector accounted for \$5.81 billion in sales. These sales represented basic inputs to a wide variety of industries ranging from agriculture and construction to glass products. The industries that depend on the outputs of the aggregates industry produced products that were subsequently used in the production of other intermediate products and eventually, produced final products for consumers and businesses. The contribution of the aggregates industry can be traced to its major consumers as summarized below and are depicted in the following diagrams and Appendix tables.

- Sales to businesses involved in new construction accounted for 37.2 percent of the total output of the aggregates industry;

- Maintenance and repair represented 24.9 percent of total sales in the aggregates industry;
- Stone and clay products firms bought 23.3 percent of the output of the aggregates industry;
- Other major consumers of outputs from the crushed stone industry include agriculture (5.2%), primary iron/steel manufacturing (1.1%) and non-metallic minerals mining (0.9%).
- Other major consumers of outputs from the sand and gravel industry include petroleum refining (10.4%), glass (5.3%), non-metallic minerals mining (2.4%) and primary iron and steel manufacturing (2.4%).

Figure 1

Output Distribution for Crushed Stone (2001)

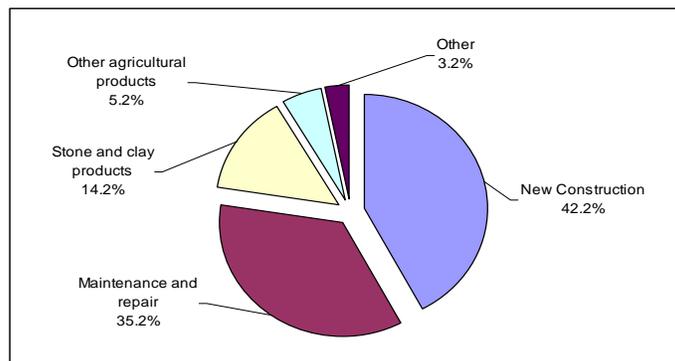
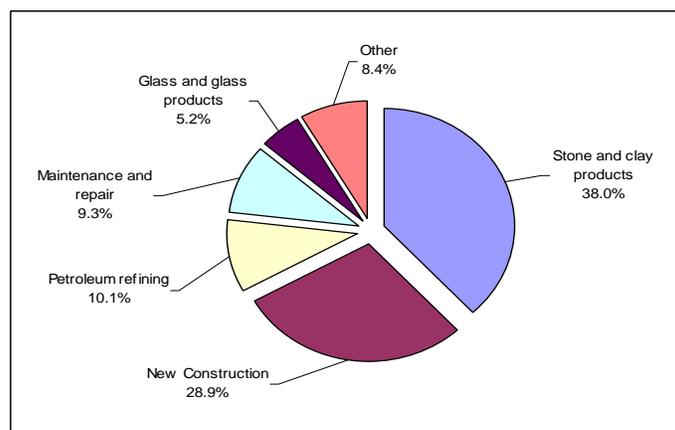


Figure 2

Output Distribution for Sand and Gravel (2001)



The full economic impact of these sales by the aggregates industry reflects both the direct value of its sales and the subsequent economic benefits resulting from the re-spending of

payroll income, purchases by these industries in support of their operations, and the re-spending of the proceeds of the industry’s sales throughout the national economy. The total value of these direct and indirect benefits at the national level represents the industry’s contributions to the total output of the economy; that is, its contribution to Gross Domestic Product. These sales and subsequent re-spending of the industry’s proceeds in the national and state economies support employment in the aggregates industry as well as across all other sectors. Similarly, this spending generates personal earnings—income in the form of payroll and wages and salary of workers supported by the re-spending of monies generated by the sales of crushed stone and sand and gravel. The magnitudes of these benefits are significant (Table 1).

- The crushed stone industry has a multiplier of 2.62—for every \$1 of output produced by the industry, an additional \$1.62 is generated in the national economy; and for each \$1 million in output, the industry generates 19.2 new jobs nationwide with personal earnings of \$722,800.
- The sand and gravel industry has a multiplier of 2.52—for every \$1 of output produced by the industry, an additional \$1.52 is generated in the national economy; and for each \$1 million in output, the industry generates 19.9 new jobs nationwide with personal earnings of \$757,300.

Table 1

Impacts of the Crushed Stone and Sand and Gravel Industries
on the U.S. Economy, 2003
(in billions of 2003 \$s)

Sector	Direct Outlays	Total Output	Personal Earnings	Jobs Generated
Crushed Stone	\$8.625	\$22.55	\$6.24	165,600
Sand & Gravel	5.810	14.63	4.40	115,612
Totals	\$14.435	\$37.18	\$10.64	281,212

Sources: multipliers from RIMS II I-O Model, U.S. Department of Commerce, Bureau of Economic Analysis, 2000.

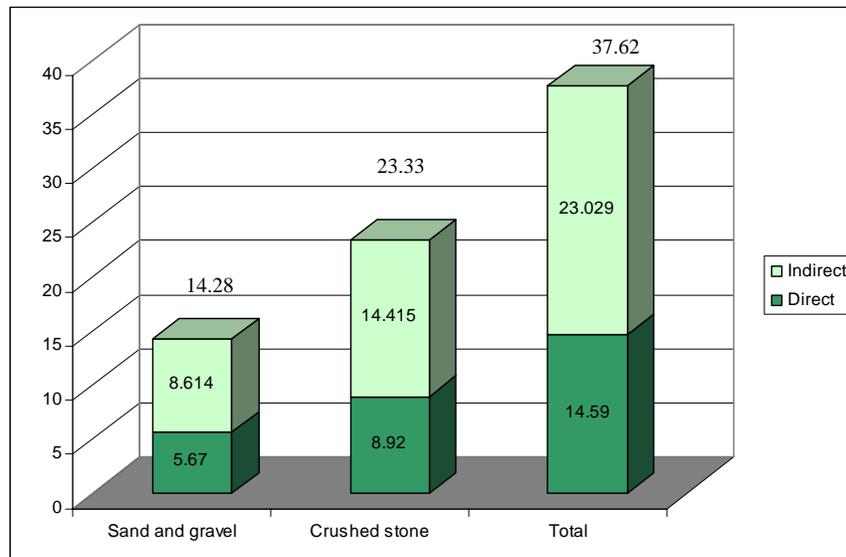
Conclusion

The aggregates industry is important to the national economy by providing essential inputs for a wide range of producers of intermediate goods. The output of the aggregates

industry generates substantial additional value to the national economy as its spending is recycled through the economy. These indirect benefits totaled \$22.745 billion in 2003. When these indirect benefits are combined with the industry's direct outputs, they represent a \$37.2 billion contribution to the national economy (GDP), support 281,212 jobs in all sectors of the economy with personal earnings totaling \$10.64 billion. All states benefit from the aggregates industry's output and its related direct and indirect spending, job growth and income generation. As basic inputs to the goods-producing industries—agriculture, manufacturing, and construction—the crushed stone and sand and gravel industries provide the foundation for nation's economic vitality.

Figure 3

Economic Impact of the Aggregates Industry, 2003 (\$s in billions)



The Impact of the Crushed Stone and Sand and Gravel Industry on the U.S. Economy

Introduction

The economic impact of the crushed stone and sand and gravel industries (hereafter termed the “aggregates industry”) can be measured in dollars and cents and by the jobs and income it generates. By these measures, the aggregates industry’s numbers are large. And, while the aggregates industry is a significant force within the national and state economies, it is even more significant than its numbers suggest because of its fundamental contribution to the physical capacity of the national and state economies and their production of goods and services and to the support of a high quality and productive environment for their businesses and residents. While the research reported herein is directed at measuring the economic impact of the aggregates industry at the national and state levels, the importance of this industry beyond these numbers should not be overlooked.

The objective of this research is to measure the contribution of the crushed stone and sand and gravel industries to the nation’s Gross Domestic Product (GDP) or the total output of the national economy. This contribution consists of the direct spending of the aggregates industry or the total value of its output in combination with the added value generated by these inputs to the construction and manufacturing processes in later stages of production. Additionally, the re-spending of the salary and wages supported by the aggregates industry and its suppliers are an important source of economic benefits. These direct and indirect (and induced) outputs constitute the industry’s total output or contribution to the national economy (GDP). The direct spending (or value of output) of the aggregates industry supports employment in the industry as well as the jobs of its suppliers and within the broad base of industries patronized by the industry’s employees. These jobs and their associated earnings supported by the direct spending of the aggregate industry provide a very real and easily understood measure of the industry’s importance within local economies.

The scope of this report builds from a brief overview of the crushed stone and sand and gravel industries that is intended to provide the broader understanding and context for the economic impact measurements developed in the subsequent sections. The economic impacts reported here document the aggregates industry’s contribution to the national and state economies in terms of direct and total dollar values, jobs and personal earnings, in 2003, the latest year for which total industry spending was available at the time of this analysis. However, these economic impacts extend down to the smallest locales in all of the states due to the large number of small businesses involved in all facets of the production of aggregates, the use of aggregates in construction and manufacturing, and beneficiaries from the infrastructure, built environment, and products resulting from the use of aggregates. As fundamental inputs to an advanced economy, the full benefits associated with the aggregates industry are substantially more significant than the dollar value of their initial sales. Still, these dollar values and the jobs and incomes they

support stand alone as economic facts about which there should be no debate. The methodology for calculating economic impacts including multipliers and inter-industry transactions is included in the appendix providing the documentation underpinning the research and related analyses.

The Importance of the Aggregates Industry

The aggregates industry has out-performed the U.S. economy during the past decade in spite of its cyclical sensitivity. Industry sales totaled \$8.86 billion in 1990 and grew to \$13.68 in 2000 for a ten-year gain of 54.4 percent. Sales in 2003, totaling \$14.44 billion, reflected a small gain from sales in 2002 but lagged the sales record set in 2001. The 2001-2003 sales pattern reflects the economic impacts of the 2001 recession and slow and halting recovery in 2002. The pattern of sales growth over this period is shown in Table 1 and the figure below:

Table 1

National Sales Trends in the Crushed Stone
and Sand and Gravel Industries: 1990-2003
(in millions of current dollars)

Year	Crushed Stone	Sand & Gravel	Total
1990	\$5,590	\$3,270	\$8,860
1991	5,140	2,810	7,950
1992	5,590	3,340	8,930
1993	5,930	3,530	9,460
1994	6,620	3,740	10,360
1995	6,740	3,900	10,640
1996	7,180	4,000	11,180
1997	7,970	4,260	12,230
1998	8,130	4,910	13,040
1999	8,180	5,390	13,570
2000	8,290	5,390	13,680
2001	8,920	5,670	14,590
% Change 1990-00	48.3	64.8	54.4
2002	8,590	5,650	14,340
2003	8,625	5,810	14,435
% Change 2000-03	4.0	7.8	5.5

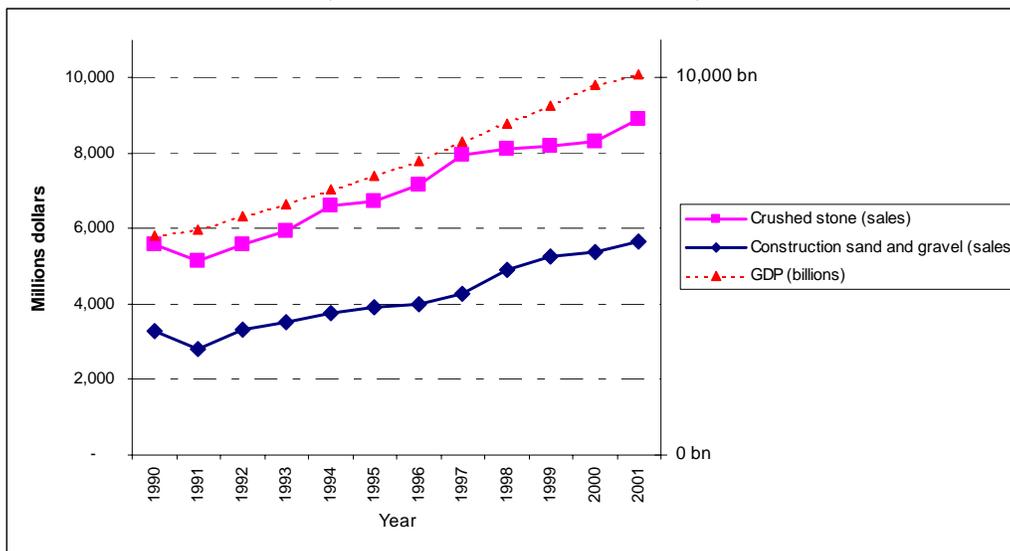
Source: United States Geological Survey, Minerals Yearbooks (1993, 1996, 1999, 2001, 2002, and USGS estimates for 2003)

The sales trends for crushed stone and sand and gravel over the 1990s show the industry was negatively impacted by the 1990-1991 recession with sales declining a combined 10.3 percent reflecting the slowdown in both private and public construction. It is also evident from this output pattern that aggregates lagged the national economy by one year. The sales gain in 1992 followed the economy's recovery by one year.

The recession of 2001 produced a similar pattern for the sales of aggregates as occurred in the early 1990s. The impact of the 2001 recession is seen lower aggregate sales in 2002 (-1.7%) but the slow recovery in 2002 and 2003 resulted in only a moderate recovery in demand for aggregates with 2003 sales up just 0.7% from 2002. This cycle's unusually slow recovery followed by the acceleration of economic activity in 2004 should be reflected in accelerating sales of aggregates in 2004 and 2005. This historic pattern of GDP and sales of aggregates is illustrated in the following figure.

Figure 1

National Sales Trends in the Crushed Stone and Sand and Gravel Industries: 1990-2001
(in millions of current dollars)



The scale of the aggregates industry is also evident in the number of firms and sites involved in producing the industry's output. In 2001, there were 1,400 firms operating 3,700 active quarries producing crushed stone in 47 states. Sand and gravel operations exist in all fifty states. In 2001, there were 3,900 firms operating in 6,000 locations. Direct employment for these 5,400 firms producing crushed stone and sand and gravel is estimated to total approximately 120,000.

While the importance of an industry is readily seen in the value of its output and the size of its business and employment base, it can also be measured by the contribution the

industry's output make to the quality and capacity of built environment; that is, by the products and facilities in which aggregates are utilized and the benefits these consumer goods and finished products have within the national economy.

An informal survey of major aggregate companies provides estimates for 2003 sales by end-user. These data provide an update for the 1998 Coopers & Lybrand report cited in the 2003 edition of this Report. These data identify the following end users and percentage share by sales value for total aggregates consumption. It shows that construction-related uses consume 96 percent of the total with government end uses accounting for 44 percent of total sales and the private sector accounts for the remaining 56 percent of the end uses; only 1 percent of total sales were reported as being consumed by non-construction (agriculture and industrial) uses. This sales pattern confirms a shift reflecting increases in residential development during 2003 while commercial and government construction slowed in response to the weak economy.

Table 2

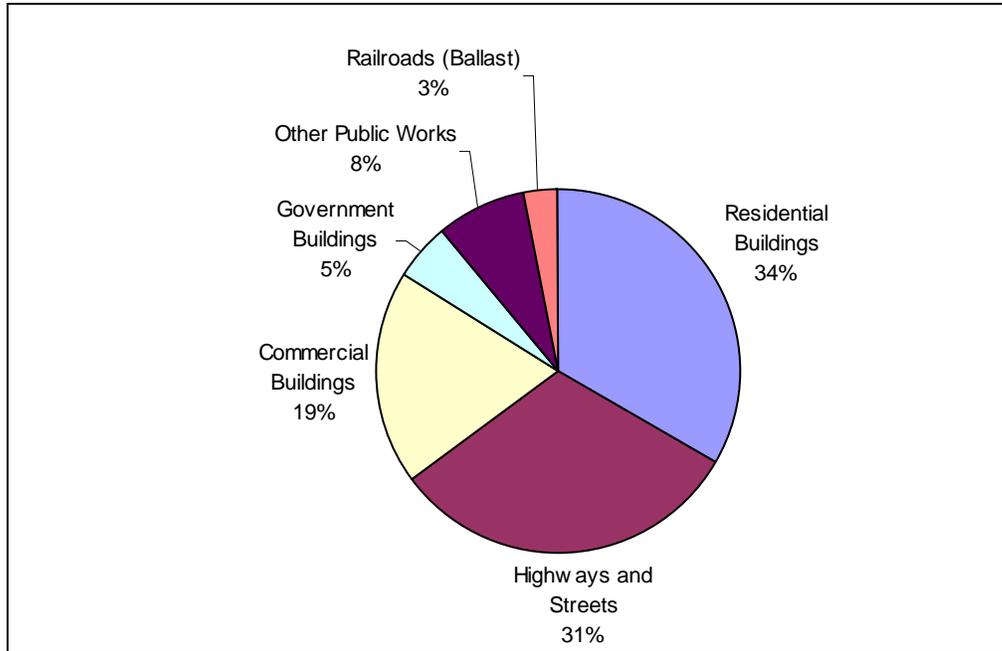
End Uses of Aggregates
(percentage)

End Uses	Percent Of Total Value
Residential Buildings	33.0
Highways and Streets	31.0
Commercial Buildings	19.0
Government Buildings	5.0
Other Public Works	8.0
Railroads (Ballast)	3.0
Private Nonconstruction	1.0
Total	100.0

Source: NSSGA, 2004

Figure 2

End Uses of Aggregates



The importance of the aggregates industry to the nation’s built environment and essential infrastructure is illustrated by some simple facts selected by a long list assembled by the National Stone, Sand & Gravel Association in 50 Fascinating Facts about Stone, Sand & Gravel and others provided by building industry sources.

- Aggregates production account for more than half of the non-fuel mining volume in the United States;
- Aggregates make up more than 94% of asphalt and 80% of concrete;
- It is estimated that 31,000 tons of aggregates are necessary to construct one mile of a four-lane (88’ wide, 12” thick) arterial highway;
- Construction of an average modern home requires about 350 tons of aggregates;
- Approximately 5,000 tons of aggregates are required for the construction of a 100,000 square foot office building excluding parking lots and façade treatment;
- An estimated 2,500 tons of aggregates are used in the foundation and slab for a 100,000 square foot retail center exclusive of parking lots and service roads;

- Crushed stone, sand and gravel are used by water and sewer facilities for filtration in water purification and sewage treatments;
- Ground and pounded aggregates are used in the manufacture of such varied household items as paper, paint, cosmetics, pharmaceuticals, toothpaste, chewing gum and cleansers; and,
- About 10 metric tons of aggregates per person (22,000 pounds) are used annually in the U.S., up from 3.5 tons per person sixty years ago.

Aggregates are basic and fundamental inputs to the building blocks of society and a strong economy. They are the essential ingredients of the nation's infrastructure—its transportation systems, sewer and water systems, and public facilities—that are required to support a growing and healthy economy. Without fast and efficient transportation and safe water supply and building systems that support rapid and continuing gains in productivity, the national economy would stagnate and lose its global competitive edge. The highways, airport facilities, schools, hospitals, cultural centers, factories, office buildings and retail centers and the housing stock are our visible measures of progress.

The ability to meet the growing needs of the population and dynamic economy and to protect and defend the United States against all enemies are our national goals. Aggregates are central to achieving these goals. They are part of every building and highway, they will be part of the system of barriers protecting the nation's strategic sites from terrorist attack, and they will continue contributing to the nation's agricultural and manufacturing base—aggregates are basic ingredients in shaping the nation's future.

In this broad context, the true value of aggregates cannot be measured in dollars and cents. Still, the direct value of aggregates as inputs purchased by consumers for use in other products can be measured and the consequences of these transactions and the value they create within the economy can be calculated. These output values and their employment and income impacts establish the basic economic dimensions of the aggregates industry. These industry values are calculated for the nation and for the states in the following sections.

The Impact of the Aggregates Industry on the National Economy

The economic impact of the aggregates industry at the national level is a function of the total magnitude of its sales and the interdependencies among its consuming sectors that will generate further value added and inter-industry sales including products incorporating aggregates from early-stage production through final consumption. The aggregates industry's role in the national economy as measured by its sales to other

industrial sectors (Table 3) provides the baseline for calculating the industry's economic impacts. The income and employment multipliers presented in Table 4 measure the secondary impacts of these sales as intermediate products incorporating aggregates are processed into final goods. These multipliers also capture the economic effects of the spending of wages and salaries generated in the aggregates industry as these funds are re-spent in the economy.

Inter-Industry Sales

The output of the aggregates industry in the United States totaled \$14.44 billion in 2003 with sales in the crushed stone industry accounting for \$8.625 billion or 60 percent and sand and gravel industry sales totaling \$5.81 billion or 40 percent of the total. The distribution of these sales by industry sectors across the national economy are presented in Table 3.

The construction industry is the largest consumer of output produced by the aggregates industry with new construction accounting for \$5.37 billion in sales, or 37.2 percent of the total and maintenance and repair accounting for \$3.6 billion in sales, or 24.9 percent. Together these two categories of aggregate consumption represented 62.1 percent of the industry. Within construction and repair and maintenance, residential activities represented the largest category of sales (\$4.212 billion out of \$8.971 billion or 47.0%). The construction and repair and maintenance of streets and highways generated \$3.7 billion in sales in 2003, accounting for 41.5 percent of combined sales to the construction industry. Stone and clay products including flat glass and gypsum is the third largest consumer of total aggregates (24.3% of total aggregates sales but is the largest consumer of sand and gravel with sales of totaling \$2.28 billion or 39.2 percent of all sand and gravel output (by value).

While new construction, stone and clay products, and maintenance and repair had sales totaling \$12.47 billion in 2003 and represented 86.4 percent of the total output of the aggregate industry, there were also a large number of smaller consumers spread across the agriculture, mining, manufacturing and service sectors. This broad-based transactions matrix underscores the interdependence of the aggregates industry within the national economy.

Table 3

Crushed Stone and Sand and Gravel Industries
Distribution of Output, 2003
(in millions of 2003 dollars)

Industry Sector	Crushed Stone (142)	Sand and Gravel (144)	Total
New Construction	\$3,640	\$1,734	\$5,374
Residential	1,919	1,049	3,002
Commercial	207	78	285
Streets/Highways	1,391	517	1,908
Infrastructure	123	56	179
Stone and Clay Products*	1,226	2,277	3,503
Maintenance and Repair	3,037	560	3,597
Residential	842	386	1,210
Commercial	119	37	156
Streets/Highways	1,703	115	1,818
Infrastructure	373	40	413
Industrial and Other Chemicals	52	--	52
Agricultural Fertilizers/Chemicals	43	--	43
Non-metallic Minerals Mining	78	139	217
Petroleum Refining	--	607	607
Other Agricultural Products	449	--	449
Primary Iron/Steel Mfg	96	139	235
Glass and Glass Products	--	310	310
Primary Non-ferrous Materials Mfg	--	30	30
Coal Mining	--	10	10
Miscellaneous Manufacturing	3	--	3
Educational/Social Services	--	4	4
Retail Trade	1	--	1
Totals	\$8,625	\$5,810	\$14,435

Sources: Bureau of Economic Analysis, US Department of Commerce; USGS Mineral Industry Survey, 2003; GMU Center for Regional Analysis

*includes flat glass, glassware, other glass products, structural clay products, concrete, gypsum and plaster products cut stone and stone products.

Not only are the aggregate industry's primary customers central to the nation's construction and manufacturing industries, but products produced for final consumption also are dependent on the industry's outputs. This sectoral breadth enlarges the secondary and induced impacts that the direct output of the aggregates industry has on the overall national economy as measured by its income and employment multipliers.

Income and Employment Multipliers

To calculate the impact of the aggregates industry on the national economy, the multipliers presented in Table 4 are applied to the value of industry sales as shown in Table 3.

Table 4

Final Demand Multipliers For the United States
Output, Earnings and Employment
(per \$1 change in output)

Sector	Output (\$)	Earnings (\$)	Employment (jobs)
Crushed Stone	2.6160	.7228	19.2
Sand & Gravel	2.5194	.7573	19.9

Source: Bureau of Economic Analysis, US Department of Commerce

Note: due to 2000 date of regional data, jobs are calculated based on output values expressed in inflation adjusted 2000 dollars.

The output multiplier indicates that for each dollar sales of crushed stone, an additional \$1.62 is generated in the national economy for a total impact of \$2.62. With sales of crushed stone totaling \$8.625 billion in 2003, the total impact of these sales on the national economy equaled \$22.55 billion. For sand and gravel, with total sales of \$5.81 billion in 2003 and an output multiplier of 2.52, the total economic impact of these sales at the national level was \$14.63 billion.

The total economic impacts of the aggregates industry represent the sum of these contributions to total output or \$37.2 billion for an aggregate multiplier of 2.576. The direct output of the aggregates industry supported a total of 281,212 full-time equivalent jobs including both direct jobs (jobs in the industry) and jobs supported by the industry's spending (payroll spending and spending by suppliers). These jobs supported total personal earnings of \$10.6 billion. The output, earnings and employment impacts of sales by the aggregates industry in 2003 are summarized in Table 5.

Table 5

The Impact of the Aggregates Industry
On the National Economy in 2003
(in billions of dollars and thousands of jobs)

Sector	Direct Outlays	Total Output	Personal Earnings	Employment Generated
Crushed Stone	\$8.625	\$22.55	\$6.24	165,600
Sand & Gravel	5.810	14.63	4.40	115,612
Totals	\$14.435	\$37.18	\$10.64	281,212

The Impact of the Aggregates Industry on State Economies

The economic impacts generated by the aggregates industry shown in Table 4 are spread across all states. The spending or output captured within each state from the production of crushed stone and sand and gravel has an associated impact on the state's economy, its job base and the level of personal earnings generated in that state. The magnitude of the multipliers (see the Appendix) varies by state depending on the geographic size of the state and the complexity of its economy. A state having a smaller geographic size and/or a simpler economy will have a lower multiplier as it captures or retains a smaller share of the indirect benefits than will a larger state or a state with a complex economy. Additionally, some indirect benefits spread across state borders and are counted at the national level but not at the state level.

Aggregates are mined in almost every state and, as a result, the economic benefits flowing from this industry are broadly distributed nationally. The production of crushed stone and sand and gravel is reported in all but three states (Delaware, Louisiana and North Dakota did not report any sales) but is concentrated within several states. The value of crushed stone production in the ten states with the greatest output totaled \$4.56 billion or 52.9 percent of the industry's total and almost twice as much as the combined sales of the next ten states. Altogether, these top twenty producing states accounted for 80.5 percent of crushed stone sales in 2003 while the remaining 37 states accounted for the remaining 19.5 percent of industry sales.

The state-by-state distribution for sand and gravel sales reflected a similar pattern to that for crushed stone. While all state economies participate in this industry, the top ten producing states had sales totaling \$3.3 billion or 57 percent of the total. Sand and gravel sales in these top ten producing states were almost three times greater than the total sales for the second grouping of states that accounted for \$1.18 billion or 20.2 percent of the total. Combined the top twenty producing states had sand and gravel sales of \$4.49 billion and accounted for 77.3 percent of the total and the remaining thirty states accounted for 22.7 percent of sales.

Figure 3

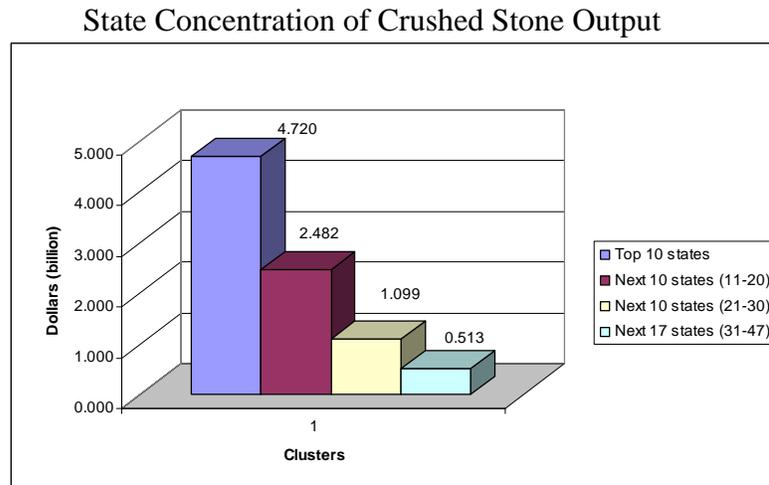
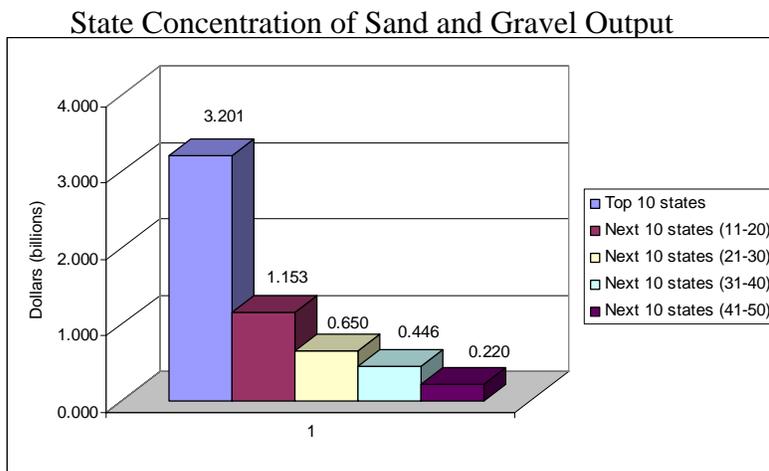


Figure 4



Summary of Economic Impacts

The crushed stone and sand and gravel industry has been shown to have a major impact on the national economy. The outputs of this industry constitute major inputs to the economy's construction sector and contribute to intermediate products that are widely used in the agricultural and manufacturing sectors. Not only are aggregates essential inputs to the nation's built environment and shape its capacity for growth, the production of aggregates occurs in every state and involves thousands of businesses. The broad-based geographic distribution of the aggregates industry helps to assure that its economic benefits are widely shared across the breadth of the economy.

The economic impacts of the aggregates industry can be measured by the growth and magnitude of its output. In 2003, sales of crushed stone totaled \$8.625 billion, up 54.3 percent from 1990, and sales of sand and gravel totaled \$5.81 billion, up 77.7 percent from 1990. The industry's performance during this period—outpacing that of the national economy—distinguishes it from most other goods-producing activities that grew only slowly or not at all. In contrast, the aggregates industry represents a vital and expanding industry that contributed to the economy's growth in dollar terms as well as in capacity building in both the private and public sectors.

In dollar terms, the full value of the aggregates industry to the national economy is reflected in its 2.58 multiplier; that is, for every new dollar of output in the industry an additional \$1.58 is generated in the national economy. In 2003, the value of aggregates sales totaled \$14.44 billion and the industry's total contribution to GDP was \$37.2 billion. Additionally, the industry directly and indirectly supported 281,212 jobs nationwide with personal earnings of \$10.6 billion. These economic benefits were widely distributed among all the states although a small number of states accounted for a disproportionately large share of total sales. The top-ten producing states for crushed stone accounted for \$4.56 billion in sales or 53 percent of the total and the top-ten producing states for sand and gravel accounted for \$3.3 billion in total sales or 57 percent of the total.

Beyond the industry's dollar contribution to the economy and its generation of significant employment and earnings, the aggregates industry has far reaching impacts on the industries that depend on its inputs for their outputs. The construction of housing, commercial structures and all other buildings, public and private, depend on aggregates. The infrastructure and public facilities serving local communities, the highway system spanning the nation, and facilities serving the defense of the nation are dependent on the outputs of the aggregates industry. The full impact of the industry is seen in the enduring strength of the U.S. economy and the high quality of life that characterizes the nation.

Appendices

Glossary of Terms

Aggregates Industry – the combinations of the sand and gravel industry and the crushed stone industry.

Direct Benefit – the dollar value of the output of an industry (firm) produced either as an intermediate good or service or for final demand.

Early-Stage Production – the production of goods or services as inputs to products or services that are used to produce products and services that are incorporated in producing other products; inputs into a production process well before the output of goods and services to be consumed by the final purchaser.

Final Goods/Final Consumption – goods and services that are sold to the final consumer for the benefit of that consumer and not for the incorporation into another good or service.

Gross Domestic Product (GDP) and Gross State Product (GSP) – the value of goods and Services produced within the economy of the designated geographic area.

Indirect Benefit – the additional economic benefits—measured in dollars or jobs—resulting from the accumulated additional value generated by the direct benefit as it is circulated within the economy inclusive of induced effects.

Induced Effects – the impacts of the payroll spending of workers in the industry on local businesses providing goods and services to households.

Input – the output of an industry (firm) that is purchased by another industry (firm) for use in producing the goods and services it sells.

Inter-industry Sales – the sales of goods or services from one industry (firm) to another industry (firm) for use in its production process.

Intermediate Goods or Services – outputs of an industry (firm) that are purchased for use in producing another good or service.

Multiplier – a numerical factor that captures the total value of a direct outlay of or benefit produced by an industry (firm) on the economy as it is re-spent within that economy; an output multiplier measures the contribution (impact) of a direct outlay on the overall economy, an employment multiplier measures the total number of jobs that can be supported by a direct outlay; and a personal earnings multiplier measures the total personal earnings (wages and salaries) generated as a result of a direct outlay and the jobs its supports.

Output – the goods and services produced by an industry (firm) for sale to other industries as intermediate goods or services or for sale to consumers for final goods or services.

Sector – a grouping of industries (firms) by similar characteristics of operations (e.g., retail trade sector, manufacturing sector, construction sector, mining sector, service sector, government sector).

Total Output – the sum of the direct and indirect benefits (outlays) reflecting the combination of the initial sales of a firm (cost of an output) and its subsequent accumulated value as it is cycled through the economy inclusive of benefits (induced) generated by the re-spending of personal earnings; contribution to GDP or GSP.

Value Added – a measure of the incremental dollar value created by an industry (firm) as a result of its production process; the value created beyond the value of the individual inputs.

Economic Impact Analysis Methodology

The input-output (I-O) model developed and maintained by the Bureau of Economic Analysis of the U.S. Department of Commerce provides the analytical framework for the calculation of inter-industry transactions and economic impacts.

Inter-Industry Transactions

The 1997 I-O Model provides a basic matrix of outputs and inputs for the national economy by two-digit commodity numbers in which nonmetallic minerals mining are disaggregated by other categories of mining activity. This transactions matrix provides the most current measure of the economic flows between all other industries in the national economy and mining and the mining sector's sub-categories. However, nonmetallic minerals mining included other activities in addition to crushed stone and sand and gravel. These individual categories were last disaggregated by SIC Code identifying 142 (Crushed Stone) and 144 (Sand and Gravel) in the 1992 I-O Model.

The transactions or inter-industry sales (their percentage distributions) were carried forward and used to calibrate and disaggregate the data provided in the 1997 reports and these (both 1992 and 1997 data on industrial sales transactions) were used as the basis for distributing the sales data for 2003 for the crushed stone and sand and gravel industries provided by the U.S. Geological Survey. The assumption implicit in relying on the structure of inter-industry transactions that characterized the national economy in 1992 and 1997 for the distribution of the aggregates industry outputs in 2003 is that technology has not changed the consumption patterns of aggregates over this period.

While it is likely that the consumption pattern affecting the internal distribution of transactions among industry segments has experienced some change over this period, the total expenditures reported using 2003 data reflect current values and so the total impacts are not affected by using the transaction matrix from an earlier time. Consequently, the inter-industry transactions and resultant distribution of sales and associated impacts should be viewed as being illustrative of the current national economic structure with the knowledge that there could have been minor shifts in consumption patterns among these constituent industries.

National and State Multipliers

The output, earnings and employment multipliers for the national economy and the fifty states were purchased from the Bureau of Economic Analysis, U.S. Department of Commerce. These were developed from its 1998 annual input-output accounts for the U. S. economy (RIMS II Model) and from 2000 regional data. The RIMS II tables of multipliers are attached for “Dimension, Crushed and Broken Stone” and “Sand and Gravel” shown as Table 1.A—Total Multipliers for Output, Earnings and Employment by State. Even though the Dimension, Crushed and Broken Stone category is more inclusive than the Crushed Stone category being assessed, it is assumed here that the multipliers for the more inclusive category provide reasonable measures for the sub-set of crushed stone as it accounts for 97 percent of the combined category’s total sales.

How To Read the Tables

Appendix Tables 1 and 2 report the sales of crushed stone and sand and gravel by state in descending order of sales in groups of ten. Appendix Tables 3 and 4 present the state output, earnings and employment multipliers for crushed stone and sand and gravel. These multipliers are applied to the sales of crushed stone and sand and gravel respectively for each state in Appendix Tables 5 and 6 and these are combined (all aggregates) in Appendix Table 7. As the economic benefits of crushed stone and sand and gravel sales extend beyond the state within which the aggregates are mined, the state-level multipliers do not capture the total economic benefits; rather they only represent the benefits captured within the state of origin.

The magnitudes of interstate spillover benefits are indicated at the bottom of Appendix Tables 5, 6 and 7, and when these are included in the state totals, the national economic impact is determined. Therefore, the state values represent the benefits flowing from the aggregates industry of that state to that state and the interstate spillover accounts for the benefits that extend across state boundaries (aggregates mined in one state and sold or consumed in another state) with the national economic impacts comprised of the sum of the states' impacts plus the interstate impacts.

The three types of impacts shown on Appendix Tables 5, 6 and 7 are calculated from the value of direct spending in the respective aggregates industry in each state multiplied by the respective state's output, earnings and employment multipliers. The total output multiplier indicates the magnitude of impact of the direct spending on the state's economy, its gross state product; that is, for each dollar of additional direct spending, how much will the overall state economy gain. In Appendix Table 5, for the State of Alabama, the crushed stone industry spending (the value of its output) totaled \$275 million in 2003. This \$275 million generated a total of \$539 million in output within the State's economy, \$275 million in direct spending by the crushed stone industry and \$263 million in additional benefits as a result of the re-spending of the crushed stone industry's payroll and operating outlays within the State economy. This calculation of the total output value resulted from the direct spending value being multiplied by the 1.9588 output multiplier (from Table 3) for the State of Alabama. All other state total output calculations are done the same way: output multiplier times direct industry spending.

The earnings calculation result from multiplying the earnings multiplier times the value for direct spending. In the case of Alabama, the earnings multiplier (from Table 3) is multiplied times \$275 million to yield \$144 million in new personal earnings (wages and salaries) generated because of the direct and indirect spending and re-spending of money generated by the crushed stone industry in Alabama. For each dollar of additional output by the crushed stone industry in Alabama, \$0.52 (52 cents) of new personal earnings (income) is generated.

This new personal earnings (taxable wages) result from the jobs supported on- and off-site throughout the state economy as a result of the crushed stone industry. The \$275 million in output by the crushed stone industry in Alabama supported 3,388 jobs; that is, for each additional \$1 million in sales (converted to year 2000\$ by multiplying 2003 sales by 0.94877), 14.6 new jobs are created within the State of Alabama.

Finally, referring to the bottom of Appendix Table 7, the aggregate industry's \$14.435 billion in direct output supported 267,062 jobs (19.5 jobs per \$1 million in 2000\$), these jobs generated \$10.64 billion in new earnings (74 cents for each \$1 in direct industry spending) for an average annual salary of \$39,840, and added \$37.18 billion to the U.S. economy (GDP) in 2003 reflecting \$22.7 billion in added economic activity resulting from the re-spending of the industry's \$14.435 billion in direct value of its output.

References

References on the I-O Model and its transactions matrix and total output distributions across industries are: Bureau of Economic Analysis, Survey of Current Business, January 2001, pp. 9-35 (see Table 2 - The Use of Commodities by Industry, 1997, pp. 26-35); US Census Bureau, General Summary, 1997 Economic Census of Mining, 1997; US Geological Survey, Minerals Yearbook, 2003; Tepordei, Valentin V., Crushed State Statistics and Information Yearbook, USGS, 2003. Minerals Commodity Summmaries 2004, USGS, 2004.

Appendix - Table 1
Sales of Crushed Stone by State in Rank Order, 2001

State	Direct spending (Billions)	
1 Texas	0.624	
2 Pennsylvania	0.564	
3 Florida	0.515	
4 North Carolina	0.485	
5 Georgia	0.467	
6 Illinois	0.459	
7 Virginia	0.446	
8 Missouri	0.411	
9 California	0.396	
10 New York	0.353	
Top 10 states		4.720
11 Tennessee	0.344	
12 Ohio	0.339	
13 Kentucky	0.331	
14 Alabama	0.308	
15 Indiana	0.278	
16 Iowa	0.189	
17 New Jersey	0.184	
18 Oklahoma	0.179	
19 Arkansas	0.169	
20 South Carolina	0.161	
Next 10 states (11-20)		2.482
21 Michigan	0.160	
22 Wisconsin	0.150	
23 Maryland	0.136	
24 Massachusetts	0.121	
25 Kansas	0.110	
26 Oregon	0.100	
27 Colorado	0.089	
28 Washington	0.084	
29 Connecticut	0.083	
30 West Virginia	0.066	
Next 10 states (21-30)		1.099
31 Hawaii	0.064	
32 Minnesota	0.057	
33 Arizona	0.050	
34 Nebraska	0.046	
35 Utah	0.041	
36 Nevada	0.040	
37 South Dakota	0.027	
38 New Mexico	0.026	
39 Vermont	0.024	
40 Maine	0.024	
41 Idaho	0.023	
42 Mississippi	0.022	
43 Wyoming	0.020	
44 New Hampshire	0.018	
45 Montana	0.012	
46 Rhode Island	0.011	
47 Alaska	0.008	
Next 17 states (31-47)		0.513
Other	0.099	
TOTAL	8.920	

Source: CRA with data from USGS Minerals Yearbook 2001

Note: No sales were reported for Delaware, Louisiana, and North Dakota

Appendix - Table 2
Sales of Sand and Gravel by State in Rank Order, 2001

State	Direct spending (billions)	
1 California	1.080	
2 Texas	0.405	
3 Arizona	0.288	
4 Michigan	0.266	
5 Ohio	0.256	
6 Washington	0.220	
7 Colorado	0.194	
8 Nevada	0.173	
9 New York	0.160	
10 Wisconsin	0.159	
Top 10 states		3.201
11 Illinois	0.156	
12 Minnesota	0.155	
13 Pennsylvania	0.128	
14 Indiana	0.124	
15 Florida	0.109	
16 Utah	0.109	
17 Oregon	0.099	
18 New Jersey	0.098	
19 Massachusetts	0.089	
20 Louisiana	0.085	
Next 10 states (11-20)		1.153
21 Maryland	0.085	
22 Mississippi	0.070	
23 Montana	0.067	
24 Alaska	0.066	
25 Virginia	0.064	
26 Iowa	0.064	
27 North Carolina	0.062	
28 Alabama	0.060	
29 Arkansas	0.058	
30 New Mexico	0.055	
Next 10 states (21-30)		0.650
31 Idaho	0.052	
32 Tennessee	0.046	
33 Missouri	0.046	
34 Maine	0.045	
35 Connecticut	0.045	
36 Oklahoma	0.044	
37 New Hampshire	0.043	
38 Nebraska	0.043	
39 South Dakota	0.042	
40 Kentucky	0.040	
Next 10 states (31-40)		0.446
41 South Carolina	0.037	
42 Wyoming	0.035	
43 Kansas	0.029	
44 Georgia	0.029	
45 North Dakota	0.026	
46 Vermont	0.020	
47 Delaware	0.019	
48 West Virginia	0.009	
49 Rhode Island	0.009	
50 Hawaii	0.006	
Next 10 states (41-50)		0.220
TOTAL	5.670	

Source: CRA with data from USGS Minerals Yearbook 2001

Appendix - Table 3
Output, Earnings and Employment Multipliers: Crushed Stone

	Multipliers		
	Output	Earnings	Employment
Alabama	1.9588	0.5221	14.6
Alaska	1.6003	0.4088	13.7
Arizona	1.8039	0.4934	16.2
Arkansas	1.8023	0.4807	16.1
California	1.8816	0.5198	11.3
Colorado	1.944	0.5448	15.2
Connecticut	1.755	0.4747	8.9
Florida	1.8413	0.5217	13.8
Georgia	1.9728	0.5424	15.1
Hawaii	1.6918	0	16.1
Idaho	1.7076	0.4445	10.7
Illinois	2.137	0.5725	13.8
Indiana	1.9304	0.5099	15.4
Iowa	1.8609	0.4989	15.8
Kansas	1.9339	0.4795	16.8
Kentucky	1.9536	0.5101	15.3
Maine	1.6987	0.4633	18.4
Maryland	1.8397	0.4773	10.4
Massachusetts	1.7348	0.4494	10.5
Michigan	1.857	0.5133	13.3
Minnesota	1.8901	0.5106	13.7
Mississippi	1.782	0.4726	19.1
Missouri	1.9831	0.501	15.2
Montana	1.7142	0.4572	16.1
Nebraska	1.7227	0.4598	11.8
Nevada	1.6012	0.4241	11.6
New Hampshire	1.6911	0.4137	9
New Jersey	1.8488	0.4548	7.5
New Mexico	1.7469	0.4673	16.9
New York	1.7266	0.4513	10.7
North Carolina	1.9216	0.5173	14.2
Ohio	2.052	0.5509	15.8
Oklahoma	1.9735	0.5324	18.5
Oregon	1.8636	0.4983	15.8
Pennsylvania	2.056	0.5454	15.5
Rhode Island	1.6087	0.3771	16.1
South Carolina	1.8926	0.5077	15.9
South Dakota	1.7438	0.4738	15.9
Tennessee	1.9661	0.5171	15.5
Texas	2.1134	0.5801	14.4
Utah	1.9721	0.538	21.9
Vermont	1.6505	0.4372	15.3
Virginia	1.9396	0.5	13.8
Washington	1.7885	0.4831	12.8
West Virginia	1.6578	0.4029	13.4
Wisconsin	1.7902	0.4634	13.7
Wyoming	1.6197	0.4316	14.3
Other			

Appendix - Table 4
Output, Earnings, and Employment Multipliers: Sand and Gravel

	Multipliers		
	Output	Earnings	Employment
Alabama	1.9085	0.5686	20.2
Alaska	1.6186	0.4764	18.0
Arizona	1.8080	0.5594	18.8
Arkansas	1.7728	0.5412	18.4
California	1.8672	0.5793	11.7
Colorado	1.9064	0.5953	15.6
Connecticut	1.7273	0.5290	8.7
Delaware	1.5328	0.3447	13.5
Florida	1.8006	0.5726	16.8
Georgia	1.9343	0.5966	17.8
Hawaii	1.7157	0.5193	10.9
Idaho	1.7038	0.5050	11.8
Illinois	2.0813	0.6185	14.3
Indiana	1.9075	0.5701	17.2
Iowa	1.8586	0.5659	19.3
Kansas	1.8689	0.5218	16.1
Kentucky	1.8977	0.5602	16.9
Louisiana	1.8181	0.5519	18.1
Maine	1.7173	0.5347	22.5
Maryland	1.8337	0.5372	10.7
Massachusetts	1.7326	0.5087	12.7
Michigan	1.8274	0.5707	15.0
Minnesota	1.8701	0.5686	15.3
Mississippi	1.8092	0.5484	22.1
Missouri	1.9509	0.5519	16.0
Montana	1.7268	0.5262	18.2
Nebraska	1.7269	0.5268	14.0
Nevada	1.6171	0.4926	12.7
New Hampshire	1.6890	0.4695	13.1
New Jersey	1.8022	0.4994	8.7
New Mexico	1.7693	0.5400	21.5
New York	1.7102	0.5109	13.6
North Carolina	1.8842	0.5719	18.4
North Dakota	1.7849	0.5303	17.8
Ohio	1.9876	0.5957	16.4
Oklahoma	1.9716	0.5990	20.5
Oregon	1.8459	0.5604	16.5
Pennsylvania	2.0012	0.5949	18.5
Rhode Island	1.6044	0.4300	13.7
South Carolina	1.8642	0.5654	18.8
South Dakota	1.7437	0.5377	19.7
Tennessee	1.9118	0.5610	12.6
Texas	2.0663	0.6279	15.7
Utah	1.9295	0.5870	20.3
Vermont	1.6455	0.5014	17.3
Virginia	1.8683	0.5384	15.4
Washington	1.7873	0.5478	13.2
West Virginia	1.6654	0.4674	11.5
Wisconsin	1.7768	0.5181	15.0
Wyoming	1.5969	0.4878	17.8

Appendix - Table 5
Impacts of the Crushed Stone Industry on State Economies

	Direct spending (billions)	Total output (billions)	Personal income (billions)	Jobs
Alabama	0.308	0.603	0.161	4,497
Alaska	0.008	0.013	0.003	112
Arizona	0.050	0.089	0.024	804
Arkansas	0.169	0.305	0.081	2,721
California	0.396	0.745	0.206	4,475
Colorado	0.089	0.172	0.048	1,345
Connecticut	0.083	0.146	0.039	740
Florida	0.515	0.948	0.269	7,107
Georgia	0.467	0.921	0.253	7,052
Hawaii	0.064	0.108	0.000	1,030
Idaho	0.023	0.038	0.010	241
Illinois	0.459	0.981	0.263	6,334
Indiana	0.278	0.537	0.142	4,281
Iowa	0.189	0.352	0.094	2,986
Kansas	0.110	0.213	0.053	1,848
Kentucky	0.331	0.647	0.169	5,064
Maine	0.024	0.041	0.011	445
Maryland	0.136	0.250	0.065	1,414
Massachusetts	0.121	0.210	0.054	1,271
Michigan	0.160	0.297	0.082	2,128
Minnesota	0.057	0.108	0.029	781
Mississippi	0.022	0.038	0.010	411
Missouri	0.411	0.815	0.206	6,247
Montana	0.012	0.021	0.006	200
Nebraska	0.046	0.079	0.021	540
Nevada	0.040	0.065	0.017	469
New Hampshire	0.018	0.031	0.008	164
New Jersey	0.184	0.340	0.084	1,380
New Mexico	0.026	0.046	0.012	441
New York	0.353	0.609	0.159	3,777
North Carolina	0.485	0.932	0.251	6,887
Ohio	0.339	0.696	0.187	5,356
Oklahoma	0.179	0.353	0.095	3,312
Oregon	0.100	0.186	0.050	1,580
Pennsylvania	0.564	1.160	0.308	8,742
Rhode Island	0.011	0.018	0.004	179
South Carolina	0.161	0.305	0.082	2,560
South Dakota	0.027	0.047	0.013	432
Tennessee	0.344	0.676	0.178	5,332
Texas	0.624	1.319	0.362	8,986
Utah	0.041	0.080	0.022	887
Vermont	0.024	0.040	0.011	372
Virginia	0.446	0.865	0.223	6,155
Washington	0.084	0.151	0.041	1,079
West Virginia	0.066	0.109	0.026	880
Wisconsin	0.150	0.269	0.070	2,055
Wyoming	0.020	0.033	0.009	292
Other	0.099			
SUB TOTAL	8.913	17.007	4.510	125,390
Interstate spillovers		6.328	1.937	45,874
TOTAL	8.920	23.335	6.447	171,264

Source: CRA with data from USGS Minerals Yearbook 2001

Note: No sales were reported for Delaware, Louisiana, and North Dakota

Appendix - Table 6
Impacts of the Sand and Gravel Industry on State Economies

	Direct spending (billions)	Total output (billions)	Personal income (billions)	Jobs
Alabama	0.060	0.115	0.034	1,216
Alaska	0.066	0.106	0.031	1,181
Arizona	0.288	0.521	0.161	5,414
Arkansas	0.058	0.102	0.031	1,060
California	1.080	2.017	0.626	12,636
Colorado	0.194	0.370	0.115	3,026
Connecticut	0.045	0.077	0.024	389
Delaware	0.019	0.030	0.007	261
Florida	0.109	0.196	0.062	1,831
Georgia	0.029	0.056	0.017	513
Hawaii	0.006	0.011	0.003	68
Idaho	0.052	0.089	0.026	618
Illinois	0.156	0.325	0.096	2,231
Indiana	0.124	0.237	0.071	2,133
Iowa	0.064	0.119	0.036	1,231
Kansas	0.029	0.054	0.015	469
Kentucky	0.040	0.077	0.023	683
Louisiana	0.085	0.155	0.047	1,543
Maine	0.045	0.077	0.024	1,010
Maryland	0.085	0.155	0.046	907
Massachusetts	0.089	0.155	0.045	1,134
Michigan	0.266	0.486	0.152	3,990
Minnesota	0.155	0.290	0.088	2,372
Mississippi	0.070	0.127	0.038	1,549
Missouri	0.046	0.089	0.025	733
Montana	0.067	0.116	0.035	1,223
Nebraska	0.043	0.074	0.023	602
Nevada	0.173	0.280	0.085	2,197
New Hampshire	0.043	0.073	0.020	567
New Jersey	0.098	0.177	0.049	853
New Mexico	0.055	0.096	0.029	1,172
New York	0.160	0.274	0.082	2,176
North Carolina	0.062	0.116	0.035	1,132
North Dakota	0.026	0.047	0.014	468
Ohio	0.256	0.509	0.152	4,198
Oklahoma	0.044	0.086	0.026	896
Oregon	0.099	0.183	0.056	1,637
Pennsylvania	0.128	0.256	0.076	2,368
Rhode Island	0.009	0.015	0.004	126
South Carolina	0.037	0.069	0.021	694
South Dakota	0.042	0.072	0.022	818
Tennessee	0.046	0.089	0.026	585
Texas	0.405	0.837	0.254	6,359
Utah	0.109	0.210	0.064	2,213
Vermont	0.020	0.033	0.010	346
Virginia	0.064	0.120	0.035	992
Washington	0.220	0.393	0.121	2,904
West Virginia	0.009	0.015	0.004	106
Wisconsin	0.159	0.283	0.082	2,385
Wyoming	0.035	0.056	0.017	625
SUBTOTAL	5.670	10.513	3.189	85,838
Interstate spillovers		3.771	1.105	26,988
TOTAL	5.670	14.284	4.294	112,826

Source: CRA with data from USGS Minerals Yearbook 2001

Appendix - Table 7
Sales of Aggregates by State in Rank Order and Total Economic Impact, 2001

	Direct spending (billions)	Total output (billions)	Personal income (billions)	Jobs
California	1.476	2.762	0.831	17,111
Texas	1.029	2.156	0.616	15,344
Pennsylvania	0.692	1.416	0.384	11,110
Florida	0.624	1.145	0.331	8,938
Illinois	0.615	1.306	0.359	8,565
Ohio	0.595	1.204	0.339	9,555
North Carolina	0.547	1.048	0.286	8,019
New York	0.513	0.883	0.241	5,953
Virginia	0.510	0.985	0.258	7,147
Georgia	0.496	0.977	0.270	7,564
Missouri	0.457	0.904	0.231	6,980
Michigan	0.426	0.783	0.234	6,118
Indiana	0.402	0.773	0.212	6,414
Tennessee	0.390	0.765	0.204	5,917
Kentucky	0.371	0.723	0.191	5,747
Alabama	0.368	0.718	0.195	5,713
Arizona	0.338	0.610	0.186	6,218
Wisconsin	0.309	0.551	0.152	4,440
Washington	0.304	0.544	0.161	3,983
Colorado	0.283	0.542	0.164	4,372
New Jersey	0.282	0.517	0.133	2,233
Iowa	0.253	0.470	0.130	4,218
Arkansas	0.227	0.407	0.112	3,781
Oklahoma	0.223	0.439	0.121	4,207
Maryland	0.221	0.406	0.110	2,322
Nevada	0.213	0.344	0.102	2,666
Minnesota	0.212	0.398	0.117	3,152
Massachusetts	0.210	0.365	0.100	2,405
Oregon	0.199	0.369	0.105	3,217
South Carolina	0.198	0.373	0.103	3,254
Utah	0.150	0.290	0.086	3,100
Kansas	0.139	0.267	0.068	2,317
Connecticut	0.128	0.223	0.063	1,129
Mississippi	0.092	0.165	0.049	1,960
Nebraska	0.089	0.153	0.044	1,142
Louisiana	0.085	0.155	0.047	1,543
New Mexico	0.081	0.142	0.042	1,613
Montana	0.080	0.137	0.041	1,423
West Virginia	0.075	0.124	0.031	987
Idaho	0.075	0.128	0.036	859
Alaska	0.074	0.119	0.035	1,292
Hawaii	0.070	0.119	0.003	1,099
Maine	0.069	0.118	0.035	1,456
South Dakota	0.069	0.120	0.035	1,250
New Hampshire	0.062	0.104	0.028	731
Wyoming	0.056	0.089	0.026	917
Vermont	0.044	0.073	0.021	718
North Dakota	0.026	0.047	0.014	468
Rhode Island	0.020	0.033	0.008	305
Delaware	0.019	0.030	0.007	261
SUBTOTAL	14.583	27.520	7.699	211,227
Interstate spillovers		10.099	3.042	72,863
TOTAL	14.590	37.619	10.741	284,090

Source: CRA with data from USGS Minerals Yearbook 2001