USGS
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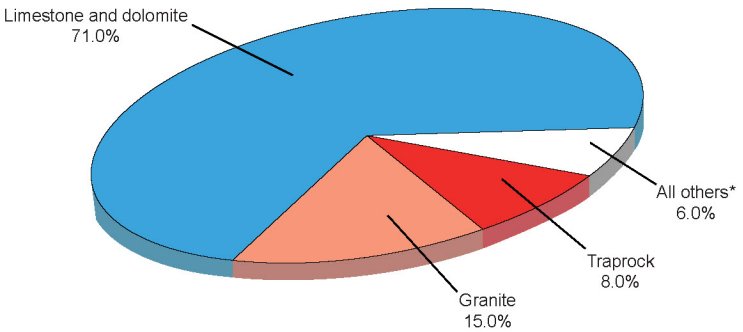
Natural Aggregates—Foundation of America's Future

Natural aggregates, which consist of crushed stone and sand and gravel, are among the most abundant natural resources and a major basic raw material used by construction, agriculture, and industries employing complex chemical and metallurgical processes. Despite the low value of the basic products, natural aggregates are a major contributor to and an indicator of the economic well-being of the Nation.



*Includes (in descending order of production) sandstone and quartzite, miscellaneous stone, marble, calcareous marl, slate, shell, and volcanic cinder and scoria.

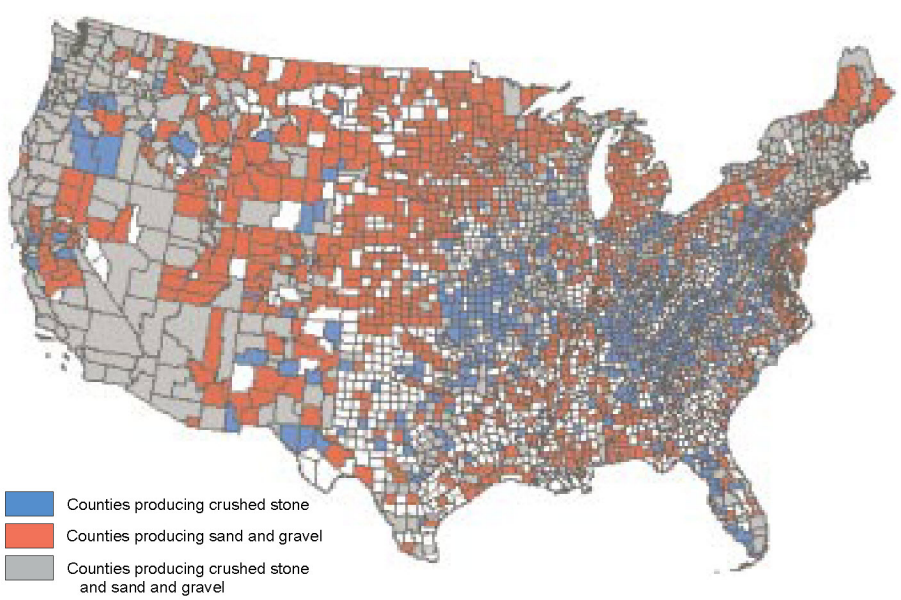
U.S. crushed stone production, by kind of stone.

Various Uses of Aggregates

Aggregates have an amazing variety of uses. Imagine our lives without roads, bridges, streets, bricks, concrete, wallboard, and roofing tiles or without paint, glass, plastics, and medicine. Every small town or big city and every road connecting them were built and are maintained with aggregates. More than 90 percent of asphalt pavements and 80 percent of concrete are aggregates. Paint, paper, plastics, and glass also require sand, gravel, or crushed stone as a constituent. When ground into powder, limestone is used as an important mineral supplement in agriculture, medicine, and household products. Aggregates are also being used more and more to protect our environment. Soil erosion-control programs, water purification, and reduction of sulfur dioxide emissions generated by electric powerplants are just a few examples of such uses.

Growth in Aggregates Demand

One way to understand and appreciate better the importance of the aggregates industries is to look at their production in the context of all mining. On the basis of either weight or volume, aggregates accounted for more than two-thirds of about 3.3 billion metric tons of nonfuel minerals produced in the United States in 1996. When coal mining is included, the amount of crushed stone and sand and gravel produced still accounts for more than one-half of the volume of all mining and more than twice the amount of coal produced. In this century, the production of aggregates increased from a modest total of about 58 million tons in 1900, when the collection of production statistics began, to 2.3 billion tons in 1996 (Bolen, 1996; Tepordei, 1996). The 1996 annual production of crushed stone and construction sand and gravel was the highest ever recorded in the United States for these mineral commodities. It is important to note that of the total natural aggregates produced in this century, more than one-half was produced and consumed in the last 25 years.



U.S. counties producing natural aggregates.

Of the crushed stone produced in the United States, limestone and dolomite account for 71 percent; granite 15 percent; and gabbro, basalt, and diabase, also known as traprock, 8 percent. The remaining 6 percent of the crushed stone produced comprises sandstone, quartzite, marble, calcareous marl, slate, shell, and volcanic cinder and scoria.

U.S. Department of the Interior
U.S. Geological Survey

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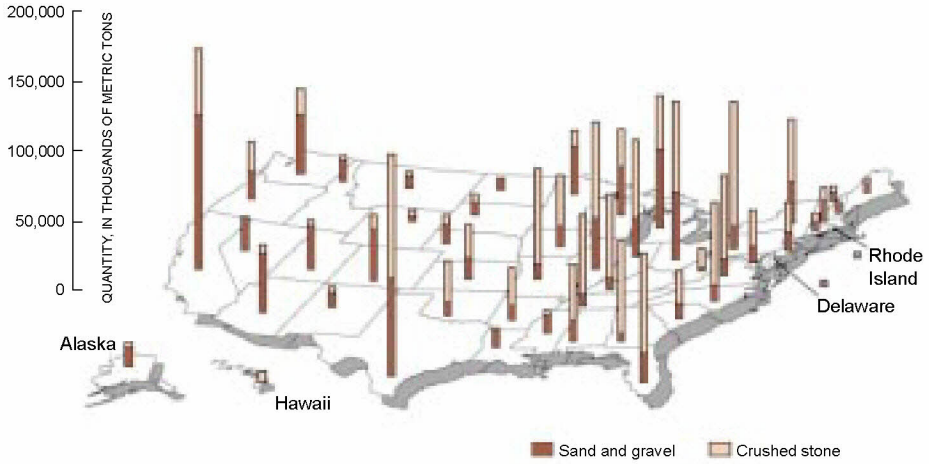
The production of natural aggregates is closely related to the population and the level of industrial development of a specific area. The major aggregates-producing States, based on 1996 data, were Texas, California, Ohio, Pennsylvania, and Illinois, in descending order. The 1996 U.S. per capita consumption of aggregates was 8.7 metric tons. The State per capita consumption of aggregates varied from highs of 28.7 tons in Alaska, 20.7 tons in South Dakota, and 17.6 tons in Iowa, to lows of 3.8 tons in Connecticut and 3.3 tons in Louisiana.



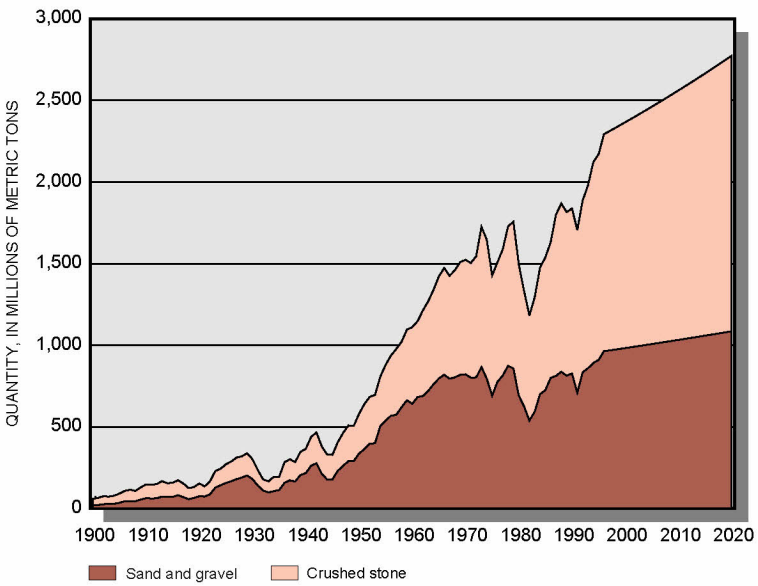
Production of natural aggregates, crushed stone and sand and gravel, by State.

The production of recycled aggregates, mostly from concrete and asphalt pavements, has also been increasing in recent years. Replaced and reconstructed old roads and buildings have become major sources of "recyclable materials." In some applications, recycled aggregate can compete with natural aggregates on price and quality. The increasing limitations imposed on the use of landfills, as well as the higher costs imposed on their use, are making the recycling of aggregates economically viable.

Continuous Growth into the Next Century

As we attempt to forecast the level of production of aggregates, we have to look back first. During the past 25 years, production of crushed stone has increased at an average annual rate of about 3.3 percent. Production of sand and gravel, which until 1974 exceeded that of crushed stone, has increased at an annual rate of less than 1 percent. The construction of the Interstate Highway System, which became the National Highway System, was one of the major reasons for this growth. By using very conservative assumptions, we have projected trends in the production of crushed stone and sand and gravel at average annual growth rates of 1 percent and 0.5 percent respectively.

Based on these assumptions, by 2020 U.S. production of crushed stone, which is expected to increase by more than 20 percent, will be about 1.6 billion metric tons, while production of sand and gravel will be just under 1.1 billion metric tons, an increase of 14 percent. The amount of crushed stone to be produced in the next 20 years will, therefore, equal the quantity of all stone produced during this century, about 36.5 billion metric tons. Combined with the projected cumulative production of sand and gravel, the total amount of aggregates to be mined in the next 25 years will be equivalent to almost all the mining that has taken place in this country for these materials in the past 100 years. These projections suggest that vast quantities of crushed stone and sand and gravel will be needed in the future and that much of it will have to come from resources yet to be delineated or defined. Therefore, interdisciplinary scientific studies specifically relevant to the aggregates industry will be needed even more in the future.



National aggregates production in the United States with projections to 2020, based on growth rate of 1.0% for stone and 0.5% for sand and gravel.

Working With, Not Against, Nature

Today, we recognize that Earth's resources, however vast, are finite. We also realize that everything we use must start with raw materials that are grown or mined. We also understand that wise stewardship of the environment is necessary to preserve natural resources for future generations. To that end, the crushed stone and sand and gravel producers have to meet all environmental regulatory requirements, and are encouraged to exceed what the laws and regulations require. Consequently, their work is planned with a clear understanding of their role in conservation and land reclamation. The results of successful reclamation projects can be seen around the country in housing subdivisions, shopping malls, community parks and lakes, golf courses, and wildlife refuges.

Caring about the environment and providing essential products are only part of today's aggregates producers' commitment to their communities. More than 90,000 employees and their families depend on the aggregates industries for their livelihood, and thousands more work in related industries that use this valuable natural resource or its byproducts.

USGS—The Major Source of Information on Natural Aggregates

For more than 100 years, the U.S. Geological Survey (USGS) has been the major source of information on the Nation's natural resources. In 1996, the USGS's capabilities to provide relevant, objective, and timely information on production, location, quality, and availability of natural resources were enhanced by the addition of minerals information specialists from the former U.S. Bureau of Mines. Today, the USGS is uniquely positioned to assist Federal, State, and local government organizations, schools and universities, private industry, interest groups, and the general public by providing information on the Nation's natural resources.

USGS mineral commodity specialists keep track of developments in the U.S. and international mineral industries. Information about the production, consumption, and recycling of minerals from U.S. companies, mines, and mineral-processing plants is collected, processed, analyzed, and published. Annual and quarterly reports on the production for consumption of natural aggregates, as well as directories of principal producing companies, are published and distributed in print and electronic form. Most of this information is available as printed reports and on CD-ROM. It can also be accessed immediately through a fax-on-demand system, MINES FaxBack, or on the World Wide Web. The geologic occurrences of potential sources of crushed stone and sand and gravel that may be used as natural aggregates in the conterminous United States are discussed in USGS Bulletin 1594 (Langer, 1988) and in USGS Circular 1110 (Langer and Glanzman, 1993).

Aerial view of the Suzio York Hill crushed stone quarry located near Meriden, Conn.

Special USGS Projects on Aggregates Resources and Urban Growth Issues

Infrastructure, such as roads, airports, utilities, and many other facilities, is vital to the growth of any populated area. Much of the Nation's infrastructure built during the 1950's and 1960's has deteriorated. In many areas of rapid population growth, the infrastructure is becoming inadequate, and new roads, streets, and sewage systems must be built to meet the increased needs. Maintenance and development of the infrastructure requires large volumes of natural aggregates. As urban areas expand, local sources of these resources are becoming less accessible. Resources that are unavailable locally must be brought in from more distant sources, often at greater costs that are passed on to the public as higher taxes or reduced services.

The successful integration of natural resource information into land-use decisions is increasingly difficult as the competing needs for lands and resources become more numerous, complex, and urgent. In response to these issues, the USGS has initiated special projects to increase better understanding of the natural resource needs and issues of urban areas.

Rocky Mountain Front Range Infrastructure Resources Project

In rapidly growing areas along the Rocky Mountain Front Range urban corridor, resource use often competes with other land uses and may be preempted by government mandates in response to local issues. The Rocky Mountain Front Range Infrastructure Resources Project began in 1997 and is being conducted in the urban corridor from Cheyenne, Wyo., to Pueblo, Colo. Initially, the project is focusing on a demonstration area in the northern part of the urban corridor and will address problems of sustaining the availability of infrastructure resources (natural aggregates, water, and energy) in rapidly growing areas along the Rocky Mountain Front Range urban corridor.

The principal goals of the project are as follows:

- Implementing a multidisciplinary evaluation of the region's infrastructure resources.
- Determining the region's projected needs for infrastructure resources.
- Identifying the issues that may affect the availability of resources.
- Providing decisionmakers with tools to evaluate alternate methods for sustaining infrastructure resources.

Mid-Atlantic Geology and Infrastructure Case Study

Sand and gravel and crushed stone used as construction aggregates are mined near urban and rapid-growth areas because the marketplace is the urban environment and the materials are costly to transport. For example, the Baltimore-Washington urban corridor is one of the Nation's fastest growing metropolitan areas, with more than 7 million people spread over 39 counties and the District of Columbia. This area, with historic high levels of production of construction materials and significant changes in resources and urban development, is typical of the mid-Atlantic region. It also provides insights into the likely future trends in other areas of the Nation. Consequently, this corridor was chosen for a USGS case study to document the regional trends in the production and the availability of aggregates and the development of infrastructure.

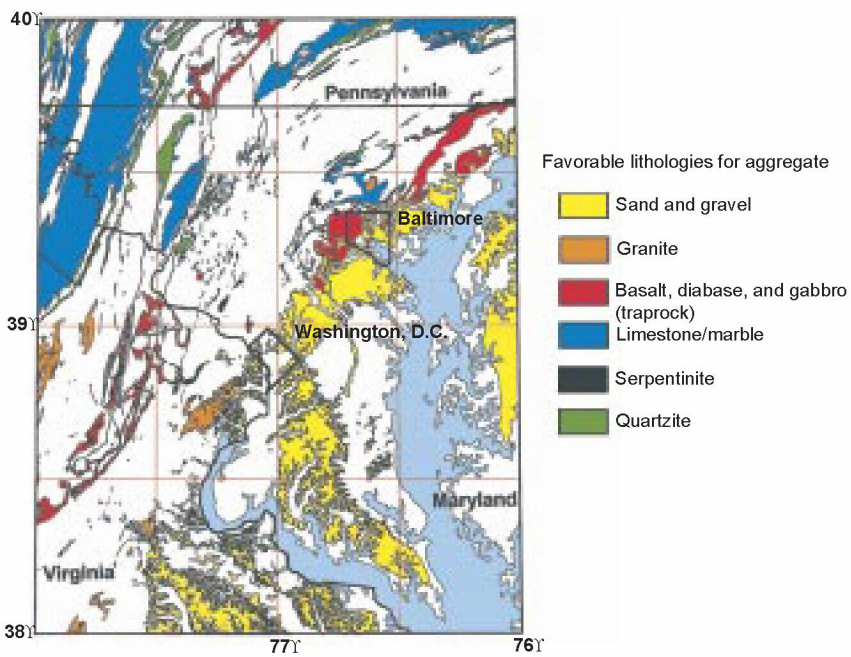
The objectives of the regional case study are as follows:

- Identification of the main geologic sources and locations of quality construction resources in the region.
- Documentation, by county, of the amount of aggregates produced and used in the region, who produces aggregates, who uses aggregates, and how much is consumed.
- Analysis of aggregates production and demographic information.
- Development of a regional aggregates resource demand forecasting tool.
- Analysis of anticipated availability of aggregates as reflected in county-level management planning.

Summary

Natural aggregates are widely distributed throughout the United States and occur in a variety of geologic environments, however, they are not universally available. Some areas lack quality aggregates, or existing aggregates deposits cannot be mined for a multitude of reasons; but economic factors require that pits or quarries be located near the population centers. However, residential communities usually require that mining of aggregates be conducted far from their boundaries.Thus, competing land-use plans, zoning requirements, and various regulations frequently prohibit extraction of aggregates near populated areas.

Because the demand for aggregates will continue and, most probably, will grow in the future, provisions to assure adequate supplies will have to be made. Long-range planning and zoning regulations will have to take into account current and future community needs for this valuable natural resource. All groups and individuals will need to work together to ensure adequate community and environmental protection, while ensuring the availability of aggregates at a reasonable cost that will allow growth and prosperity.



Study area for the Mid-Atlantic Geology and Infrastructure Case Study in the Baltimore-Washington urban corridor.

References

Bolen, W.P., 1997, Construction sand and gravel: U.S. Geological Survey Minerals Yearbook 1995, v. 1, p. 703-714.

Langer, W.H., 1988, Natural aggregates of the conterminous United States: U.S. Geological Survey Bulletin 1594, 33 p.

Langer, W.H., and Glanzman, V.M., 1993, Natural aggregate—Building America's future: U.S. Geological Survey Circular 1110, 39 p.

Tepordei, V.V., 1997, Crushed stone: U.S. Geological Survey Minerals Yearbook 1995, v. 1, p. 783-809.

Information

More information on natural aggregates can be found on the Internet at:
http://minerals.er.usgs.gov/minerals
http://webserver.cr.usgs.gov/frirp/FRIRP.html

or by fax from
MINES FAXBACK at (703) 648-4999

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