EXPERT REPLY REPORT

SUBMITTED IN THE MATTER OF AN ARBITRATION UNDER CHAPTER ELEVEN OF THE NORTH AMERICAN FREE TRADE AGREEMENT AND THE UNCITRAL RULES OF 1976

-between-

WILLIAM RALPH CLAYTON, WILLIAM RICHARD CLAYTON, DOUGLAS CLAYTON, DANIEL CLAYTON AND BILCON OF DELAWARE, INC.

-and-

GOVERNMENT OF CANADA

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MINERAL
VALUATION &
CAPITAL, INC.

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CERTIFICATION

I certify that to the best of my knowledge and belief:

- The statements of fact contained in this report are true and correct.
- The reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions and are my personal, impartial, unbiased professional analyses, opinions, and conclusions.
- I have no present or prospective interest in the property that is the subject of this report, and I have no personal interest with respect to the parties involved.
- I have no bias with respect to the property that is the subject of this report, or to the parties involved with this assignment.
- My engagement in this assignment was not contingent upon developing or reporting predetermined results.
- My compensation is not contingent on an action or event resulting from the analysis, opinions and conclusions in this report or from its use.
- My compensation for completing this assignment is not contingent upon the development or reporting of predetermined assignment results, or assignment results that favor the cause of the client, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this report.
- [redacted]
- No one provided significant review or other professional assistance to the person signing this report.
- The author has the training, knowledge, and experience to complete the assignment competently and/or has taken all steps necessary (as disclosed herein where appropriate) to complete the assignment competently.

John Lizak, Professional Geologist–IL, IN, KY, PA
Mineral Valuation & Capital, Inc.
Industrial Minerals & Construction Materials Group

GLOSSARY

Aggregate – Any combination of sand, gravel, and crushed stone in their natural or processed state.

Bituminous Concrete – Bituminous concrete also known as asphalt, asphalt concrete, hot mix asphalt, blacktop, or pavement is a composite material commonly used to surface roads, parking lots, driveways and airports. It consists of mineral aggregate bound together with asphalt, laid in layers, and compacted.

CIMVAL – Special Committee of the Canadian Institute of Mining, Metallurgy and Petroleum on Valuation of Mineral Properties

CIM – Canadian Institute of Mining, Metallurgy, and Petroleum

CSA – Canadian Securities Administrators – An umbrella association of Provincial Securities Commissions across Canada.

Coarse aggregate – Crushed stone or gravel predominantly retained on a 3/8-inch (9.5-mm) sieve essentially all of which is retained on the No. 4 (4.75-mm) sieve.

Construction aggregate – Any combination of sand, gravel, and crushed stone in their natural or processed state used for construction.

Crushed stone – The product resulting from the artificial crushing of rock, boulders, or large cobblestones, substantially all faces of which have resulted from the crushing operation.

EIS – Whites Point Environmental Impact Statement

Fine aggregate – Aggregate passing the 3/8-inch (9.5-mm) sieve essentially all of which passes the No. 4 (4.75-mm) sieve and is predominantly retained on the No.200 sieve.

IMVAL – International Mineral Valuation Committee

JRP – Whites Point Joint Review Panel

Metric ton – A unit of weight equal to 1,000 kilograms (2,205 lb). It is also called a long ton or tonne.

NI 43-101 – Canadian National Instrument 43-101 Standards of Disclosure for Mineral Projects

Natural aggregate – Rock fragments that are used in their natural state, or are used after mechanical processing such as crushing, washing, and sizing. Quarry stone is crushed and processed to produce aggregate. In this report, the term natural aggregate (or aggregate) includes mined or quarried stone that has been crushed, washed, and sized, as well as sand and gravel.

NSDNR – Nova Scotia Department of Natural Resources.

NYSDOT – New York State Department of Transportation

ONDR – Ohio Department of Natural Resources

Portland Cement Concrete (PCC) – A mixture of paste and aggregates. The paste, composed of Portland cement and water, coats the surface of fine and coarse aggregates. Through a chemical reaction called hydration, the paste hardens and gains strength to form the rock-like mass known as concrete, ready-mix concrete, or redi-mix concrete.

Prices – All prices are reported in United States dollars unless otherwise noted.

Sand and gravel – Any clean unconsolidated mixture of fine and/or coarse aggregate material found in a natural deposit. Most sand and gravel deposits are formed by deposition in water.

Short ton – A unit of weight equal to 2,000 pounds (907.18474 kg) that is most commonly used in the United States where it is known simply as a ton. All volumes are reported in short tons unless otherwise noted.

Tidewater quarry – A quarry located near tidewater (water effected by the flow and ebb of the tide) or the seacoast

USGS – United States Geological Survey

Vertical Integration – The combination under single ownership of two or more distinct stages of production, distribution, or service that are usually separate. In the construction materials business, vertical integration results from integrating aggregate with value-added products, such as bituminous concrete and Portland cement concrete.

Volume – All volumes in this report are reported in short tons (2,000 pounds) unless otherwise noted.

Whites Point Project – A quarry and a marine facility proposed to be constructed and operated by Bilcon at Whites Point in Digby Neck, Nova Scotia.

INTRODUCTION

Nash Johnston LLP retained Mineral Valuation and Capital, Inc. (MVC) to provide an opinion regarding the market analysis submitted by SC Market Analytics ("SC") on June 9, 2017, in the *damages phase* of the arbitration under the North American Free Trade Agreement (NAFTA), between the Investors and the Government of Canada ("Canada"). More specifically, I was asked to review and opine on the reliability of: (1) the data SC relies upon, (2) the methods SC uses, and [redacted] Some of the opinions I reach with respect to SC's report are also relevant to assumptions and conclusions proffered by The Brattle Group ("Brattle") in its report submitted on June 9, 2017.

I was also asked to provide an opinion regarding a conclusion derived by Brattle in its report submitted on June 9, 2017.

The intended user of this report is Nash Johnston LLP. I understand that this report may also be shared with the NAFTA Tribunal and the attorneys for Canada. This report is not intended for use by any other party or for any other purpose without the expressed written consent of Mineral Valuation and Capital, Inc.

This report is based on the information that was available to me as of the date of this report. Requests for SC to provide the data used to support its conclusions have been unfruitful. I understand that Canada and Bilcon may provide additional information in the future. Accordingly, I may revise, supplement, or expand my opinions based on further review and analysis of information and opinions provided to me after filing this report.

Summary of Conclusions

For the reasons explained in more detail in this report, I conclude as follows with respect to the conclusions reached in the SC report and the Brattle report:

The SC Report

[redacted]

SC's report lacks other features that are generally required to proffer a reliable market study. SC does not provide sufficient data, references, and explanation to enable the user to replicate all of its methods and results. These factors negatively impact the reliability of SC's opinions.

Inspection of the subject and the competitor quarries is a standard practice in a comprehensive market study. SC does not reveal that any report contributors inspected the Whites Point quarry, or any of the relevant quarries in Canada and the United States. [redacted]

[redacted] These omissions further undermine the reliability of the SC's data, methodology and conclusions.

[redacted]

Furthermore, any value opinions that are derived from SC's opinions by Brattle, or others, are by extension unreliable.

The Brattle Report

[redacted]

QUALIFICATIONS

John Lizak graduated with a B.Sc. degree in Fundamental Sciences from Lehigh University with a specialty in geology and geotechnical engineering. He received a M.Sc. degree in geology from Purdue University. Mr. Lizak also has considerable post-graduate study in mineral economics, mining engineering, corporate finance, and the valuation of minerals and mineral extraction companies. He is a Licensed Professional Geologist in Pennsylvania, Illinois, Indiana, and Kentucky and a "qualified" mineral valuation expert. Mr. Lizak has five professional associations/designations recognized by the CSA, and meets all of the requirements of an "independent qualified person" as defined in *Canadian National Instrument 43-101*.

John Lizak has been involved in mineral valuation, acquisition and development for over thirty- five years with Fortune 100 and private companies. He has held leadership positions with several large public and private companies. He worked as a exploration and development geologist with Exxon Coal & Minerals, Inc., and served as a senior manager with British Petroleum's acquisition and development group where he was directly involved in closing transactions valued in excess of $1.2 billion in the 1980s. Mr. Lizak was the Manager of Business Development with Eastern Industries, a New Enterprise Stone and Lime affiliate with over thirty-five construction aggregate mines. He served as Chief Geologist and Manager of Business Development for the Millington Group of Companies. John Lizak was also General Manager of Delta Carbonate, Inc., a producer of crushed stone, sand and gravel, and ground calcium carbonate. Mr. Lizak was the President of Diversified Mineral & Land Company, an energy mineral exploration and development company. He was also a co-owner of Coalbed Methane Development, Inc., a company specializing in the development of unconventional gas resources.

Mr. Lizak has been specializing in the valuation, development, acquisition, and divestiture of energy mineral, industrial mineral and construction material companies, and properties for over twenty-five years. During this period, he successfully developed and implemented business development strategies for public and privately-held companies. Mr. Lizak has been directly involved in closing numerous energy mineral, industrial mineral, and construction material company transactions. He has also evaluated over 500 domestic and international mineral ventures and markets. He was directly involved in implementing growth and diversification strategies involving acquisitions, divestitures, mergers, joint ventures, mineral importing and exporting ventures, and startups.

Mr. Lizak is a principal in MINERAL VALUATION & CAPITAL, INC. (MVC), a consulting company specializing in the valuation of minerals and mineral extraction companies, mineral development, mergers and acquisitions, divestitures, capital sourcing, market studies, strategic formulation and implementation, bank workouts, and turnaround management. The firm is a respected advisor as evinced by the fact that MVC's clients include respected law firms, appraisal companies, institutional investment companies, mineral and royalty trusts, accounting firms, banks, governments and regulators, international conservation groups, and international and domestic mining and construction material companies.

Mr. Lizak is primarily responsible for MVC's energy mineral, industrial mineral and construction materials practice. He specializes in the energy mineral, crushed stone, sand and gravel, ready-mix and bituminous concrete, ground calcium carbonate, and lime industries. He has been directly involved in numerous asset sales, company and mineral property valuations, and market studies. His mineral valuations and consultations have been used in litigation, shareholder disputes, tax appeals and filings, conservation easements, workout and repositioning strategies, mergers and acquisitions, arbitration, divestitures, financing, feasibility studies, estate and gift tax planning, anti-trust and bankruptcy proceedings, contract disputes, succession planning, marital dissolutions, and portfolio valuations.

John Lizak has also negotiated, acquired, sold, valued, and/or managed over 100 mineral lease contracts. He has owned, acquired, and sold royalty interests.

John Lizak is also a principal in LIZAK GEOSCIENCE & ENGINEERING, INC. (LGE) a geological, mining, and environmental consulting company. The firm is a respected advisor on geology, mineral extraction, mineral reserve and environmental issues. Mr. Lizak has been involved in numerous mining, geology, hydrogeology, and environmental projects in the U.S. and overseas.

Mr. Lizak has given expert testimony on mineral valuation, resource extraction, and geoscience issues in numerous public forums. He has provided expert testimony and/or litigation consulting in international tribunals and many federal and/or state courts in the United States including California, Illinois, Indiana, Louisiana, New Jersey, Ohio, Oklahoma, and Pennsylvania, on behalf of individuals, governments, and companies. He has been retained as an expert witness on behalf of the U.S. Department of Justice in high value mineral valuation cases associated with Hurricane Katrina, Tribal Trust claims, etc. Mr. Lizak has also been appointed as a "court master," an arbitrator, and a mediator to resolve energy mineral and construction material disputes.

Mr. Lizak is a member of the Society of Mining & Exploration (SME) and the past Chairman of the Mineral Management Resource Committee. He is the former President of the Indiana-Kentucky Geological Society. He is also member of the American Association of Petroleum Geologists and was a member candidate of the American Society of Appraisers.

Mr. Lizak was nominated to SME's Valuation Standards Committee (VSC), a group of seven internationally-recognized mineral valuation experts assigned to:

> Participate globally with minerals industry institutes, through the International Mineral Valuation Committee (IMVAL) and by other means, in the development of harmonized mineral valuation standards and guidelines.
>
> Interact with other valuation standards setting and regulatory bodies as may be found appropriate, such as the International Valuation Standards Council and International Accounting Standards Board, through IMVAL

and by other means, to assist them in development and maintenance of valuation standards, guidelines, and reporting regulations appropriate for the minerals industry sector.

Assist SME in adopting, modifying and or enhancing, and maintaining valuation standards and guidelines, and instructions appropriate for SME's members that are compatible with overarching national and international standards and regulations.

Assist SME in providing mineral valuation education and educational materials to its members, the minerals industry sector, and users of mineral valuations.

John Lizak has written and presented numerous papers. He was the 2011 recipient of the American Institute of Mineral Appraisers (AIMA) Cartwright Award which is presented annually for the best mineral valuation paper presented at the joint AIMA-SME mineral valuation session. He was also chosen as a SME 2011-2012 Henry Krumb Distinguished Lecturer for his presentation titled *Discount Rates in Mineral Company and Mineral Property Valuation.* The Henry Krumb Distinguished Lecture series was established in 1966 "so that local SME sections could hear prominent minerals professionals speak on subjects in which they have recognized expertise." He has also presented other mineral valuation papers such as *What's The Current Market Value of an Industrial Mineral Company?*, and *A Dose of Reality-What Companies Are Actually Paying for Construction Material Acquisitions.*

Mr. Lizak was also an Adjunct Professor at several universities including the University of Evansville (Mineral Land Management Program) and Raritan Valley College. Several of his professional presentations are utilized in continuing education and graduate courses that focus on mineral property and mineral company valuation, that are offered by the South Dakota School of Mines, the Colorado School of Mines, the University of Arizona, AIMA, etc.

<u>Recent Construction Mineral Cases in which Mr. Lizak has been retained as an Expert Witness</u>

Allen Hogan, et.al v. The United States – Case No.: C2-99-1371
United States District Court for the Southern District of Ohio Eastern Division

Township of Sparta v. Limecrest Quarry Developers, LLC – Docket No. 0798-2008
Tax Court of New Jersey

Weldon Quarry Co., LLC v. Borough of Hopatcong – Docket No.: 001563-2007
Tax Court of New Jersey

National Food and Beverage Company, Inc. v. United States – Case No. 10-152L
United States Court of Federal Claims

Apple Outdoor, Inc.et al. v. Terrence S. Stewart, et al. – Case No. 2011-SU-003445-44
Court of Common Pleas in Pennsylvania

Chickasaw Nation and Choctaw Nation v. United States – Case No. 05-1524
United States District Court for the Western District of Oklahoma

Grace M. Goodeagle, et al. v. United States, Case No. 12-431L
United States Court of Federal Claims

White Oak Realty, LLC, and Citrus Realty, LLC v. United States – Case No. 13-04761
Eastern District of Louisiana

REBUTTAL PERTAINING TO SC'S MARKET ANALYSIS

[redacted]

This conclusion is underpinned by the following implicit or explicit assumptions:

- [redacted]
- [redacted]
- [redacted]
- [redacted]

It will be proven that these assumptions are untenable, and that the conclusion derived from them is wrong.

[redacted]

Finally, it will be evinced that SC does not provide sufficient data, references, and explanation to enable the user to replicate all of its methods and results, and that these omissions adversely impact the reliability of SC's conclusions and should disqualify SC's report.

Crushed Stone Prices

An accurate determination of prices is a key component of a market analysis and a mineral valuation, because prices underpin earnings, mineral value, etc.

[redacted]

1. [redacted]
2. [redacted]

Using these unreliable proxies distorts and understates the price of crushed stone. These errors are examined below.

[redacted]

[redacted]

The example from the USGS *Minerals Yearbook* (SC's data source) shown below, however, demonstrates that SC's confidence is misplaced, and that its methodology is flawed.

[redacted]

[redacted]

Crushed Stone Sales (Volumes)

While regional sales data may give a general indication of the macroeconomic trends in aggregate sales, they are rarely a suitable proxy for modeling prices and local trends.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

The Regional U.S. Market for Bilcon's Crushed Stone

SC's failure to analyze, or even consider, the regional market for Bilcon's stone negatively impacts its conclusions.

MVC submitted a comprehensive analysis of the regional market for Bilcon's crushed stone in the report submitted to Nash Johnston LLP on November 30, 2016. The regional market includes stone imported into the Atlantic and Gulf Coast ports located south of New York City and northern New Jersey. It includes port cities such as Baltimore, Maryland; Norfolk, Virginia; Charleston, South Carolina; Savannah, Georgia; Tampa, Florida; Mobile, Alabama; New Orleans, Louisiana; Port Arthur, Texas; and Houston, Texas (Figure 4),

MVC proved, among other things, that:

- The regional market for Whites Point stone is vibrant and offers significant opportunities for growth. The USGS (2002) noted at the outset of Bilcon's venture, for example, that "in the Mid-Atlantic region...the resource demand [for construction aggregate], particularly in urban and high-growth areas, remains large and continuous."

- Canadian producers shipped significant quantities of crushed stone to ports in the regional market. Over three million tons of stone were shipped from Canada in some years. Yearly stone imports grew at an advantaged rate over the long term.

- Bilcon could have captured 700,000 to 1,000,000 tons of the yearly, regional crushed stone sales from 2005 to 2016. Bilcon's yearly regional sales could ultimately have increased to 2,000,000 annual tons by 2050.

[redacted] But SC fails to consider the broader regional market in which Vulcan, Bilcon, and others can compete, [redacted]

For example:

- SC acknowledges that the regional market for imported stone is vibrant. It states that the "southeastern US market" has "valuable outlets" for Vulcan's Black Point quarry stone (SC Paragraph 80). [redacted]

- Vulcan's piers and redistribution centers are concentrated in Virginia, the Carolinas, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. [redacted]

- Vulcan has hundreds of affiliate operations that produce Portland cement concrete and bituminous concrete. They collectively consume a significant portion of Vulcan's aggregate. But these affiliates are concentrated in Virginia, the Carolinas, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. [redacted]

- Interestingly, Vulcan did not announce its decision to undertake the Black Point venture until after Canada rejected Bilcon's venture. SC does not consider that Vulcan may not have pursued the Black Point project had Canada approved Bilcon's Whites Point quarry venture.

- [redacted]

[redacted] Aggregate shipped via large ocean ships is often the low cost option in these coastal markets.

Conclusion: SC's failure to analyze, or even consider, the regional market for Bilcon's stone negatively impacts its conclusions.

[redacted]

There is a body of published papers, presentations and court judgments to guide the market analyst in the choice of data, methods, and approaches. They typically mandate that if a market exists for a mineral, then a supportable determination must be made concerning the physical characteristics of the minerals located on the property. Studies regarding the physical characteristics of the minerals should be conducted by specialists (usually geologists and/or mining engineers) who make determinations concerning important factors such as the quantity of the mineral deposit, the quality of the mineral deposit, and any quality variations that might be found on the property.

SC overlooks these and other important factors, and fails to consider how they advantage Bilcon's ability to market Whites Point crushed stone. Some of the salient factors that SC fails to analyze are discussed below.

Stone quantity and reserve depletion – Quarry reserves are finite. Stone depletion leads to supply disruption, shortages, increased prices, etc. Consequently, an analysis of the stone reserve base and its depletion rate is an integral component of a market study.

Yet SC fails to investigate: (1) the reserve base within the regional market, (2) the depletion of the reserve base, and (3) the prospects for new entrants.

[redacted]

Review of analyses conducted by Bilcon (MVC, 2016), the NSDNR (John Lizak, Witness Statement and Exhibits, July 8, 2011), the USGS (USGS, 1999; Robinson, 2002), etc., indicate that opportunities to identify and develop new quarry deposits will be limited. For example, no new quarries have been permitted in northern New Jersey and southeastern New York since 1988. Despite rapid depletion, aggregate producers in the region are encountering difficulty expanding existing operations, developing new sites and building new plants. Regulators are increasingly limiting producers by enacting restrictive zoning and land- use restrictions. Potential reserves are also being lost to development.

[redacted]

SC analyzes none the aforementioned factors. SC incorrectly assumes, implicitly or explicitly that: (1) the stone reserve base is non-finite, (2) reserve depletion is irrelevant, and (3) the regional reserve base can be theoretically sustained by "other new entrants" (SC Paragraph 80).

But SC does not indicate where exploration geologists will find the rare prospective quarry deposits that must meet dozens of exploration, development, and regulatory criteria. Nor does SC reveal the venue where these unique sites can gain regulatory approval.

Brattle adopts an equally unsupported and theoretical view. Brattle theorizes that the regional stone reserve base will be sustained by the industry's move "...toward its long-run equilibrium price, which reflects the state where suppliers will earn normal returns for the addition of new capacity..." (Brattle, Paragraph 140).

[redacted]

[redacted]

Conclusion: SC fails to: (1) investigate the quantity, quality, and consistency of the stone produced by Bilcon's rivals, (2) study the reserve base, (3) analyze reserve depletion, (4) investigate the prospects for new entrants, and [redacted] These omissions and methodological errors adversely impact the reliability of SC's theoretical conclusions.

Characteristics of Whites Point Products that Impact its Price

The conclusion SC reaches regarding the characteristics of Whites Point stone that impact its prices is unsupported and, hence, unreliable.

[redacted]

But as the California Geological Survey (2012) notes "The preferred use of one aggregate material over another in construction practices depends not only on specification standards, but also on economic considerations."

[redacted]

Additional Observations Regarding SC's Report

In addition to the data deficiencies and methodological errors identified above, SC's report lacks other features that are generally expected in a reliable market analysis. These deficiencies include: (1) the inability to replicate SC's data, analyses and results, and (2) the apparent lack of a field inspection.

Inability to Replicate SC's Data, Analyses and Results – The production of data that support calculations and results is standard practice so that the reviewer can verify the author's data, methods, and conclusions.

There is a body of published papers, presentations and court judgments to guide the analyst on the type of data and information that must be included in a report. International mineral institutes like the International Mineral Valuation Committee (IMVAL), the Special Committee of the Canadian Institute of Mining, Metallurgy and Petroleum on Valuation of Mineral Properties (CIMVAL), and the SME Valuation Standards Committee publish standards and guidelines on the type of data and information that should be included and produced.

As evinced below, transparency and the full disclosure of material data and information are basic tenets of the international mineral institutes. (*Transparent* means that the material data, the information, the assumptions, the approaches, and the methods used in the report must be set out clearly. [CIMVAL, 2003])

CIMVAL (2003) states that "The guiding philosophy and intent of the CIMVal Standards and Guidelines is...that all relevant information be fully disclosed." In addition, CIMVAL states that all material data should be included, verified, and transparent. CIMVAL also states that the author should describe the: (1) "information reviewed, or relied upon, and its source," (2) "steps taken to assure the reliability of the information relied upon," (3) "how Data Verification was done," and (4) "if data are confidential, and why."

The SME Standards Committee (2016) states that:

> The Valuation Report, whether a Public Report or not, must contain, at a minimum the... sources of information, including data, and a statement as to whether or not the information has been accepted as reliable without further verification...Where it is impossible or impractical to obtain sufficiently accurate or reliable data, this must be stated.
>
> All assumptions regarding material technical and economic input parameters, the risks, limitations, and effects associated with those assumptions must be set out clearly...
>
> Information should not be presented in a minimal or unclear form, from which the intended user accepting this information at face value could draw incorrect implications or conclusions. Any implications that would be revealed by a more thorough or deeper evaluation or explanation of the material issues should be disclosed.

SC does not provide sufficient data, references, and explanation to enable the user to replicate its methods and results. Requests for SC to provide the data used to support its conclusions have been unfruitful. By failing to produce the data it relies upon, SC's violates standard practice and its report is unreliable.

Some examples of the salient information that SC fails to provide are given below.

- [redacted]

[redacted] SC undermines the reliability of this information at the outset with the caveat that "the calculations in this figure are estimates and are intended to provide a graphical representation of the rough dynamics of the market, rather than represent exact calculations of the costs of each quarry" (SC Footnote 28).

In addition, SC fails to disclose the data and the rough calculations that underpin its aggregate cost estimates, the methodology its employs in its hypothetical extrapolation, and the products it defines as "equivalent coarse aggregate." [redacted] But SC does not disclose important information. It does not reveal that a significant component of Atlantic's product mix is not construction stone, but chemical and metallurgical grade carbonate stone used for: (1) lime production, flue-gas desulphurization, ore pelletization, steel making, and (2) the production of precipitated calcium carbonate used for pulp/paper production, and other chemical and industrial uses. Further, SC provides no data that shows if, when, and where Atlantic sold construction aggregate in the Eastern Seaboard of the United States.

[redacted]

SCMA's "Proprietary Aggregates Model" appears to be a variant of what is called the per capita consumption model. The per capita consumption model has proved to be effective for projecting aggregate demand in some major metropolitan areas. The California Geological Survey (2012) shows, however, that "...the per capita model may not work well...in P-C [Production-Consumption] regions that import or export a large percentage of aggregate resulting in a low correlation between P-C region production and population. In such areas, projections may be made based on historical production or multiple projections based on differing assumptions that may be used to better characterize a range of future demand."

[redacted]

➢ SC challenges the reliability of the Portland Cement Association (PCA) forecast [redacted]

➢ SC states that its "Water borne transportation costs for other suppliers are estimated based on SCMA's experience" (Paragraph 61, Footnote 47). But SC provides no transportation cost data for review or analysis.

➢ SC makes a broad hypothetical conclusion about the elasticity of construction aggregate prices in Paragraph 78. SC states that "Based on our knowledge of economic theory and 30 years of real world experience analyzing aggregates markets, this commodity has a price elasticity of approximately zero." But theory and indeterminate experience are not evidence. SC provides no facts, data, or other evidence to corroborate this hypothetical conclusion.

Conclusions: The inability to verify and replicate SC's data, analyses and results undermines the reliability of the marketing opinions derived by SC.

Market Reconnaissance – Inspection of the subject quarry, the competitor quarries, and the general market is standard practice in a mineral valuation and a market study. Personal inspections are particularly important because they enable a qualified individual to become familiar with conditions on the property. The individual can observe the geology; the rock quality, continuity, and consistency; the type and depth of the overburden; site ingress and egress; the mining and processing methods; cultural and environmental considerations; etc. A personal inspection is typically required even for properties with poor exposure, and the personal inspection cannot be delegated.

[redacted]

Conclusion: The failure to conduct market reconnaissance, if true, further undermines the reliability of the SC's data, methodology and conclusions.

REBUTTAL PERTAINING TO THE BRATTLE REPORT

[redacted]

The evolution of Canada's *National Instrument 43-101* ("NI 43-101") will be reviewed below. More specifically, the impetus for NI 43-101 and the intent of the instrument will be analyzed. [redacted]

It will be shown that Brattle's conclusion is misleading and untenable because: (1) NI 43-101 was never applicable to the Bilcon venture, and (2) [redacted]

Evolution of NI-43-101

Bre-X Minerals Ltd's ("Bre-X's") massive gold mining fraud was the catalyst for the development of NI 43-101. Salinger, Grundhauser, and Price reported that:

> Bre-X was a small Canadian gold exploration company that committed the world's biggest mineral stock fraud in history (Salinger, 2005).

> The gold reserves at Bre-X's Busang, Indonesia property were alleged to be 200 million ounces (6,200 t), or up to 8% of the entire world's gold reserves at that time. However, it was a massive fraud and there was no gold. The core samples had been faked by salting them with outside gold. An independent lab later claimed that the faking had been poorly done, including the use of shavings from gold jewelry (Grundhauser, 2015).
>
> Bre-X stock ultimately rose so high that it qualified for inclusion in the Toronto Stock Exchange (TSX) 300...Bre-X investors lost about $3 billion when the scam was revealed in the spring of 1997. This incident caused a massive shattering of investor confidence and tarnished the reputation of the Canadian securities industry (Salinger, 2005).
>
> There was fallout in the Canadian financial sector. The fraud also proved a major embarrassment...for the then-head of the Toronto Stock Exchange (resulting in his ousting by 1999), and began a tumultuous realignment of the Canadian stock exchanges...The Bre-X hoax led to the development of Canadian *National Instrument 43-101, Standards for Disclosure of Mineral Projects*...(Price, 2013).

The objective for passage of NI 43-101 was to promulgate a codified reporting scheme to make it more difficult for fraud to occur, and to reassure investors that projects have been assessed in a scientific and professional manner.

NI 43-101 took effect on February 1, 2001. The CSA (2001) describes NI 43-101 as:

> a rule that governs how issuers disclose scientific and technical information about their mineral projects to the public. It covers oral statements as well as written documents and websites. It requires that all disclosure be based on advice by a "qualified person" (a term defined in NI 43-101) and in some circumstances that the person be independent of the issuer and the property. NI 43-101 also requires issuers to file technical reports at certain times and there is a prescribed format for the technical report. Issuers are required to make disclosure of reserves and resources using definitions approved by the CIM, except for coal and diamonds

Brattle, however, fails to consider, or even acknowledge, that the CSA (2001) stipulates that issuers could also report information under "a code generally accepted in a foreign jurisdiction (an 'acceptable foreign code')." Issuers could, for example, report resources and reserves under the code outlined in United States Geological Survey Circular 831 titled *Principles of a Resource/Reserve Classification for Minerals* (USGS, 1980).

Anticipation and change are fundamental to NI 43-101. The salient standards of disclosure for mineral projects were amended, repealed and replaced several times since the inception of the instrument, and the Whites Point project, in 2001.

The CSA noted at the instrument's debut in 2001 that "...changes are likely. We are monitoring NI 43-101 and are prepared to make changes to it in the future...we are identifying areas where relief is required and matters that need clarification...Until NI 43-101 is amended, we will provide relief and clarification through orders and...FAQs [Frequently Asked Questions]."

Companion Policy 43-101CP (2005) contains a section titled "Evolving Industry Standards and Modifications to the Instrument" that states that the "Mining industry practice and professional standards are evolving in Canada and internationally. The Securities Regulatory Authorities will...consider recommendations from their staff and external advisers as to whether modifications to the Instrument are appropriate."

The CSA published sixteen amendments or guidance documents from 2001 to 2007 (OSC, 2016). The definitions, and the components, of important topics such as a feasibility study, mineral resources, and mineral reserves changed several times.

The *CIM Definition Standards for Mineral Resources and Mineral Reserves*, for example, were amended in 2005, 2010 and 2014 (CIM, 2017). Further complicating the standards for reporting resources and reserves is that "acceptable foreign codes" like the USGS *Principles of a Resource/Reserve Classification for Minerals* pre-date the CIM standards.

The CSA was particularly concerned that deciding whether a study should be classified as a "preliminary feasibility study" or a "feasibility study" was inherently subjective; that one person's resource was another person's reserve, or that one person's preliminary feasibility study was another's feasibility study. The CSA (2001) emphasizes that:

> Formulating the definitions using an objective test rather than a subjective test strengthens the basis upon which the regulator may object to a person's application of the definition in particular circumstances. The definition of 'preliminary feasibility study' and 'pre-feasibility study' requires the application of an objective test. For a study to fall within the definition, the considerations or assumptions underlying the study must

be reasonable and sufficient for a qualified person, acting reasonably, to determine if the mineral resource may be classified as a mineral reserve.

[redacted]

Brattle fails to acknowledge that NI-43-101 only applies to a Canadian public company that is a securities regulated issuer that discloses scientific and technical information to the Canadian public about a mineral project. An issuer is only an entity that issues a public security in Canada (CSA, 2001).

[redacted]

The basic elements of a feasibility study include:

- A mineral resource and mineral reserve estimate
- Mining and processing methods
- A market analysis
- Environmental considerations
- A capital and operating cost analysis
- An economic analysis

[redacted]

[redacted]

[redacted]

[redacted]

SC and Brattle ultimately underpin several of the aforementioned conclusions with economic theory, hypothetical models, and academic conjecture. Several conclusions are also underpinned by vague references to industry experience and knowledge. But theory and indeterminate experience are not facts or evidence.

By contrast, I want to close by highlighting some of the real world characteristics of the construction aggregate industry that make it unique, advantaged, ascendant and, thus, highly sought-after.

My valuation and strategic advisory practice focuses solely on minerals. Consequently, I have the opportunity to analyze, develop, operate, and own a wide array of mineral commodities ranging from energy minerals such as coal, oil, and gas; to industrial minerals such as clay, crushed stone, sand, and gravel.

Clients invariably want to know where they can most effectively deploy their capital. They want to know if their growth and/or diversification strategy should target gold, oil, coal, stone, or another mineral commodity. And they want to understand the long-term risk/return tradeoff for the different mineral sectors. I often recommend the construction aggregate industry because of the factors highlighted below.

- Each region in the country always has a baseline demand for construction aggregate that responds to the continuing need for road construction and maintenance. Superimposed on this need are the requirements of cities and towns for housing, offices, hospitals, manufacturing plants, schools, etc. Adding to these requirements are the demands of major construction projects such as interstate highways, airports, rail transit, flood control, and bridges that are publicly funded.

Figure 6 shows that there was a significant baseline stone demand throughout the sixty-five years shown on the graphic. The "Great Recession" that began in 2008 is arguably the greatest economic trauma since the "Great Depression." Yet there was significant stone demand even during the worst economic turmoil, and stone sales quickly rebounded toward their pre-recession record.

- Compared to the pricing volatility in the metal and energy mineral sectors, construction aggregate prices are stable. Note that stone prices are ascendant throughout virtually the entire sixty-five year history shown on Figure 7. The price drop during the "Great Recession" was minimal and short-lived. Prices have been attaining record levels every year since 2013. The price growth is largely an outgrowth of consolidation within the industry, the rapid depletion of increasingly scarce aggregate reserves, and the pricing discipline employed by the market participants.

Furthermore, stone prices are established at a local level compared to the higher-priced fungible commodities like metals, oil, gas, etc., whose prices are established globally by less predictable market actors that often add an element of political risk.

- The barrier to entry is high in the construction aggregate industry. Operating enough quarries with reserves sufficient to supply diverse and growing markets is essential for ongoing business. But receiving regulatory approval is increasingly difficult near metropolitan areas where the demand for aggregates is highest. Competing land-use plans, zoning requirements, and various regulations frequently prohibit extraction of aggregates near populated areas.

- The exploration, extraction, and processing risk for the construction aggregate industry is typically low compared to other minerals. Quarry deposits are usually at, or near, the surface and can be readily explored, accessed, mined, and processed. The existence and the quality of quarry deposits are relatively certain compared to complex metal, coal, or oil and gas deposits. The geologic character of a quarry deposit can usually be more clearly defined and there is less risk of failure of continuity.

Processing crushed stone is typically simpler, and less costly, than coal and metal processing. Smelting is not required. Quality issues with crushed stone can often be solved with selective mining, blending, etc.

- Construction material companies can benefit from vertical integration. Companies in the concrete business, for example, can integrate into the aggregate business to control one of their most important sources of raw materials. Costs can be reduced by lowering the cost of buying and selling associated with multiple stages of ownership. Overhead expenses can be lowered by eliminating or reducing such things as the sales force, promotion, purchasing, and other functions involved in the transfer of goods. Cost-efficiencies can be obtained by: controlling the quality and the consistency of the aggregate supply, coordinating aggregate production, and improved inventory control. By controlling two or more stages of production, an integrated owner can increase profitability beyond what can be earned if each stage is controlled by a separate producer.

- Private and public construction aggregate companies are achieving their best performance. Companies such as Vulcan Materials Company and Martin Marietta Materials, Inc. are reporting record results for the second quarter of 2017 (Rock Products, 2017).

All of these features make the construction aggregate industry a unique, advantaged, ascendant and highly sought-after business.

CONCLUSIONS

Nash Johnston LLP retained Mineral Valuation and Capital, Inc. (MVC) to provide an opinion regarding the market analysis submitted by SC Market Analytics ("SC") on June 9, 2017 in the *damages phase* of the arbitration under the North American Free Trade Agreement (NAFTA), between the Investors and the Government of Canada ("Canada"). More specifically, I was asked to review and opine on the reliability of: (1) the data SC relies upon, (2) the methods SC uses, and [redacted]

I was also asked to provide an opinion regarding a conclusion derived by Brattle in its report submitted on June 9, 2017.

For the reasons explained in detail this report, I conclude as follows with respect to SC's report, analysis, and conclusions:

The data deficiencies and methodological errors in SC's report individually, and collectively, significantly affect SC's analysis, and make SC's conclusions unsupported and unreliable. More specifically,

- [redacted]

- [redacted]
- [redacted] This unsound methodology further renders SC's model, and the conclusions derived from this model, unreliable.
- The production data that underpin SC's market share analysis are inappropriate.
- [redacted]
- SC fails to analyze, or even consider, the regional market for Bilcon's stone.
- SC does not assess the quantity, quality, and consistency of the stone produced by Bilcon's rivals.
- SC does not analyze the reserve base within the market, the depletion of the reserve base, and the prospects for new entrants.
- SC's conclusion pertaining to the [redacted] unsupported and, therefore, unreliable. SC also ignores the myriad of quality parameters and economic factors [redacted]
- SC does not provide sufficient data, references, and explanation to enable the user to replicate its methods and results.
- SC does not reveal that any of the report contributors inspected the Whites Point quarry or any of the quarries it describes in Canada and the United States. [redacted]

Overall, the data deficiencies and methodological errors identified above make SC's market analysis unreliable. [redacted]

[redacted]

Furthermore, any value opinions that are derived from SC's opinions by Brattle, or others, are also unreliable.

For the reasons explained in detail this report, I conclude as follows with respect to Brattle's report, analysis, and conclusions:

- [redacted]
- [redacted]

[redacted]

PRIMARY SOURCES OF INFORMATION

[redacted]

[redacted]

FIGURES

[redacted]

[redacted]

[redacted]

[redacted]

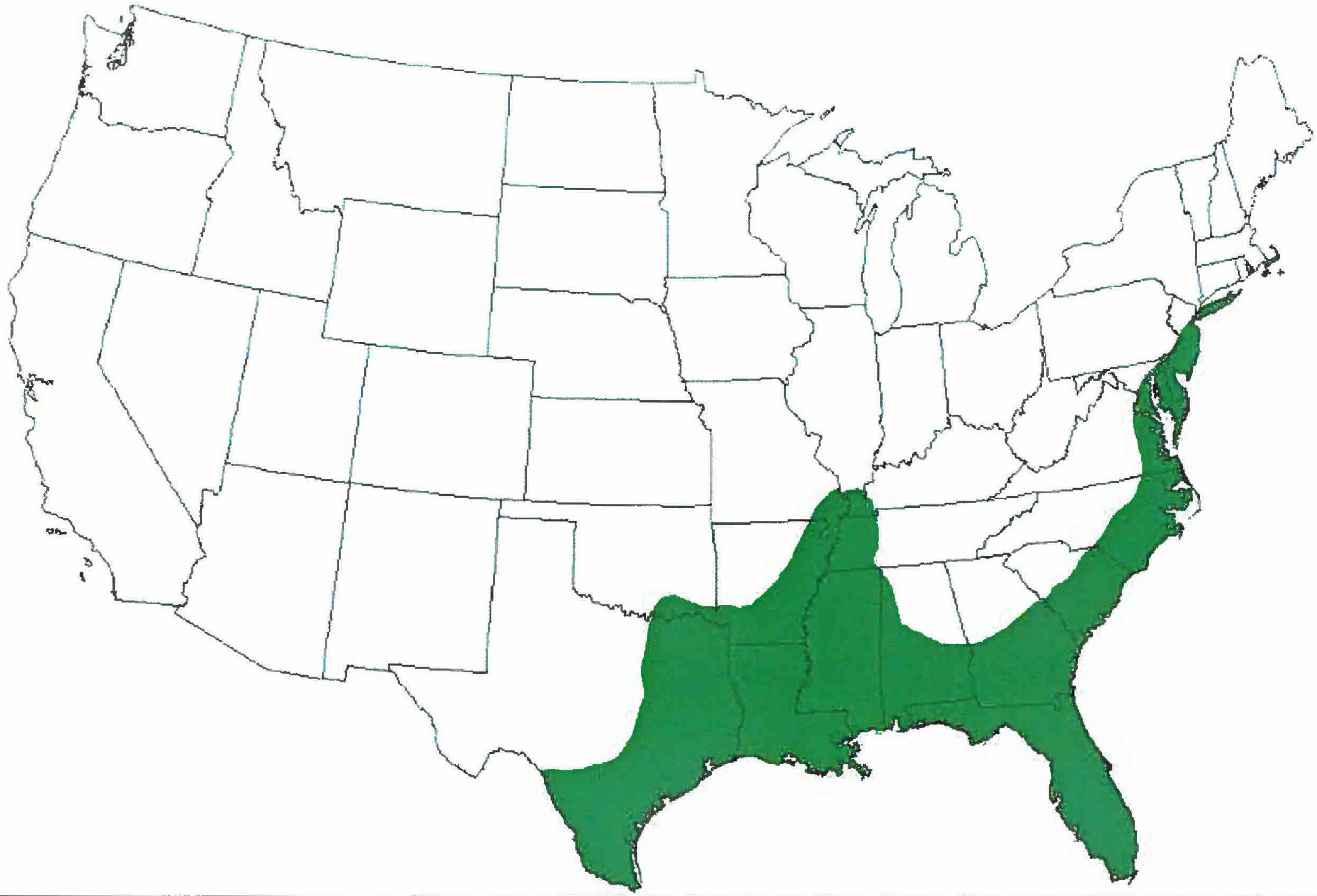


Figure 5 – Map of the United States Coastal Plain

Figure 6 - Crushed Stone Sold or Used in the United States, 1950-2016

(Source: United States Geological Survey)

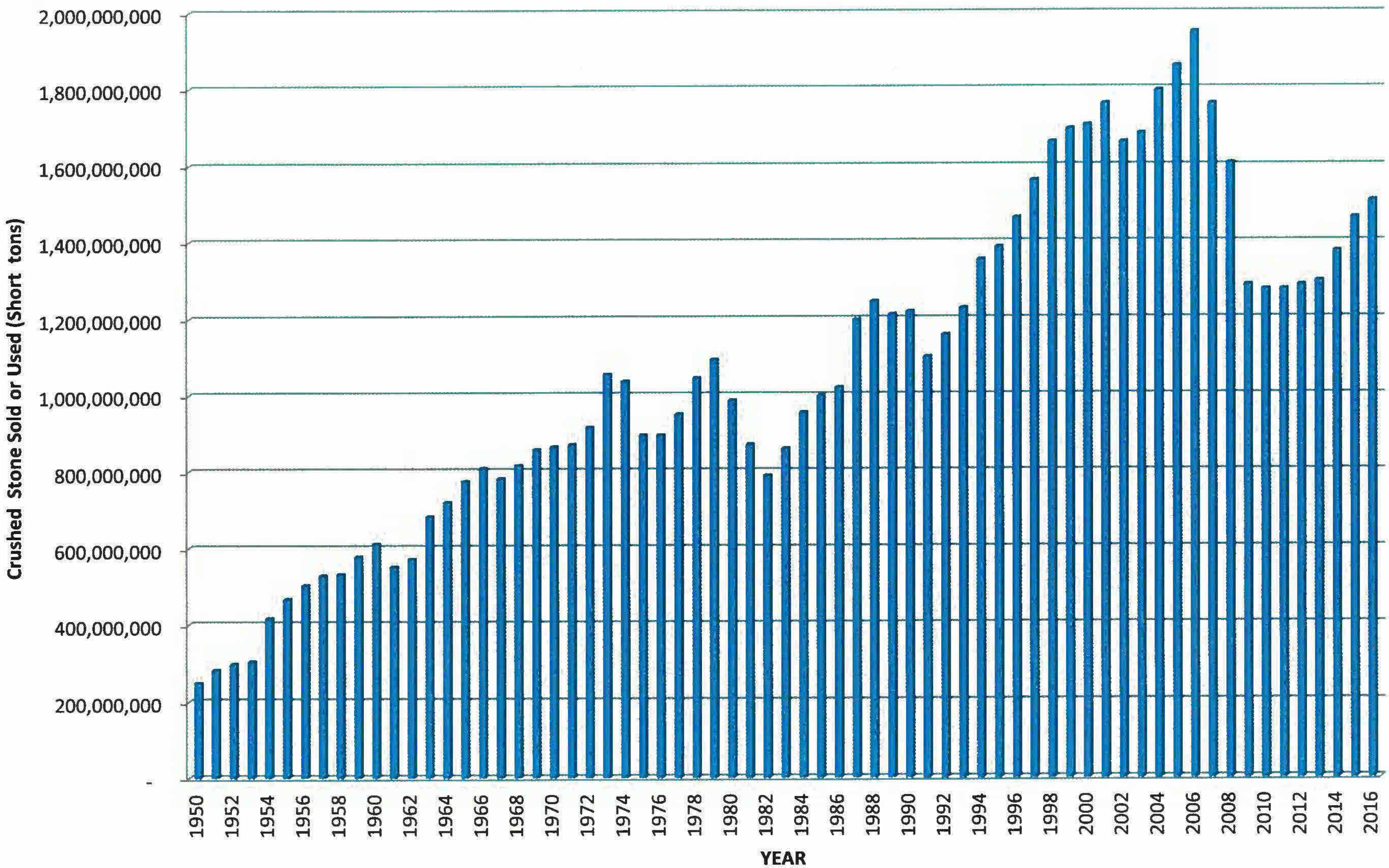
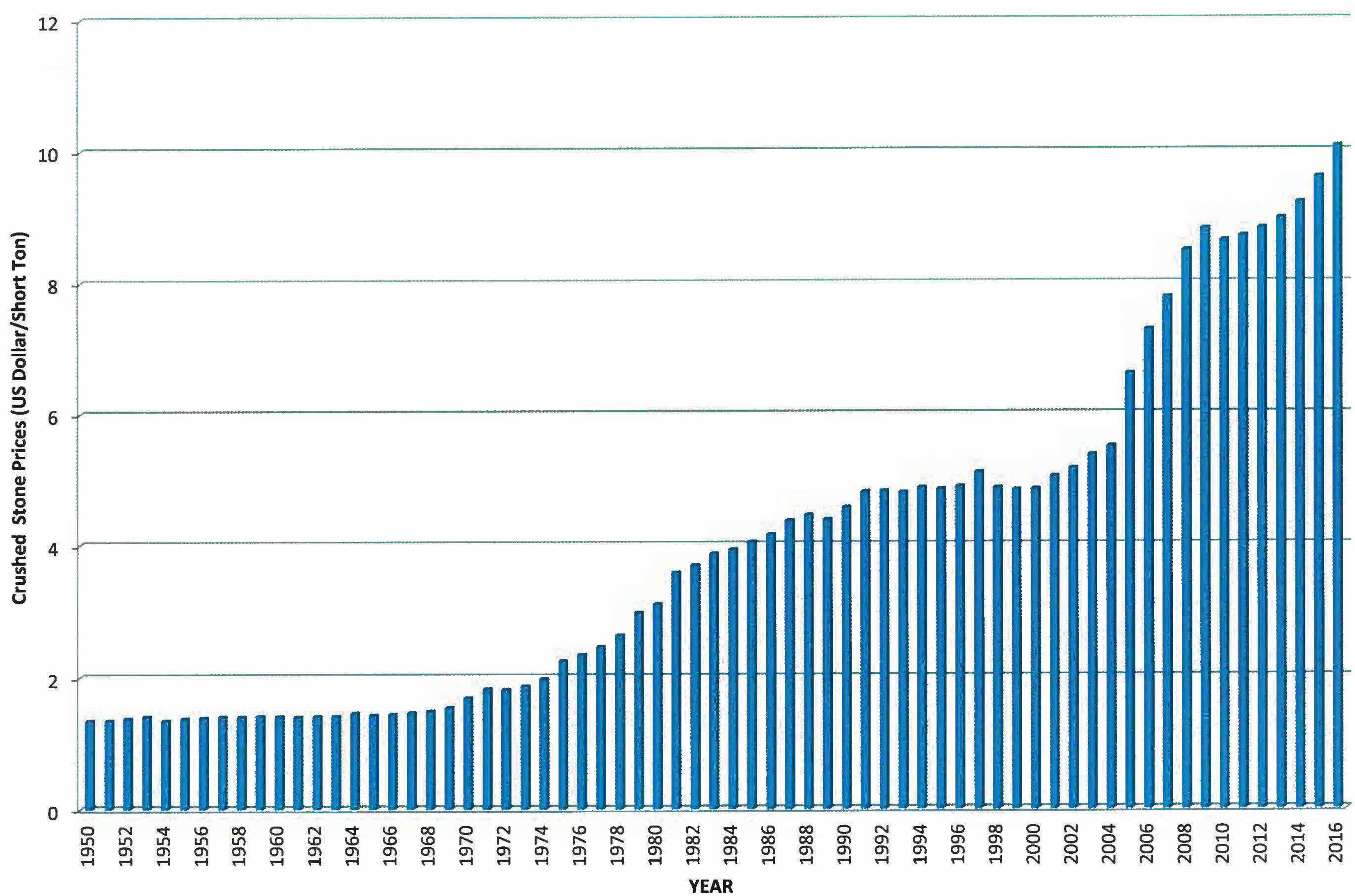


Figure 7 - Crushed Stone Prices in the United States, 1950-2016

(Source: United States Geological Survey)



TABLES

[redacted]

APPENDIX 1

USGS
science for a changing world

2005 Minerals Yearbook

STONE, CRUSHED

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

February 2007

Granite.—The output of crushed granite increased by 1.2% to 263 Mt valued at $2.16 billion compared with 2004 (table 2). Crushed granite was produced by 129 companies at 364 operations with 339 quarries in 35 States. The leading States were, in descending order of tonnage, Georgia, North Carolina, Virginia, South Carolina, and California; the total production of these five States was 191 Mt, or 72.6% of the U.S. output (table 9). The leading producers were, in descending order of tonnage, Vulcan Materials, Martin Marietta, Hanson, Luck Stone Corp., and Florida Rock. Their combined total production was 165 Mt, or 63.1% of the U.S. granite total.

Limestone.—The 2005 output of crushed limestone, including some dolomite, increased by 3.3% to 1.1 Gt valued at $7.5 billion compared with 2004 (table 2). Limestone was produced by 686 companies at 1,800 operations with 1,867 quarries in 47 States. In addition, 37 companies with 61 operations and 61 quarries reported producing limestone and dolomite from the same quarries. Their production of about 33 Mt of limestone and dolomite combined is included with the limestone listed in table 2. The limestone totals listed in this chapter, therefore, include an undetermined amount of dolomite in addition to the dolomite reported separately.

The leading producing States were, in descending order of tonnage, Texas, Florida, Missouri, Ohio, and Tennessee; the total production of these five States was 461 Mt, or 42.5% of the total U.S. output (table 8). The leading producers of limestone were, in descending order of tonnage, Vulcan Materials, Martin Marietta, Hanson, Lafarge, and Rinker Materials. Their combined total production was 337 Mt, or 31.0% of the U.S. total.

Marble.—Production of crushed marble decreased by 21.7% to 7.8 Mt valued at $58.7 million compared with the total for 2004 (table 2). Crushed marble was produced by 12 companies with 22 operations and 20 quarries in 12 States. The leading producers of crushed marble were, in descending order of tonnage, Imerys Marble, Inc.; Omya, Inc.; Pluess Staufer Industries; Vulcan Materials; and Huber Engineered Materials. Their combined total production was 7.2 Mt, or 93.1% of the U.S. marble total.

Miscellaneous Stone.—Output of other kinds of crushed stone increased by 10.8% to 33.0 Mt valued at $226 million compared with 2004 (table 2). Miscellaneous stone was produced by 90 companies at 149 operations with 147 quarries in 29 States. The leading producing States were, in descending order of tonnage, Pennsylvania, North Carolina, California, Oregon, and Alaska; their combined production was 18.9 Mt, or 57.4% of the total U.S. output. Leading producers were, in descending order of tonnage, the U.S. Bureau of Land Management; Haines & Kibblehouse, Inc.; and Wake Stone Corp. Their combined total production was 10.1 Mt, or 30.6% of the U.S. miscellaneous stone total.

Sandstone and Quartzite.—The output of crushed sandstone and quartzite increased by 9.3% to 55.3 Mt valued at $387 million compared with the total for 2004 (table 2). Crushed sandstone was produced by 90 companies with 114 quarries in 22 States, while quartzite was produced by 33 companies with 40 quarries in 18 States.

The leading producing States were, in descending order of combined tonnage of sandstone and quartzite, Arkansas, Pennsylvania, Colorado, California, and South Dakota, and their combined total production was 32.3 Mt, or 58.4% of the U.S. output (table 9). The leading producers of sandstone and quartzite were, in descending order of tonnage, Lafarge; Martin Marietta; Ashland Paving and Construction, Inc. (APAC); CEMEX; and Pine Bluff Sand and Gravel Co. Their combined total production was 19.5 Mt, or 35.3% of the U.S. sandstone and quartzite total.

Shell.—Shell is derived mainly from fossil reefs or oyster shell banks. The output of crushed shell more than tripled to 4.42 Mt valued at $27.2 million compared with the 2004 total (table 2). Crushed shell was produced by nine companies with eight quarries in six States. The leading producers were, in descending order of tonnage, Schroeder-Manatee Ranch, Inc.; Caloosa Shell Corp.; and Langenfelder & Sons, Inc.

Slate.—The output of crushed slate decreased by 5.5% to 3.3 Mt and its value decreased by 11.7% to $23.6 million compared with 2004 (table 2). Crushed slate was produced by 15 companies at 16 quarries in 11 States. Most of the crushed slate was produced in North Carolina. The leading producers were, in descending order of tonnage, Martin Marietta, McCartney Construction, and NAPA Development Corp., Inc. Their combined total production was 2.3 Mt, or 69.8% of the U.S. slate total.

Traprock.—Production of crushed traprock increased by 5.0% to 130 Mt compared with 2004 total (table 2). Traprock was produced by 199 companies at 331 operations with 348 quarries in 24 States. The leading producing States were, in descending order of tonnage, Oregon, Virginia, New Jersey, California, and Washington; these five States produced 76.6 Mt, or 58.9% of U.S. output (table 9). Leading producers were, in descending order of tonnage, Oldcastle; Luck Stone; Vulcan Materials; MDU Resources Group, Inc.; and Deatley Co., Inc. Their combined total production was 52.7 Mt, or 40.5% of the U.S. traprock total.

Volcanic Cinder and Scoria.—Production of volcanic cinder and scoria increased by 54.8% to 3.0 Mt compared with the total for 2004 (table 2). Volcanic cinder and scoria were produced by 22 companies from 39 operations with 40 quarries in 13 States. Owing to the small numbers of companies operating in most States, only one or two, no State totals could be published for those States, and therefore leading producing States could not be identified (table 11). The leading producer was the U.S. Forest Service with about one-half of the 2005 production of volcanic cinder and scoria.

Consumption

Crushed stone production reported to the USGS is actually material that was either sold to other companies or consumers or was used by the producers. Stockpiled production is not included in the reported quantities. The "sold or used" tonnage, therefore, represents the amount of production released for domestic consumption or export in a given year. Because some of the crushed stone producers did not report a breakdown by end use, their total production is included in the "Unspecified, reported" use category. The estimated production of nonrespondents is included in the "Unspecified, estimated" use category.

In 2005, U.S. apparent consumption of crushed stone, which is defined as U.S. production plus imports minus exports, was 1.71 Gt, a 3.7% increase compared with the apparent consumption of 2004. Of the 1.71 Gt of crushed stone consumed, 540 Mt, or 31.7% of the total, was "Unspecified, reported," and 304 Mt, or 17.8% of the total, was "Unspecified, estimated." Of the remaining 841 Mt, reported by uses by producers, 84.7% was used as construction aggregate, mostly for highway and road construction and maintenance as well as residential construction and sewers; 12.4%, for chemical and metallurgical uses, including cement and lime manufacture; 1.6%, for agricultural uses; and 1.4%, for special and miscellaneous uses and products (table 13). Unspecified uses are not included in the calculation of the above percentages. It is suggested that, in marketing analysis or use-pattern studies, the quantities included in unspecified uses be prorated and added to the reported uses by applying the above percentages calculated for the reported quantities. Using this procedure, the analyst assumes that the breakdown by uses of the unspecified uses is similar to that of the reported uses.

In 2005, the value of the total construction put in place increased to $1,140 billion, or 10.5%, as reported by the U.S. Census Bureau (2006§[1]). The value of total private construction increased by 11.8% to $899 billion, while the value of total public construction increased by 6.2% to $245 billion. The value of private construction showed signs of slower growth when compared with the 14.4% increase reported in 2004. The public construction sector recorded its largest increase since 2001, and the 6.2% increase in 2005 was an improvement compared with last year's 2.9% increase.

In 2005, there was also a 5.4% increase in the U.S. consumption of portland cement to 124 Mt compared with the 2004 total consumption of 117 Mt, another indication of increased construction activity at the national level.

Calcareous Marl.—Of the 4.9 Mt of crushed calcareous marl consumed, 2.5 Mt, or 50.1% of the total, was in "Unspecified, uses." Most of the remaining 2.5 Mt was used for cement manufacturing.

Dolomite.—Of the 95.2 Mt of crushed dolomite consumed, 29.0 Mt or 30.5% of the total, was in "Unspecified, reported" uses, and 8.4 Mt, or 8.9% of the total, was in "Unspecified, estimated" uses. Of the remaining 57.8 Mt of crushed dolomite reported by uses by the producers, 51.0 Mt, or 88.2%, was used as construction aggregates; 3.5 Mt, or 6%, was used for chemical and metallurgical applications, and 1.2 Mt, or 2%, for agricultural uses. An additional undefined amount of dolomite consumed in a variety of uses, mostly construction aggregates, is reported with limestone (table 14).

Additional detailed information for total combined limestone and dolomite by State and major uses is provided in table 15.

Granite.—Of the 263 Mt of crushed granite consumed, 119 Mt, or 45.3%, was in "Unspecified, reported" uses, and 31 Mt, or 11.8%, was in "Unspecified, estimated" uses. Most of the remaining 113 Mt was used as construction aggregates (table 17).

Limestone.—Of the 1,090 Mt of crushed limestone consumed, 294 Mt, or 27.1% of the total, was in "Unspecified, reported" uses, and 214 Mt, or 19.8% of the total, was in "Unspecified, estimated" uses. Of the remaining 577 Mt of crushed limestone, reported by uses by the producers, 464 Mt, or 80.4%, was used as construction aggregate; 94.2 Mt, or 16.3%, was used for chemical and metallurgical applications, including cement and lime manufacturing; 11.5 Mt, or 2.0%, for agricultural uses; and 4.2 Mt, or 0.7%, for special and miscellaneous uses and products (table 14).

Marble.—Of the 7.8 Mt of crushed marble consumed 4 Mt, or 51.7%, was in "Unspecified, estimated." Of the remaining 3.8 Mt of crushed marble reported by uses by the producers, 2.9 Mt, or 77.3%, was used as construction aggregates; 608,000 metric tons (t), or 16.2%, was used for special uses including fillers and extenders, and 241,000 t, or 6.4%, for agricultural uses (table 16).

Miscellaneous Stone.—Of the 33.0 Mt of miscellaneous crushed stone consumed, 12.3 Mt, or 37.1% of the total, was in "Unspecified, reported" uses, and 8.2 Mt, or 24.9% of the total, was in "Unspecified, estimated" uses. Construction aggregate accounted for more than 90% of the remaining 12.5 Mt reported by uses by the producers (table 19).

Sandstone and Quartzite.—Of the 37.2 Mt of crushed sandstone consumed, 14.0 Mt, or 37.8%, was in "Unspecified, reported" uses, and 10.9 Mt or 29.3%, in "Unspecified, estimated." Most of the remaining 12.2 Mt of crushed sandstone reported by uses by the producers was used as construction aggregates (table 18).

Of the 18.1 Mt of crushed quartzite consumed in the United States, 9.5 Mt, or 52.2% of the total, was in "Unspecified, reported" uses, and 2.3 Mt, or 12.8% of the total, was in "Unspecified, estimated" uses. Most of the remaining 6.4 Mt of crushed quartzite reported by uses by the producers was used as construction aggregate (table 18).

Shell.—Of the 4.4 Mt of crushed shell consumed, 480,000 t, or 10.9%, was reported as "Unspecified, uses." Most of the remaining 3.9 Mt was used as construction aggregate.

Slate.—Of the 3.3 Mt of crushed slate consumed, two-thirds of the total, or 2.2 Mt, was in "Unspecified, uses." The remaining one-third was used as construction aggregate including roofing granules.

Traprock.—Of the 130 Mt of crushed traprock consumed, 58.8 Mt, or 45.2%, was in "Unspecified, reported" uses, and 21.5 Mt, or 16.5%, was in "Unspecified, estimated" uses. Most of the remaining 49.9 Mt was used as construction aggregate (table 17).

Volcanic Cinder and Scoria.—Of the 3.0 Mt of volcanic cinder and scoria consumed, 1.6 Mt, or 53.5% of the total, was in "Unspecified, reported" uses, and 286,000 t, or 9.7% of the total, was in "Unspecified, estimated" uses. Most of the remaining 1.1 Mt of crushed volcanic cinder and scoria was used as construction aggregate (table 19).

Additional information regarding production and consumption of crushed stone by type of rock and major uses in each State

[1]A reference that includes a section mark (§) is found in the Internet Reference Cited section.

and the State districts may be found in the USGS Minerals Yearbook, volume II, Area Reports: Domestic.

Recycling

As the recycling of most waste materials increases, aggregates producers are recycling more cement concrete and asphalt concrete materials recovered from construction projects to produce concrete and asphalt aggregates and other aggregate materials, especially fill and road base. The recycling of cement concrete is done at some quarries and increasingly at sales yards or distribution sites, whereas asphalt concrete is recycled mostly at the construction sites. The annual survey of crushed stone producers collects information on recycling of cement and asphalt concretes produced by the crushed stone producers only. These amounts represent a small percentage of the total recycled cement and asphalt concretes because the recycling of these materials is done mostly by construction or demolition companies, and those companies are not surveyed by the USGS.

Asphalt Concrete.—A total of 1.9 Mt of asphalt concrete valued at $17.7 million was recycled in 2005 by 46 companies in 21 States. The tonnage of recycled asphalt concrete decreased by 17.1% compared with the 2004 total (tables 20, 21). The leading recycling geographic regions were, in descending order of tonnage, the Northeast with 591,000 t, the West with 549,000 t, and the South, with 499,000 t (table 20). The leading recycling States were, in descending order of tonnage, California, Florida, Pennsylvania, New York, and Indiana. Their combined total represented 67.8% of the U.S. total. The leading recycling companies, in descending order of tonnage produced, were Vecellio & Grogan, Inc.; Oldcastle; and Hanson.

Cement Concrete.—A total of 3.9 Mt of portland cement concrete valued at $29.4 million was recycled by 40 companies in 19 States. This tonnage represents a 37.2% increase compared with 2004 (tables 22, 23). The leading recycling geographic regions were, in descending order of tonnage, the Midwest with 1.7 Mt, the West with 1.6 Mt, and the South with 332,000 t. The leading recycling States were, in descending order of tonnage, Illinois, California, Virginia, New York, and Wisconsin. Their combined total represented 95.5% of the U.S. total. The leading companies were, in descending order of tonnage produced, Vulcan Materials, Stevens Creek Quarry Inc., and Oldcastle.

Prices

Prices in this chapter are the average annual free on board plant prices, usually at the first point of sale or captive use, as reported by the crushed stone producing companies. This value does not include transportation from the plant or yard to the consumer. It does, however, include all costs of mining, processing, in-plant transportation, overhead costs, and profit. In 2005, fewer than one-half of the operations responding to the annual survey reported the value of their production. The number of operations that reported the value of their production increased slightly in 2005. The average unit value for operations reporting production and value in 2005 was $7.26. This was an increase of 8.2% compared with the average unit value of $6.71 in 2004. The annual reports of the top three U.S. producing companies reported an 8% price increase in 2005 compared with prices in 2004. The average unit prices, by kind of stone, increased for every stone type except slate (table 2). For those operations that reported production only, the unit values of total production or specific end uses were estimated based on what other operations in the same State reported. The average unit value for specific end uses within a State was used in the estimation of value for operations reporting specific end uses. The State average was used in the estimation for operations reporting a total production but not total value. The estimation process was modified from previous years to align with the methodology used in the construction sand and gravel chapter.

Additional information regarding prices of crushed stone by type of rock and uses in the United States and each State and the State districts may be found throughout the tables included in this chapter as well as in the USGS Minerals Yearbook, volume II, Area Reports: Domestic.

Transportation

For 883 Mt, or 52.4%, of the 1.69 Gt of crushed stone produced for consumption in 2005, no means of transportation was reported by the producers. Of the remaining 802 Mt of crushed stone, 669 Mt, or 83.4%, was reported as being transported by truck from the quarry or the processing plant to the first point of sale or use; 48.7 Mt, or 6.1%, by rail; and 23.8 Mt, or 3.0%, by waterway. For 48.9 Mt, or 6.1%, of the specified production was reported as not having been transported and, therefore, is assumed to have been used onsite (table 24).

Shipment by truck remains the most widely used method of transportation for crushed stone. The significant increase in the number of sales and distribution yards in the past couple of years and the increase in the volume of crushed stone going through these sites have had a positive impact on the industry as well as the communities they serve. Distribution sites located near metropolitan areas significantly reduce the distance most trucks have to travel to pick up and deliver crushed stone. Therefore the transportation costs are reduced, as is the impact of heavy traffic on the infrastructure and the environment. Sales yards serve both to distribute products and increasingly as recycling sites. This provides efficiency for the industry while helping protect the environment.

Information regarding means of transportation used by the producers to ship crushed stone from the production site to the consumer in each geographic region is provided in table 24.

Foreign Trade

The widespread distribution of domestic deposits of stone suitable for mining as crushed stone, the large number of existing active operations around the country, and the high cost of transportation limit foreign trade to mostly local transactions across international boundaries. Shipments of crushed stone by water, especially from Canada, the Caribbean, and Mexico, continue to increase. U.S. imports and exports continue to be small, representing little more than 1% of domestic consumption.

TABLE 4

CRUSHED STONE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY STATE[1, 2]

State	2004 Quantity (thousand metric tons)	2004 Value (thousands)	2004 Unit value	2005 Quantity (thousand metric tons)	2005 Value (thousands)	2005 Unit value
Alabama	47,800 r	$296,000 r	$6.19 r	49,500	$325,000	$6.57
Alaska[3]	2,270 r	14,200 r	6.25 r	2,360	15,600	6.60
Arizona[4]	14,100 r	75,900 r	5.37 r	12,000	69,300	5.75
Arkansas[5]	34,100 r	173,000 r	5.07 r	35,400	223,000	6.29
California[6]	55,300 r	364,000 r	6.59 r	54,300	455,000	8.37
Colorado	11,100 r	68,300 r	6.14 r	13,000	89,100	6.85
Connecticut	10,100 r	75,700	7.53	10,100	92,600	9.19
Delaware[7]	--	--	--	W	W	6.89
Florida[8]	105,000	680,000 r	6.50 r	115,000	994,000	8.67
Georgia	79,700 r	548,000 r	6.88 r	79,400	606,000	7.63
Hawaii	5,470 r	61,300 r	11.21 r	6,170	82,300	13.34
Idaho	3,420 r	18,100 r	5.30 r	4,450	23,900	5.37
Illinois	75,300 r	462,000 r	6.14 r	76,200	545,000	7.16
Indiana	56,800	265,000 r	4.68 r	57,500	311,000	5.40
Iowa	35,800 r	219,000 r	6.12 r	34,500	251,000	7.27
Kansas	20,600 r	122,000 r	5.93 r	22,100	159,000	7.20
Kentucky[9]	62,100 r	384,000 r	6.18 r	58,200	421,000	7.24
Louisiana[10]	W	W	11.27 r	W	W	8.18
Maine	4,370	29,500	6.75	4,490	30,700	6.85
Maryland	35,300 r	214,000 r	6.05 r	33,100	274,000	8.28
Massachusetts	13,700 r	109,000	7.97 r	13,200	121,000	9.19
Michigan[11]	36,700 r	143,000 r	3.90 r	36,100	141,000	3.89
Minnesota[12]	10,400 r	64,900 r	6.24 r	10,500	86,900	8.30
Mississippi[13]	2,760	34,200	12.40	3,500	41,700	11.90
Missouri	92,600 r	564,000 r	6.09 r	99,400	733,000	7.37
Montana	4,090	13,700 r	3.35 r	3,540	16,800	4.76
Nebraska	6,900	51,900	7.52	6,950	49,300	7.10
Nevada	9,760	72,800	7.46	9,320	66,800	7.17
New Hampshire	4,720 r	23,900 r	5.06	5,100	40,900	8.02
New Jersey[14]	25,400 r	185,000 r	7.29 r	22,700	160,000	7.04
New Mexico[15]	2,830 r	16,400 r	5.79 r	3,010	20,100	6.67
New York	49,400 r	327,000 r	6.62	52,700	445,000	8.44
North Carolina	72,300 r	549,000 r	7.59	74,300	638,000	8.59
North Dakota[16]	W	W	3.88 r	89	396	4.45
Ohio	76,500 r	396,000 r	5.17 r	75,200	437,000	5.82
Oklahoma	39,800	206,000 r	5.19 r	45,400	257,000	5.67
Oregon	22,700 r	126,000	5.54 r	26,000	157,000	6.01
Pennsylvania	113,000 r	639,000 r	5.68 r	106,000	704,000	6.67
Rhode Island[17]	1,600	12,400	7.74	1,610	12,400	7.74
South Carolina[18]	31,300	210,000	6.70	33,800	258,000	7.61
South Dakota	6,410 r	27,600 r	4.30 r	6,650	30,600	4.60
Tennessee	57,900	381,000 r	6.58 r	63,900	482,000	7.55
Texas	122,000	621,000 r	5.11 r	134,000	823,000	6.15
Utah	8,030 r	45,100 r	5.62 r	8,350	46,600	5.58
Vermont[19]	5,110	30,800	6.03	5,480	37,000	6.75
Virginia[20]	73,700 r	540,000 r	7.33 r	86,200	778,000	9.03
Washington	12,100 r	75,500 r	6.25 r	13,900	96,300	6.92
West Virginia	14,700	72,600 r	4.95 r	14,500	99,400	6.86
Wisconsin	39,300 r	172,000 r	4.38 r	38,900	227,000	5.83
Wyoming	6,300 r	35,300 r	5.60 r	7,370	41,800	5.68
Other	7,240 r	71,400 r	9.86 r	11,000	86,500	7.89
Total or average	1,630,000 r	9,890,000 r	6.08 r	1,690,000	12,100,000	7.18

See footnotes at end of table.

TABLE 13
CRUSHED STONE SOLD OR USED BY PRODUCERS IN THE UNITED STATES
IN 2005, BY USE[1]

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Construction:			
Coarse aggregate (+1½ inch):			
Macadam	5,100	$35,700	$7.01
Riprap and jetty stone	15,000	152,000	10.19
Filter stone	8,920	82,200	9.21
Other coarse aggregate	16,900	119,000	7.06
Coarse aggregate, graded:			
Concrete aggregate, coarse	80,200	669,000	8.34
Bituminous aggregate, coarse	65,200	518,000	7.94
Bituminous surface-treatment aggregate	15,000	134,000	8.93
Railroad ballast	9,000	61,800	6.86
Other graded coarse aggregate	87,800	747,000	8.51
Fine aggregate (-3/8 inch):			
Stone sand, concrete	21,200	155,000	7.34
Stone sand, bituminous mix or seal	15,500	98,800	6.37
Screening, undesignated	16,800	120,000	7.12
Other fine aggregate	35,500	281,000	7.93
Coarse and fine aggregates:			
Graded road base or subbase	147,000	907,000	6.17
Unpaved road surfacing	24,300	155,000	6.38
Terrazzo and exposed aggregate	1,120	16,300	14.55
Crusher run or fill or waste	26,300	149,000	5.69
Roofing granules	1,700	73,800	43.32
Other coarse and fine aggregates	109,000	750,000	6.87
Other construction materials[2]	10,600	104,000	9.87
Agricultural:			
Agricultural limestone	10,800	64,200	5.94
Poultry grit and mineral food	1,060	11,400	10.76
Other agricultural uses	1,200	18,300	15.24
Chemical and metallurgical:			
Cement manufacture	76,100	349,000	4.58
Lime manufacture	18,600	134,000	7.21
Dead-burned dolomite manufacture	W	W	5.73
Flux stone	4,360	22,800	5.24
Chemical stone	334	5,890	17.64
Glass manufacture	1,180	11,500	9.76
Sulfur oxide removal	3,610	22,000	6.09
Special:			
Mine dusting or acid water treatment	208	4,550	21.87
Asphalt fillers or extenders	1,160	15,400	13.29
Whiting or whiting substitute	103	1,280	12.44
Other fillers or extenders	4,330	66,100	15.27
Other miscellaneous uses:			
Chemicals	34	1,120	32.94
Refractory stone	W	W	2.00
Sugar refining	224	1,240	5.54
Waste material	W	W	2.00
Other specified uses not listed	5,500	42,500	7.73
Unspecified:[3]			
Reported	540,000	3,830,000	7.09
Estimated	304,000	2,170,000	7.13
Total or average	1,690,000	12,100,000	7.18

See footnotes at end of table.

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