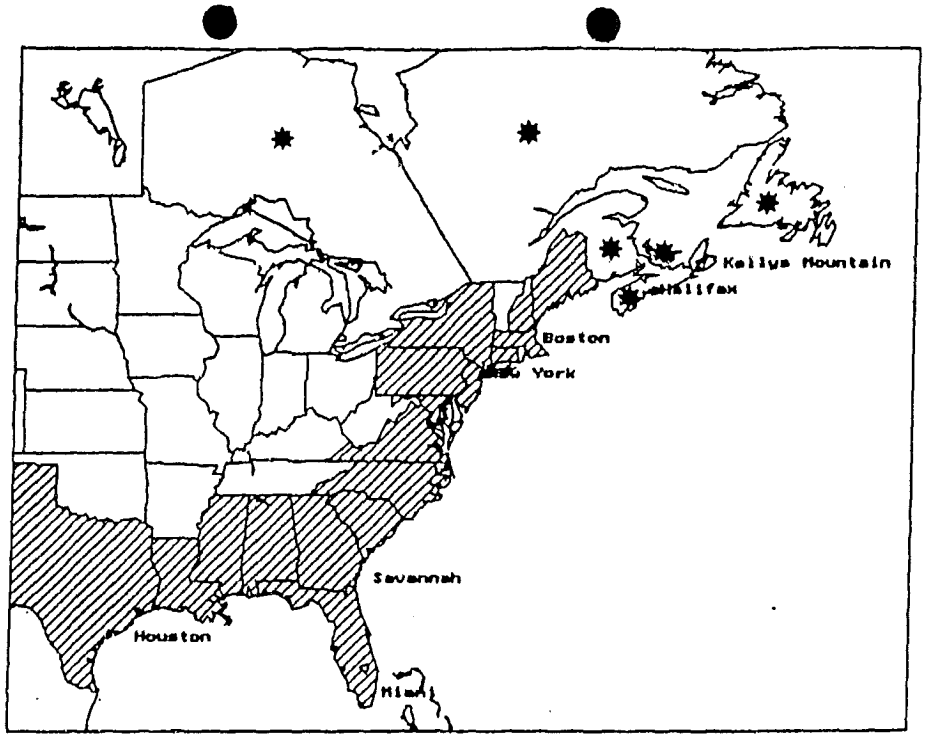

AN OVERVIEW OF THE AGGREGATE INDUSTRY POTENTIAL MARKETS IN EASTERN NORTH AMERICA IN RELATION TO COASTAL QUARRY POTENTIAL IN NOVA SCOTIA

S.E. Yundt
S.E. Yundt Limited
April, 1992

OUTLINE

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REPORT NOTE

This Report was commissioned by the Canada-Nova Scotia environmental assessment panel reviewing the Kellys Mountain Quarry project. The views expressed, however, are strictly the author's own and do not necessarily reflect the views of the members of the Panel.

This Report is an overview of the information as of April 1992. Information changes rapidly in this field. In depth studies should be conducted as required. All aggregate production numbers in this study are in tonnes in Canada and Europe and in tons in the United States. If conversions are to be made the following formulas are suggested– 1 ton X .9072 = tonne or 1 tonne X 1.102 = ton.

1. INTRODUCTION

Aggregates (sand, gravel and crushed stone) are an essential raw material for all road building and construction industries. They are fixed-location, non renewable resources which can be extracted only where they occur. Aggregates are large volume, low cost mineral resources that are continually in demand and diminishing in availability.

Aggregates are vital ingredients for cement and asphalt products and therefore are significant to the economic well being, standard of living and development of the world and its people. The aggregate industry exists to respond to public demand for the resource.

Aggregates are fundamental resources which provide:

- ♦ highways/roads;
- ♦ houses/apartments/residences;
- ♦ shopping centres/commercial buildings;
- ♦ airports/dams/bridges/shore protection; and
- ♦ manufactured products eg. concrete, asphalt, steel & glass.

Growth and prosperity require an adequate supply of aggregates but the social and environmental factors linked to their extraction must never be overlooked.

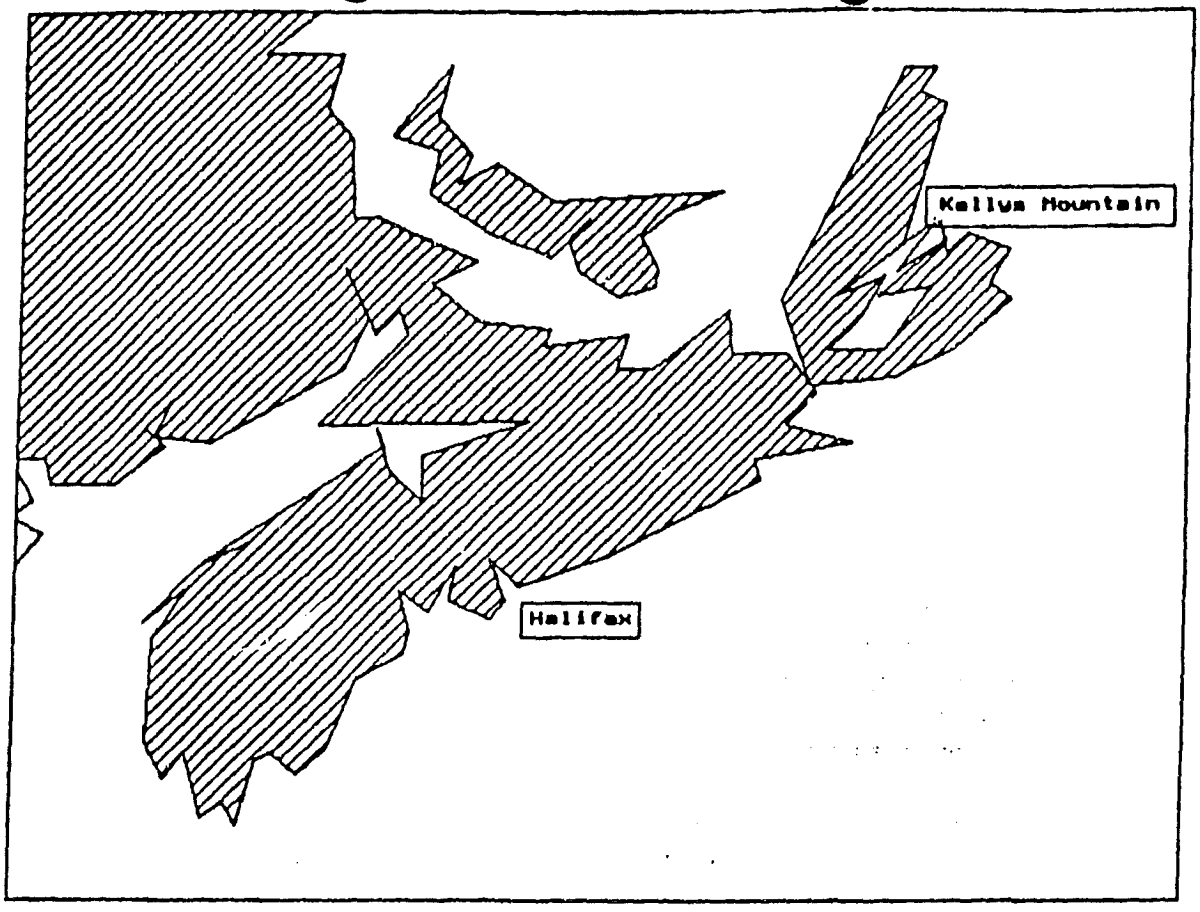
Aggregates must be extracted within the context of sustainable development with minimal social and environmental costs. This means the development must meet the needs of the present without compromising the ability of future generations to meet their own needs. (The World Commission on Environment and Development 1987) Sustainable development is premised on our ability to forge links between the environment and the economy that can support an enhanced quality of life--now and in the future. (Ontario Round Table on Environment and Economy 1990)

Any aggregate operation must be undertaken within the context of sustainable development, permitting extraction of the resource, as an interim land use, while ensuring progressive rehabilitation of the land back to a productive use in relation to the surrounding land uses.

2. KELLYS MOUNTAIN PROPOSAL

2.1 INTRODUCTION

Kelly Rock Limited is proposing to start a new coastal quarry on Kellys Mountain, St. Ann's Bay, Cape Breton Island, Nova Scotia. (See Map 1) The proposal includes a quarry, crushing and processing equipment, storage, maintenance and administrative facilities and a marine shipping terminal.



MAP 1 LOCATION OF PROPOSED KELLYS MOUNTAIN QUARRY
CAPE BRETON ISLAND, NOVA SCOTIA

The aggregate to be extracted is granite and production would eventually reach 5.4 million tonnes per year. The quarry design is based on the use of the "glory hole" technique which involves hollowing out the inside of a hill and dropping extracted material down the central shaft or "glory hole" onto an intersecting horizontal tunnel conveyor belt that transports the material to a processing plant. The major advantages of the "glory hole" are that the material is moved vertically by force of gravity alone, with little environmental impact and preventing the need for an open rock face. The quarry would produce several products including coarse and fine concrete aggregate, rail ballast and coarse and fine asphalt aggregate. Kelly Rock Limited estimate employment opportunities of over 100 jobs. (Kelly Rock Limited, Registration of Undertaking 1990)

2.2 ENVIRONMENTAL REVIEW

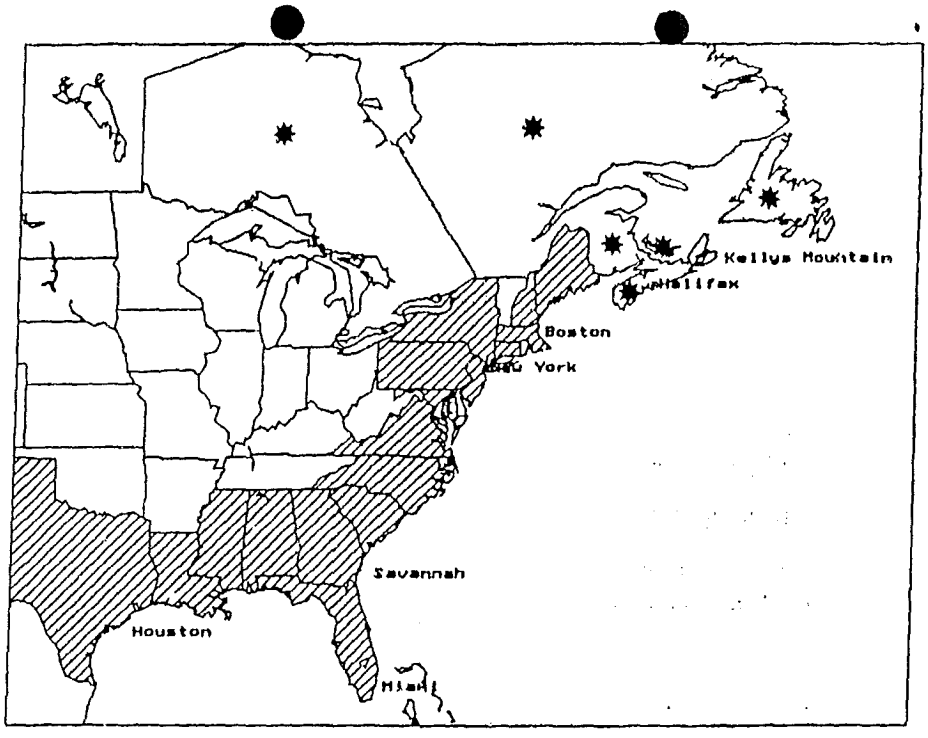
On March 11, 1991 the Federal Environment Minister and Nova Scotia Environment Minister announced the appointment of a federal-provincial environmental assessment panel to review the proposed quarry on Kellys Mountain. The Panel was established under the provisions of the Nova Scotia Environmental Assessment Act and the authority of the federal Environmental Assessment and Review Process. The Panel's mandate is to conduct a public environmental review of Kelly Rock Limited's proposed granite quarry and shipping facilities at Kellys Mountain, Nova Scotia. The Panel will advise the Minister of the Environment of Nova Scotia and Canada whether the project can be carried out without causing significant adverse effects to the environment. (Minister of the Environment 1991)

3. STUDY AREA

For the purposes of this Report the Study Area shown on Map 2 was chosen. The Study Area consists of the following Canadian provinces and U.S. states.

Canadian Provinces	U.S. States		
Newfoundland	Alabama	Maryland	Pennsylvania
Nova Scotia	Connecticut	Massachusetts	Rhode Island
Prince Edward Island	Delaware	Mississippi	South Carolina
New Brunswick	Florida	New Hampshire	Texas
Quebec	Georgia	New Jersey	Virginia
Ontario	Louisiana	New York	
	Maine	North Carolina	

This Study Area was chosen because parts or all of these provinces and states are accessible by water and therefore, crushed rock from the proposed quarry by Kelly Rock Limited could be shipped by water to these provinces and states.



MAP 2 STUDY AREA

CANADIAN PROVINCES ✸

EAST COAST STATES

4-59

4. COASTAL QUARRIES

4.1 PHILOSOPHY (BACKGROUND)

In the mid 1970's the United Kingdom government sponsored a committee under the Chairmanship of Sir Ralph Verney to review how the aggregate demand throughout the U.K. could be met to the end of the century. In 1976 "Aggregates--the way ahead" was published with Verney predicting continued increases in aggregate demand with supply problems in S.E. England centred on London. Verney also forecast that in the early 1990's new sources of supply would have to be established and one of these could be mammoth coastal quarries. (Tidmarsh 1991)

Verney stated that very large scale rock quarries if carefully sited and developed in areas far removed from centres of population near the coast, could have many advantages and offend the least number of people. Verney proved to be correct in his forecasts related to all of these matters and currently the Department of the Environment has a major study underway on coastal superquarries. (Verney 1976)

At the same time as the Verney Committee was undertaking its work in the U.K, Vulcan Materials Co. of Birmingham, Alabama envisioned supplying crushed stone products from Mexico into the United States. In 1973 Vulcan first began investigating stone deposits in Mexico. (Archibald & Beard, Part 1 1991)

Coastal quarries are not new--since the beginning of mankind men have used the sea as a means of transportation. Norway has several small coastal quarries established in the late 1960's and early 1970's. Many articles have been written related to coastal quarries (Tidmarsh 1989 & 1991, Gribble 1989 & 1991, Kirk 1990, Yeoman 1987, Rukavina 1990 & 1991 & Archibald & Beard 1991) and they all agree to the following essential criteria for establishing a coastal quarry:

- a site less than 2 km from the sea;
- reserves of quantity rock (250 million tonnes);
- high quality rock;
- water depth (minimum 10 metres);
- protection from adverse weather;
- environmental effects minimized; and
- market place facilities to receive, store & redistribute. (Tidmarsh 1991)

4.2 GLENSANDA, SCOTLAND, THE YEOMAN STORY

In 1978 the late John Yeoman, Managing Director of Foster Yeoman Ltd. started to search for a coastal quarry site. He concluded the site must fulfil the following conditions:

- ♦ contain a significant quantity of suitable material;
- ♦ be located immediately adjacent to deep and sheltered water; and
- ♦ be remote (away from public view and future encroaching development).

Yeoman found no suitable sites in England, Wales or Ireland so he concentrated his search in Scotland. The eastern coast of Scotland was dismissed because of a lack of sheltered water and difficult climatic conditions. Western Scotland had the Gulf Stream to ensure a 365 day working year and the lochs provided sheltered areas. (Tidmarsh 1991)

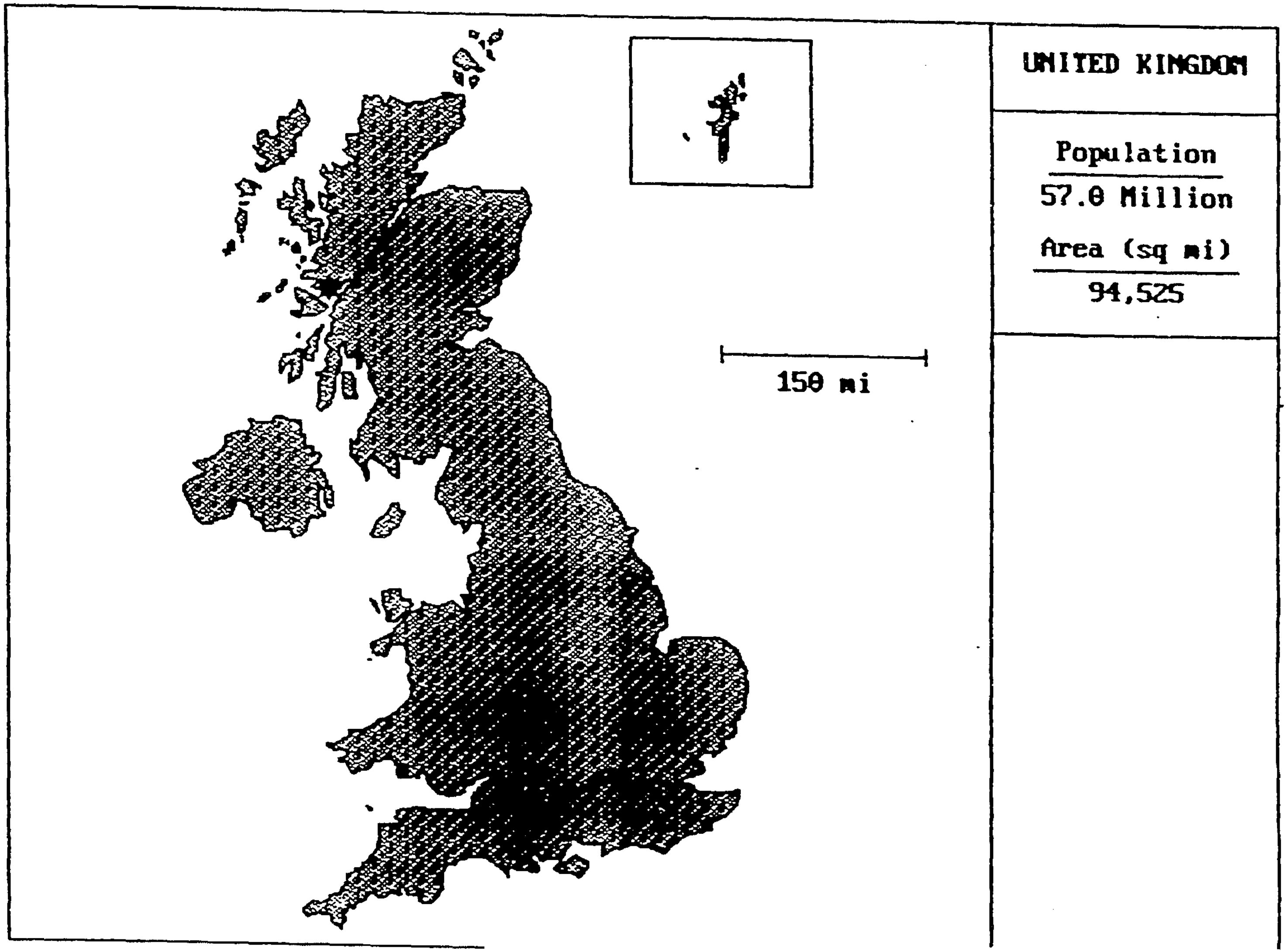
In 1980, Yeoman purchased 6000 acres of the west coast of Scotland known as the Glensanda Estate. The site is on Loch Linnhe in the Morvern Peninsula. (See Map 3) Reserves with planning permission, within the 300 acre granite quarry boundary, exceed 450 million tonnes. The berth is capable of accepting ships of up to 120,000 tonnes deadweight drawing 14 metres. Currently, 75,000 tonne vessels are loaded within 24 hours and the round trip from Glensanda to London return takes 8 days. This makes the transportation cost approximately $3.50 U.S. (Tidmarsh 1991)

Glensanda's trade of aggregates to the Gulf Coast of the United States has caused considerable discussion. Only the cost of distribution has allowed this to take place. The traditional trade between North America and Europe is virtually all one way (ie. eastward) and the vast majority of ships return empty to North America. Yeoman took advantage of this empty leg and by making a small deviation in the ships voyage achieved low rates. (Tidmarsh 1991) Even though Yeoman have shipped aggregate to the United States with backhauls of grain and coal because of the very high future demand in Europe, it is unlikely that they will ship aggregate to the United States on a regular basis.

> The backhaul concept was initiated on a small scale in the 1880's when ships transported American cotton to England and then had their holds partially loaded with cobblestones and brick as ballast on return trips to Newport News, Virginia; Charleston, South Carolina; and San Francisco. (Rukavina 1987)

In 1990 Glensanda produced 2.6 million tonnes with the majority of the material supplied to S.E. England and Northern European markets. Future output is expected to reach 15 million tonnes.

MAP 3 GLENSANDA QUARRY, FOSTER YEOMAN LTD., SCOTLAND



4.3 OTHER UNITED KINGDOM COASTAL QUARRIES

Wimpey Fleming (Quarries) Ltd. are operating a gritstone quarry at Bantry Bay, County Cork in Ireland. Production is 2 million tonnes per year. There are several other sites in various stages of approval or investigation in Scotland such as: Haggrister, Sullom Voe Aggregates, Lingara Bay, Redland Aggregates and other sites in the Hebrides and Highlands. It would seem likely that even if all these current proposals were approved there would still be considerable shortfalls in S.E. England.

4.4 UNITED KINGDOM COASTAL SUPERQUARRIES STUDY

The United Kingdom Department of the Environment has commissioned a study entitled "Coastal Superquarries to Supply South East England Aggregates Requirements." It is the U.K. Government policy that the construction industry must continue to receive an adequate and steady supply of aggregates at the best balance of social, environmental and economic costs. Britain consumes 300 million tonnes of aggregate per year and South East England consumes 70 million tonnes. Some 34 million tonnes of this is produced from local sources (mainly sand and gravel) and the remainder is "imported" from other areas in the U.K. or marine-dredged. (Department of the Environment 1991)

The 1990 forecasts by the U.K. Department of the Environment indicate shortages of aggregate in S.E. England as follows:

1995	16 million tonnes
2000	29 million tonnes
2005	37 million tonnes
2010	57 million tonnes. (Tidmarsh 1991)

The U.K. government is concerned because the local land supplies of aggregate will not be able to meet this demand so they commissioned the superquarry study to see if large coastal quarries could supply some of the increased demand. The study parameters include:

- a superquarry must produce +5 million tonnes per year;
- there must be 150 million tonnes of resources available, at each site;
- deep water must be available for loading large vessels;
- the topographic situation must be considered for the plant and infrastructure;
- environmental and planning policies must be established;
- wharf/depot/distribution infrastructure must be examined;
- a review of the economics of the operation must be done; and
- locations of deposits must include Great Britain, Northern Ireland, Scandinavia, Spain and Portugal. (Department of the Environment 1991)

4.5 YUCATAN PENINSULA, MEXICO, THE VULCAN STORY

Vulcan Materials Co. of Birmingham Alabama started to search for quality stone deposits on the Mexican coast as early as 1973 but they encountered problems related to loading the material into ships and the project was put on hold. Rapid development along the gulf coast was depleting local sources of aggregate and prices were increasing along with longer distance transportation and related increased costs.

In 1981, Vulcan resurrected the project to locate deposits close to the Mexican shore, identify potential markets in the Gulf Coast area of the U.S., analyze an efficient shipping system and determine the overall viability of the project. (Archibald & Beard, Part 1 1991)

In Mexico, a mining operation must be at least 51 per cent controlled by a Mexican company. Vulcan teamed up with Ingenieros Civilness Asociados, S.A. (Grupo ICA) of Mexico City and they formed three joint venture companies.

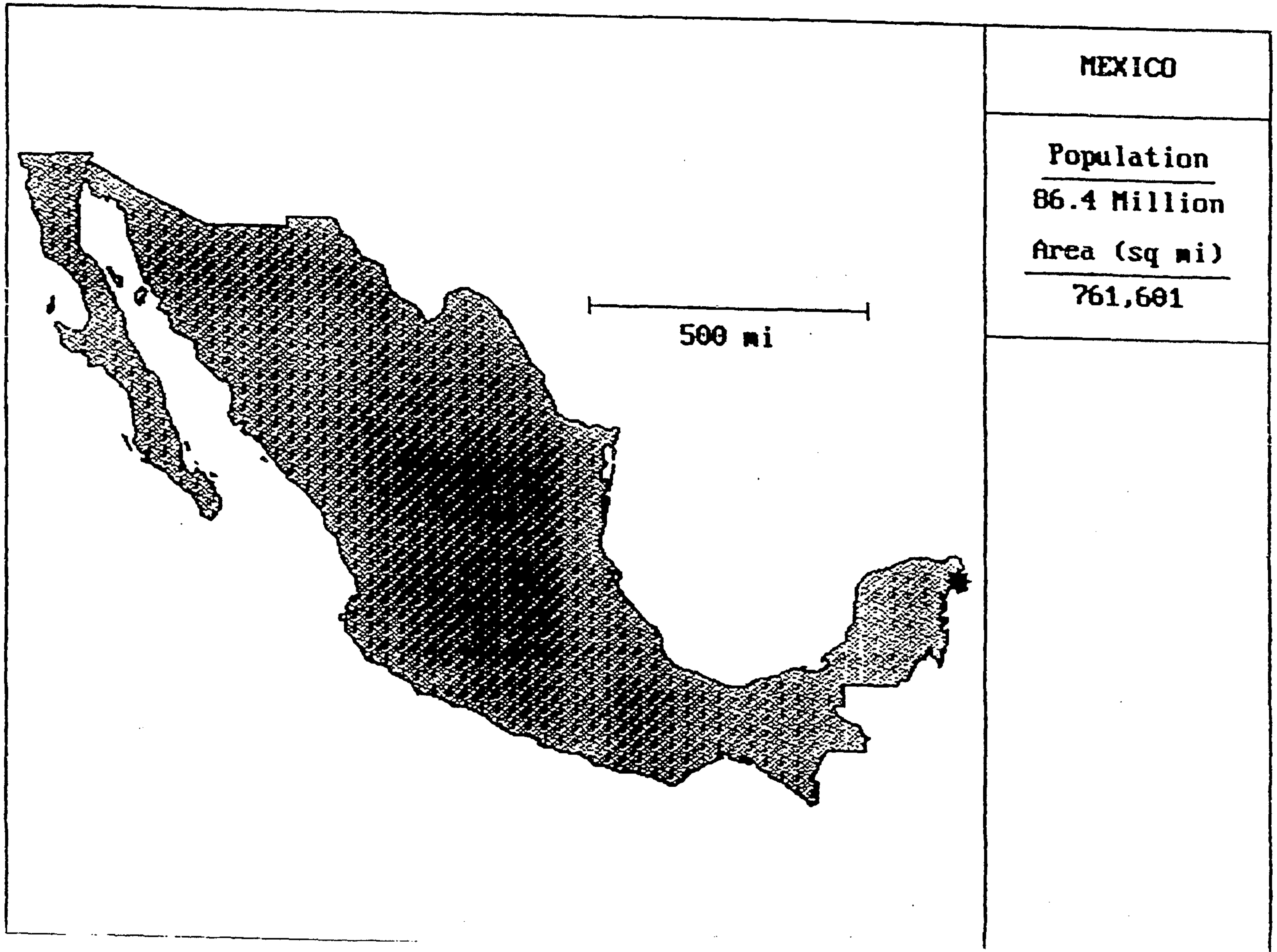
- Calizas Industriales del Carmen, S.A. de C.V. (Calica) actual mining and stone production;
- Vulica shipping; and
- Vulcan/ICA marketing and distribution.

The need for a deep water port narrowed the search area. In 1986 the Sac Tun Quarry complex approvals were granted in the state of Quintana Roo, 45 miles south of Cancun, on the east coast of the Yucatan Peninsula. (See Map 4) The reserves are estimated at 245 million short tons of limestone with a planned extraction rate of 6 million tons per year. The first load of aggregate was shipped early in 1991. Self-unloading Panamax-class vessels with a capacity of over 60,000 tons of aggregate are used to ship the aggregates. A Panamax class vessel is the maximum size vessel able to fit through the Panama Canal. Markets for the Mexican stone include:

- Houston, Galveston, Beaumont & Corpus Christi Texas;
- New Orleans & Lake Charles Louisiana;
- Mobile Alabama; and
- Tampa Florida.

The round trip from the Yucatan Peninsula to the U.S. gulf coast and back takes 7 days, including loading in Mexico and unloading in the U.S. Many environmental considerations had to be managed including ecology, hurricanes and Mayan ruins. (Rukavina 1991)

MAP 4 SAC TUN QUARRY, VULCAN MATERIALS CO., MEXICO



4.6 CANADA

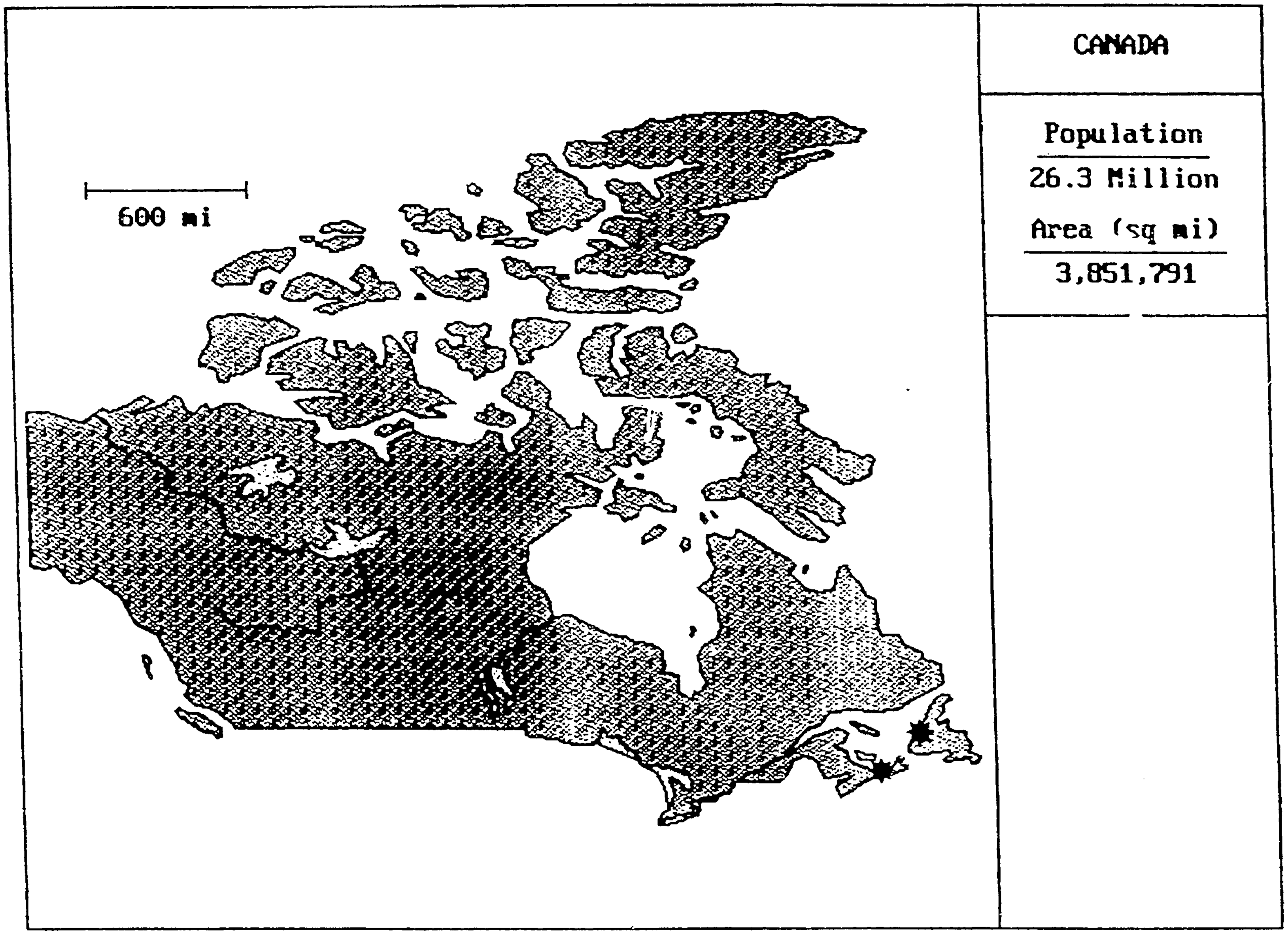
There are currently two coastal quarries in operation on the Canadian east coast marketing aggregate to the U.S., Newfoundland Resources and Mining Co. Ltd. and Construction Aggregates Limited.

Newfoundland Resources and Mining Co. Ltd. a subsidiary of Explaura Holdings Plc of London, England is located in the Port au Port Peninsula, Lower Cove, Stephenville, Newfoundland. (See Map 5) It is producing two million tonnes per year and marketing material to the east coast of the U.S. (Rukavina 1990) Explaura Holdings has been shipping 62,500 tons of limestone to Valente Industries Corp.--a major New York concrete producer. The delivery is part of a 7 million ton, 10 year supply agreement with Valente. Explaura Holdings has also began quarrying a high-purity, calcium carbonate limestone suitable for industrial use. They hope to ship the high purity limestone to Canadian customers along the eastern coastline. (Rock Products 1992)

Construction Aggregates Limited operate the Cape Porcupine Mountain Granite Quarry at Auld's Cove near Port Hawkesbury, Nova Scotia. (See Map 5) They are producing around one million tonnes of aggregate per year and marketing material to Bermuda and the east coast of the U.S.
(Consedine 1990)

Rock Products magazine reported in February, 1992 that Aguathuna Mining Inc. of Aurora, Ontario will build a $7 million limestone and dolomite quarry at Aguathuna, Newfoundland. No further information is currently available on this project. (Rock Products 1992)

MAP 5 LOWER COVE QUARRY, NEWFOUNDLAND RESOURCES AND MINING CO. LTD. & CAPE PORCUPINE MOUNTAIN QUARRY, CONSTRUCTION AGGREGATES LIMITED, CANADA



5. MARINE TRANSPORTATION ISSUES

5.1 INTRODUCTION

Aggregates are bulky, low-valued materials that require large scale transportation systems and volumes for economic haulage. The key is to produce aggregate at low costs and keep transportation costs low so the delivered price is competitive. Transportation is the critical element in analyzing the feasibility of distance markets from a Maritime quarry. Nova Scotia is very well situated on the great circle shipping routes. (See Map 6)

This information on marine transportation is not all encompassing but a general overview. A detailed study for a specific project would have to be conducted to cover all aspects of marine transportation.

5.2 CRITICAL ELEMENTS

There are many critical elements related to marine transportation that must be considered including:

- water depth at the quarry site;
- weather conditions;
- ice conditions;
- physical features of ports and approaches;
- regulatory controls
  - Navigable Waters Protection Act
  - waterlots
  - environmental concerns
  - port administration and control;
- pilotage; and
- market place facilities (receive, store & redistribute). (Tidmarsh 1991 & Leslie MacIntyre Maritime Associates Inc. 1988)

Another critical element relates to the vessels used to transport the aggregate. The vessels that are currently being used and will be used more frequently in the future for transporting aggregates are 75,000 tonne self-unloading Panamax-class vessels with a capacity of over 60,000 tonnes of aggregates. These self-unloaders discharge the cargo by radial stacker at any point without additional equipment.

MAP 6 NOVA SCOTIA AND WORLD SHIPPING ROUTES

> The self-unloading ships feature hoppers with a loop-belt conveyor system that runs along the bottom of the ship, collecting gravity-fed aggregate cargo from the holds. This loop-belt system lifts the cargo vertically and drops it onto a conveyor belt mounted atop an articulated boom of the ship. The cargo is spewed off at 5,000 tons per hour to dockside stockpiles at various distribution terminals. (Rukavina 1991)

5.3 BULK COMMODITY TRANSPORT

The Leslie MacIntyre Maritime Associates Inc. study entitled Marine Transport Study for Nova Scotia reviews in some detail the issues related to bulk commodities transport including:

- solid materials handling;
- stockpiling and reclaiming;
- shiploaders;
- ship size considerations (port limitations & vessel size);
- ship type;
- ocean transport; and
- methods of transport
  - spot freight shipment,
  - contract (term),
  - time charter; and
  - ownership.

In an April, 1990 article in Quarry Management, Kirk expands on the methods of transport.

> A coastal quarry must have control of its shipping, either through ownership or time charter, if it is to supply its customers on time at consistent prices. (Kirk 1990)

Buying ships is very expensive, for example a 70,000 tonne ship was estimated to cost $60 million in 1990 and all the evidence indicates that lower freight rates are achieved by utilizing larger ships. Spot market quotes are the most expensive option and in busy times it is difficult to obtain a ship. There is no potential to seek backhaul cargoes to reduce the costs of transporting the aggregate. Time charter is usually the most effective and flexible method of shipping. The charterer controls the full ship operation and can negotiate backhaul cargoes. (Kirk 1990)

In a May, 1991 article in Rock Products, Suttill and Darling explain that:

> It has been estimated that it costs the same to haul rock 800 miles by ship as it does to deliver within a 15 mile radius with a 20 tonne truck, and that the economies of scale associated with shipping 38,000 tonnes in a single unit to the Isle of Grain result in at least a halving of haulage costs compared to shipping in 3,000 to 4,000 tonne ships from the continent. (Suttill & Darling 1991)

Berson in a 1990 article in Mining Engineering outlined the costs and distances for various transportation methods as indicated below.

Method	Cost ($U.S./Ton/Mile)	Effective Market Area (Miles)
truck	12 cents	60
rail	5 cents	140
marine (barge)	1 cent	1000
marine (ship)	<1 cent	6000

The Leslie MacIntyre Maritime Associates Inc. study also includes distances in nautical miles to various markets. An example of some of these distances from Sydney, Nova Scotia to various ports is given in Figure 1.

5.4 MARINE FREIGHT RATES

Freight rate analysts will give representative freight rates only, based on the following criteria:

- minimum 500,000 tonnes per annum;
- majority of demand between April and November;
- stockpiling at the destination is the responsibility of the purchaser; and
- most of the aggregate is under two inches in size to eliminate loading and unloading problems or damage to the transport vehicles. (ADI Limited 1986)

The ADI Report entitled Study of Markets for Aggregate Materials Accessible from Nova Scotia and New Brunswick compared costs for truck, rail and marine transportation from Nova Scotia to ports in the eastern United States. The marine freight rates are the only economical transportation mode. Figure 2 is from the ADI Report giving examples of marine freight costs to various U.S. cities. Currently there are no commodity export tariffs applied to transborder shipments or transport subsidies available to the carriers for mineral aggregate. (ADI Limited 1986)

FIGURE 1
DISTANCES IN NAUTICAL MILES FROM SYDNEY, NOVA SCOTIA

BOSTON, MASSACHUSETTS	600
CAPE TOWN, SOUTH AFRICA	6423
CHARLESTON, S. CAROLINA	1291
CHARLOTTETOWN, P.E.I.	216
COLON, PANAMA	2481
GASPE, QUEBEC	260
GRASSY BAY, BERMUDA	908
HAVANA, CUBA	1817
HALIFAX, NOVA SCOTIA	249
JACKSONVILLE, FLORIDA	1453
KINGSTON, JAMAICA	1981
LONDON, ENGLAND	2560
NASSAU, BAHAMAS	1562
NEW LONDON, CONNECTICUT	680
NEWPORT, RHODE ISLAND	645
NEW YORK, NEW YORK	807
NORFOLK, VIRGINIA	996
PHILADELPHIA, PENNSYLVANIA	956
PORTLAND, MAINE	560
PORT OF SPAIN, TRINIDAD	2189
REYKJAVIK, ICELAND	1684
SAINT JOHN, NEW BRUNSWICK	511
ST. JOHN'S, NEWFOUNDLAND	378
SAN JUAN, PUERTO RICO	1733
SAVANNAH, GEORGIA	1367

SOURCE: LESLIE MACINTYRE MARITIME ASSOCIATES INC. MARITIME TRANSPORT STUDY FOR NOVIA SCOTIA, MAY 30, 1988.

FIGURE 2

EXPORT MARINE FREIGHT COSTS FROM ORIGINATING TO DESTINATION PORTS ($CAN./TONNE)

DESTINATION / ORIGIN	BOSTON	NEW YORK	PHILADELPHIA	BALTIMORE	HAMPTON	WILMINGTON, NC.	SAVANNAH	MIAMI	HOUSTON
SAINT JOHN	4.00	4.74	5.18	6.08	5.63	6.53	7.28	7.72	11.60
NEWCASTLE	6.01	6.75	7.20	8.10	7.64	8.55	9.29	9.73	13.62
BELLEDUNE	6.22	6.98	7.43	8.32	7.87	8.76	9.52	9.96	13.84
DALHOUSIE	6.30	7.05	7.49	8.40	7.95	8.84	9.59	10.03	13.92
SYDNEY	5.04	5.78	6.22	7.13	6.68	7.57	8.32	8.76	12.65
MULGRAVE	4.74	5.48	5.93	6.83	6.37	7.28	8.02	8.46	12.35
HALIFAX	4.29	5.04	5.48	6.37	5.93	6.83	7.57	8.02	11.91
LIVERPOOL	4.06	4.81	5.27	6.16	5.71	6.60	7.34	7.79	11.68

SOURCE: ADI LIMITED 1986

The ADI Report also compares costs for trucking, rail and marine from Nova Scotia to Quebec City, Montreal and Toronto. Truck and rail transport would be too costly or difficult, so marine transport would have to be used. Figure 3 is from the ADI Report and it gives the marine freight rates that could be expected.

Another example of transportation costs relates to the Glensanda, Scotland operation of Foster Yeoman using Panamax-class vessels delivering to a London terminal.

> As an indication of cost, the round trip from Glensanda to a London terminal takes eight days: a day to load, three days steaming, a day to discharge and three days return; at current rates, this would give a transportation cost of approximately $3.50 US.(Tidmarsh 1991)

5.5 EXAMPLES OF REPORTED SELLING PRICES

In the January 1991 issue of Mining Engineering, Zdunczyk gave the following examples of reported selling prices.

1. Nova Scotia to Charleston, South Carolina
   - $3.30 US per tonne f.o.b. quarry
   - $4.40 US per tonne freight
   - $2.20-3.30 US per tonne stevedoring
   - total $9.90-11.00 US per tonne f.o.b. port

2. Newfoundland to Philadelphia, Pennsylvania
   - $8.80 US per tonne f.o.b. port

3. Nova Scotia to Bermuda
   - $33.00 US per tonne f.o.b. port

Zdunczyk indicates the economics to produce and ship crushed stone from Canada may be marginal. However, with more environmental regulations in the United States and the NIMBY syndrome (not in my back yard), imports of aggregates from other countries may become as common as cement shipments. (Zdunczyk 1991)

5.6 DEPOTS AND DISTRIBUTION

Facilities must be available at the market to receive ships, store different grades of aggregate and redistribute it to the final customer. A location for these facilities is expensive and difficult to find.

FIGURE 3

DOMESTIC MARINE FREIGHT RATES FROM ORIGINATING TO DESTINATION PORTS ($CON./TONNE)

DESTINATION ORIGIN	QUEBEC CITY	MONTREAL	TORONTO
SAINT JOHN	6.55	7.30	10.45
NEWCASTLE	5.15	6.05	9.45
BELLEDUNE	4.25	5.00	8.15
DALHOUSIE	4.25	5.00	8.15
SYDNEY	4.32	5.07	8.22
MULGRAVE	4.30	5.05	8.20
HALIFAX	4.35	5.10	8.25
LIVERPOOL	5.04	5.90	9.22

SOURCE: ADI LIMITED 1986

The basic facility requirements are:

- 10-20 acres of land adjacent to deep water;
- a berth able to receive a ship up to 75,000 tonnes;
- access to land to discharge aggregate into stockpiles;
- storage capacity of 150,000 tonnes divided into a variety of sizes;
- facilities to reload small ships and barges, to reload trains and to reload trucks for local deliveries; and
- ideally facilities for ready mixed concrete and asphalt plants. (Tidmarsh 1989 & 1991)

6. GOVERNMENT STUDIES

6.1 BACKGROUND

Under the Canada-Nova Scotia Mineral Development Agreement four reports were completed in the late 1980's that are directly relevant to coastal quarries and the proposal by Kelly Rock Limited.

6.2 STUDY OF MARKETS FOR AGGREGATE MATERIAL ACCESSIBLE FROM NOVA SCOTIA AND NEW BRUNSWICK

ADI Limited completed the Study of Markets for Aggregate Material Accessible from Nova Scotia and New Brunswick under the Canada-Nova Scotia Mineral Development Agreement in March 1986. (ADI Limited 1986) This study describes the current market for aggregates accessible from New Brunswick and Nova Scotia, it includes a forecast of market potential to the year 2005 and identifies other relevant factors that could influence aggregate marketing. The market area for this study includes nineteen American States and Quebec and Ontario. The terms of reference for the study excluded consideration of the Maritime Provinces. Many of the details of this study are included in the Marketing Section of this Report.

6.3 POTENTIAL STONE DEPOSITS ON TIDEWATER IN NOVA SCOTIA

Under the Canada-Nova Scotia Mineral Development Agreement, Gordon Dickie wrote a report on Potential Stone Deposits on Tidewater in Nova Scotia in November 1987. (Dickie 1987) In 1986, Construction Aggregates Limited at their granite quarry near Port Hawkesbury, Nova Scotia exported 1 million tonnes by bulk ocean carrier to destinations such as Bermuda, Savannah, New Orleans and Houston. Nova Scotia is very well situated on the great circle shipping routes to Europe and on established shipping routes to the United States Eastern Seaboard and Gulf Coast. (See Map 6) Dickie indicated that Nova Scotia is ideally situated to take advantage of aggregate shipment to these coastal markets.

Dickie describes five locations in Nova Scotia where high quality rock occurs suitable for the export market. (See Map 7). Dickie did his site selection of potential crushed stone deposits based on the following criteria:

- rock types;
- topography;
- water depth; and
- property ownership.

Kellys Cove is one of the five locations chosen in his study. (Dickie 1987)

6.4 MARINE TRANSPORT STUDY FOR NOVA SCOTIA

Leslie MacIntyre Maritime Associates Inc. completed a study under the Canada-Nova Scotia Mineral Development Agreement on May 30, 1988 entitled Marine Transport Study for Nova Scotia. (Leslie MacIntyre Maritime Associates Inc. 1988). This study examines the major components of marine transport in relation to Nova Scotia's industrial minerals including aggregates.

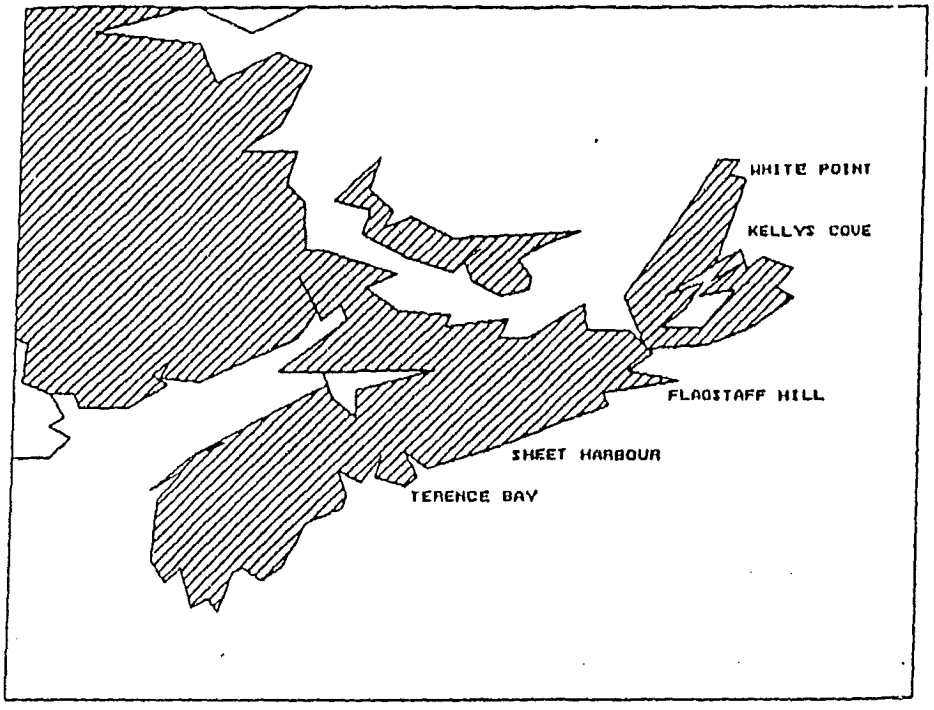
The study examines many factors related to marine transportation, reviews issues related to bulk commodities transport and trends in marine transportation markets. The study concludes that Nova Scotia producers of aggregate, through careful planning and control of their after-production costs (including transportation costs), are physically in a position to access many markets given their strategic marine transport location. (Leslie MacIntyre Maritime Associates Inc. 1988)

6.5 AGGREGATE MARKET STUDY FOR NEW BRUNSWICK AND NOVA SCOTIA (FINAL REPORT)

ADI Limited prepared this report also under the Canada-Nova Scotia Mineral Development Agreement in June 1988. (ADI Limited 1988) This study describes the market for aggregates within New Brunswick and Nova Scotia including production and consumption information.

Some of the topics covered include:

- quantities of aggregates produced;
- value of product;
- cost of production;
- aggregates specifications;
- survey of producers;
- directory of producers;
- quantities of aggregates consumed;



MAP 7 LOCATION OF POTENTIAL CRUSHED STONE DEPOSITS IN NOVA SCOTIA

SOURCE: DICKIE 1987

- value and price;
- consumer specifications;
- survey of consumers;
- directory of consumers; and
- aggregate distribution. (ADI Limited 1988)

This study is very useful to gain and understanding of the use of aggregates in Nova Scotia but it is not as valuable as the other three studies outlined above in terms of the current study related to a major coastal quarry.

7. EASTERN CANADA AGGREGATE INDUSTRY

7.1 PRODUCTION

The Canadian Minerals Yearbook produced by Energy, Mines and Resources Canada indicates a total production of 356 million tonnes of aggregate for Canada in 1990. This production is made up of 244 million tonnes of sand and gravel and 112 million tonnes of crushed stone. (Energy, Mines & Resources, Canada)

Figure 4 gives the total number of tonnes of sand and gravel and crushed stone for selected Canadian provinces in the Study Area. Figure 6 shows these production numbers graphically and it clearly indicates how the production of aggregates is directly related to the economy. The recessions of 1987 and 1990 clearly stand out with less aggregate required in a time of general economic recession.

The Canadian provinces in Figure 4, Figure 6 and shown on Map 2 have produced approximately 254 million tonnes of aggregate per year for the past five years. (Energy, Mines & Resources, Canada) This 254 million tonnes of aggregate is estimated to be over 65% of the total aggregate produced in Canada. Not all areas in these Canadian provinces are accessible by water but the Maritime provinces and the major urban demand areas of Montreal, Quebec City and Toronto are accessible by water. It may seem unlikely that crushed stone would be transported by water from Nova Scotia to Toronto, however, another industrial mineral is being transported this distance. Gypsum is being shipped on 11,000-40,000 tonne vessels from Nova Scotia to Quebec and Ontario. Although the final selling price of gypsum is higher than crushed stone, there are lessons that can be learned from this water transport movement. Competition in the Toronto market for crushed stone would be tough but moderate in Quebec as indicated in Section 9.

There are several cities in the Maritime provinces that could receive crushed rock by ship. Prince Edward Island produces no crushed rock at all and Halifax has a growing need for crushed rock.

FIGURE 4
TOTAL SAND, GRAVEL AND STONE PRODUCTION
SELECTED CANADIAN PROVINCES * (THOUSANDS TONNES ROUNDED)

	1970	1975	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
S & G	126013	171650	187200	171400	119700	124400	121900	131500	136800	156100	166400	153500	129400
STONE	54896	83988	92000	77600	51900	58800	71900	75800	88400	115500	113300	108300	102500
TOTAL	180909	255638	279200	249000	171600	183200	193800	207300	225200	271600	279700	261800	231900

SOURCE: ENERGY, MINES AND RESOURCES CANADA, CANADIAN MINERALS YEARBOOK
* NEWFOUNDLAND, NOVA SCOTIA, PRINCE EDWARD ISLAND, NEW BRUNSWICK, QUEBEC AND ONTARIO

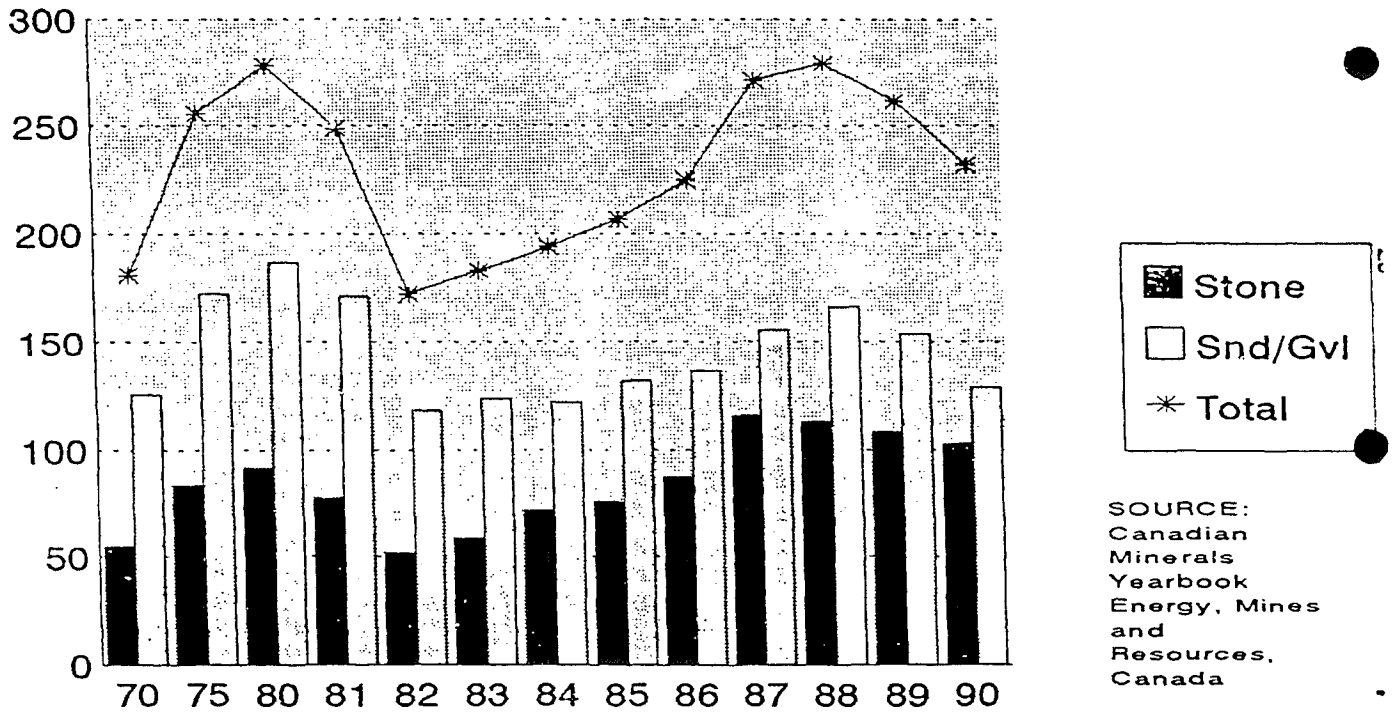
FIGURE 5
TOTAL SAND AND GRAVEL AND CRUSHED STONE SOLD OR USED BY PRODUCERS
SELECTED EAST COAST STATES * (THOUSANDS OF SHORT TONS ROUNDED)

	1970	1975	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
S & G	245400	222100	216400	207600	190700	207500	250500	255400	288500	286200	293800	259600	271300
STONE	371360	374500	446100	412200	373600	423900	479700	510700	522700	608600	628200	598400	598000
TOTAL	616760	596600	662500	619800	564300	613400	730200	766100	811200	894800	922000	858000	869300

SOURCE: U.S. BUREAU OF MINES, MINERAL INDUSTRY SURVEYS, MINERALS YEARBOOK, VOLUME 1, METALS AND MINERALS.

* ALABAMA, CONNECTICUT, DELAWARE, FLORIDA, GEORGIA, LOUISIANA, MAINE, MARYLAND, MASSACHUSETTS, MISSISSIPPI, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, NORTH CAROLINA, PENNSYLVANIA, RHODE ISLAND, SOUTH CAROLINA, TEXAS AND VIRGINIA.

SAND & GRAVEL AND STONE PRODUCTION
SELECTED CANADIAN PROVINCES *



SOURCE:
Canadian Minerals Yearbook
Energy, Mines and Resources, Canada

(MILLIONS OF TONNES)
* SEE MAP 2

FIGURE 6

Figure 7 gives population statistics that indicate a steady population growth in Nova Scotia and Prince Edward Island. Figure 8 gives population statistics for selected Canadian Metropolitan Areas and again indicates steady growth in population in Halifax.

7.2 MARKETS

In the Maritime provinces, Halifax represents a medium sized market with existing local pits and quarries becoming exhausted and major difficulties being encountered by aggregate producers wishing to open new operations. Halifax is projected to continue to have steady population growth until the year 2001. Charlottetown is a small market but there is no crushed rock produced on the Island. If the fixed link between New Brunswick and Prince Edward Island becomes a reality this would consume large amounts of aggregates.

The Montreal and Quebec City markets are considered moderate for competition. Together they represent a large aggregate market with current local supplies coming from many producers. This could be a market that is easy to break into but the downside is generally low aggregate prices.

The Toronto market is considered tough for competition but it is a large market (65 million tonnes per year in the Greater Toronto Area) and the prices of aggregate are high.

8. EASTERN U.S.A. AGGREGATE INDUSTRY

8.1 PRODUCTION

The United States Bureau of Mines estimates a total of 2.1 billion short tons of aggregates were sold or used by producers in the United States in 1990. This production is made up of 897 million tons of sand and gravel and 1.2 billion tons of crushed stone. Most of the sand and gravel is used in construction--as fine aggregate for concrete and asphalt. Sand and gravel is also used as road base material and as construction fill. (U.S. Bureau of Mines)

The 1.2 billion tons of crushed stone has the following composition:

- 68% limestone;
- 14.5% granite;
- 8.3% traprock;
- 3% dolomite;
- 2.3% sandstone & quartzite; and
- 3.9% miscellaneous rock. (U.S. Bureau of Mines 1989)

FIGURE 7
POPULATION SELECTED CANADIAN PROVINCES ('000)

PROVINCE	1980	1990	% GROWTH
NEWFOUNDLAND	566	573	1
NOVA SCOTIA	845	892	5
PRINCE EDWARD ISLAND	123	130	5
NEW BRUNSWICK	695	724	4
QUEBEC	6386	6762	6
ONTARIO	8570	9731	12
TOTAL	17185	18812	9

SOURCE: STATISTICS CANADA, MARKET-RESEARCH HANDBOOK 1991

FIGURE 8
POPULATION SELECTED CANADIAN METROPOLITAN AREAS ('000)

AREA	1981	1991	% GROWTH
TORONTO	3130	3822	18
MONTREAL	2862	3084	7
QUEBEC CITY	584	622	6
HALIFAX	278	312	11

SOURCE: STATISTICS CANADA, MARKET RESEARCH HANDBOOK 1991

Over 50% of the crushed stone produced in the United States is utilized as construction aggregate primarily in road construction as road base or in concrete and asphalt. Crushed stone is also essential in the manufacture of cement and lime. There are also many other uses--riprap and shoreline protection stone, flux, railway ballast, agricultural lime and many industrial uses. (U.S. Bureau of Mines)

Figure 5 gives the total number of short tons of sand and gravel and crushed stone for selected east coast states in the Study Area. Figure 10 shows these production numbers graphically and it clearly indicates how the production of aggregates is directly related to the economy. The three major recent recessions in the mid 1970's, early 1980's and early 1990's clearly indicate reduced demand for aggregates.

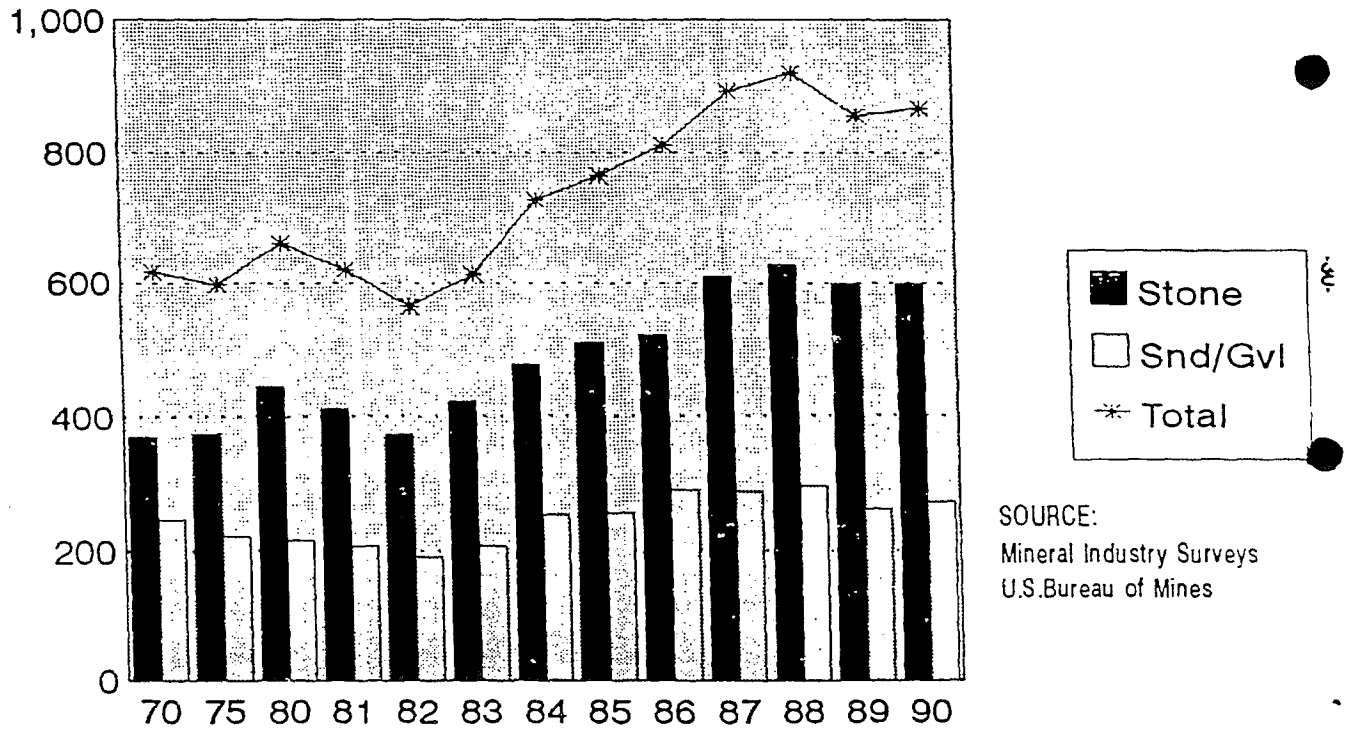
The eastern coast states in Figure 5, Figure 10 and shown on Map 2 have produced or used approximately 870 million tons of aggregate per year for the past five years. (U.S. Bureau of Mines) This 870 million tons of aggregate produced in the eastern coast states in the Study Area is estimated to be 42% of the total aggregate production of the U.S.A. It is estimated that approximately 200 million tons of the total 870 million tons are used in the densely populated coastal fringe cities listed in Figure 11. These cities are directly accessible by water. Figure 11 clearly shows the % growth of population in the Metropolitan Statistical Areas. The Philadelphia area is the only area with decreased population. The highest % growth occurred in the Tampa, Washington, Miami, Boston and Houston areas. This will result in higher demands for aggregates in those areas.

This large demand for aggregates has led many aggregate producers to expand or explore for new deposits in their market area, as existing local resources become depleted. Generally, most of the Coastal Plain Region of the United States, from New Jersey to Texas lacks deposits of quality stone. Some major U.S. companies, such as Vulcan Materials, Dravo Basic Materials, Lone Star Industries and others, have increased their efforts in locating rock near deep water in nearby countries, primarily Mexico and Canada, for production and vessel shipment of crushed stone to the United States. (Zdunczyk 1991)

8.2 MARKETS

Aggregate consumption follows population. Figure 12 gives the populations of the east coast states in the Study Area. These figures indicate the fastest growing states are: Florida 24%, Texas 20%, New Hampshire 19% and Georgia 18%. It is predicted that by the year 2000 the most populous states will be California followed by Texas and Florida. This means that the aggregate demand will greatly increase in these states in the coming years. Generally, the population and aggregate production in the North East United States is steady with some states declining, while the South East United States is in the midst of an economic boom.

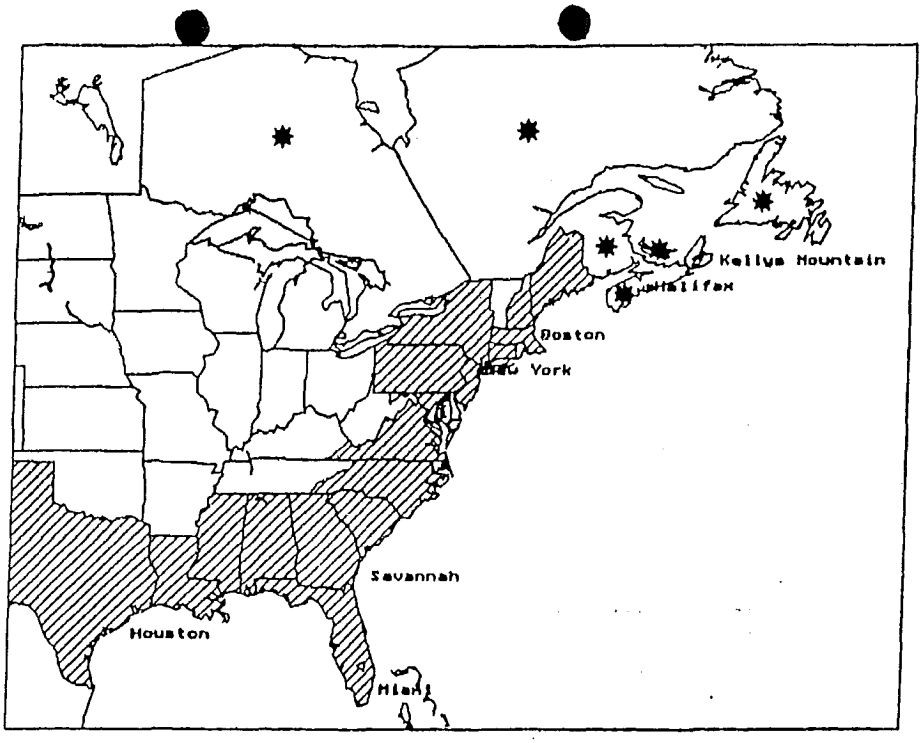
SAND & GRAVEL AND CRUSHED STONE SOLD OR USED BY PRODUCERS
SELECTED EAST COAST STATES *



SOURCE:
Mineral Industry Surveys
U.S.Bureau of Mines

(MILLIONS OF SHORT TONS)
*SEE MAP 2

FIGURE 10



MAP 2 STUDY AREA

CANADIAN PROVINCES ✸

EAST COAST STATES

FIGURE 11
POPULATION SELECTED METROPOLITAN STATISTICAL AREAS ('000)
ACCESSIBLE BY WATER

AREAS	1980	1990	% GROWTH
NEW YORK, N. JERSEY & LONG ISLAND	16120	18087	11
PHILADELPHIA, WILMINGTON, TRENTON	5549	4857	-12
BOSTON, LAWRENCE, SALEM	3448	4172	17
WASHINGTON DC	3060	3924	22
HOUSTON, GALVESTON, BRAZORIA	3101	3711	16
MIAMI, FORT LAUDERDALE	2640	3193	17
BALTIMORE	2174	2382	8
TAMPA, ST. PETERSBURG, CLEARWATER	1569	2068	24
NEW ORLEANS	1187	1239	4
TOTAL	38848	43633	11

SOURCE: U.S. DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS 1991.

FIGURE 12
POPULATION SELECTED EAST COAST STATES ('000)

STATE	1980 (1)	1990 (1)	% GROWTH 1980-1990	2000 PROJECTION (2)	% CHANGE 1990-2000
ALABAMA	3890	4181	7	4415	5.3
CONNECTICUT	3108	3279	5	3062	-6.6
DELAWARE	595	666	11	638	-4.2
FLORIDA	9740	12818	24	17438	26.5
GEORGIA	5464	6663	18	6708	.7
LOUISIANA	4204	4513	7	5160	12.5
MAINE	1125	1212	7	1308	7.3
MARYLAND	4216	4729	11	4582	-3.1
MASSACHUSETTS	5737	5880	2	5490	-6.6
MISSISSIPPI	2521	2699	7	2939	8.2
NEW HAMPSHIRE	921	1142	19	1364	16.3
NEW JERSEY	7364	7899	7	7428	-6.0
NEW YORK	17557	17773	1	14990	-15.7
NORTH CAROLINA	5874	6690	12	6868	2.6
PENNSYLVANIA	11867	11827	0	11208	-5.2
RHODE ISLAND	947	1002	6	926	-7.6
SOUTH CAROLINA	3119	3549	12	3907	9.2
TEXAS	14228	17712	20	20739	14.6
VIRGINIA	5346	6157	13	6389	3.6
TOTAL	107823	120391	11	125559	4.2

SOURCE: 1. U.S. DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS 1990
2. STATISTICAL ABSTRACT OF U.S. 1990

Florida is the fastest growing state in the Study Area and although the aggregate production for the state is high, there is opportunity to find market niches for high quality crushed rock especially in the Tampa and Miami areas. Texas is the second fastest growing state in the Study Area and Houston has high population growth and high aggregate selling prices. There would be competition in these southern states from the Vulcan Materials quarry in the Yucatan Peninsula, however, Vulcan Materials is producing limestone and not granite as is the case at the proposed Kelly Rock Limited site.

In a maturing market, such as the United States, the composition of the total aggregate production is shifting to more crushed stone and less sand and gravel. This is a result of exhaustion of developable sand and gravel deposits, urbanization and increased environmental constraints. This should make it easier from crushed rock from Nova Scotia to compete in the U.S.A.

There are many other markets in the east coast states that could be targeted such as, New York City, Boston, The Virginia coast, Louisiana and Georgia. The aggregate producer needs to identify customers special needs and produce a high quality aggregate product that is generally not available in that market area. One other important factor is that there are no commodity export tariffs applied by the United States for imported Canadian aggregates.

9. MARKETING

9.1 INTRODUCTION

Aggressive market development is becoming more critical in the aggregate industry. There is a big difference between marketing and selling aggregates. Selling assumes that price is the only factor differentiating one producers' product from another. Marketing is the best approach in the aggregate industry. Marketing involves a complex combination of:

- ♦ PEOPLE (qualified & trained)
- ♦ ANALYSIS (economic information, competition, markets & demand)
- ♦ TOOLS OF THE TRADE (contact, seminars, mail, publications, etc.)
- ♦ PLANNING (objectives, strategies, policy & programs)

The following criteria are essential in marketing:

- identify customer needs;
- develop & produce the right product;
- identify customer groups & products; and
- improve profit performance. (Barksdale 1991)

Concentration on short term profits can cause a company to miss key market changes and do long term damage to company competitiveness.

There are three generic strategies in market positioning:

1. LOW COST PROVIDER--low labour costs, minimum transport costs or automation or innovation
2. DIFFERENTIATION--unique from your competition
3. FOCUS--target a particular customer segment or geographic area and combine this with low cost or differentiation.

It is essential that your customers know the differences between your firm and its competitors. (Barksdale 1991)

9.2 STUDY OF MARKETS FOR AGGREGATE MATERIAL ACCESSIBLE FROM NOV. SCOTIA AND NEW BRUNSWICK

ADI Limited in their 1986 study examined current and potential markets for Nova Scotia and New Brunswick crushed rock in depth. This work is still valid to day and provides for more detail than is possible in this Overview Report.

The ADI Limited study includes a market evaluation that explains that an aggregate producer can control many variables such as production, price and distribution but is also faced with many uncontrollable variables such as competition, legal and political actions, technology and public attitudes. Producers must always be informed about uncontrollable variables to anticipate changes in market conditions and use opportunities to advantage. (ADI Limited 1986)

The study reviews the existing structure of the aggregate industry in various markets to facilitate entry into the market and characterizes the markets by level of competition. The study analyzes the levels of competition in the following ways:

> "A high level of competition is indicative of a market with many small or very small suppliers, none of which has a market share over five percent. A medium level occurs in a market with several large and medium sized firms with one or two holding a share over five percent. A low level occurs when there are several very large, large and medium firms with more than two holding five percent market share. A very low level occurs when there are many very large and large firms with several holding markets shares over ten percent." (ADI Limited 1986)

For a New Brunswick or Nova Scotia supplier, it would be preferable to enter markets with high or medium levels of competition, as there would be little organized opposition to market penetration. Markets with low or very low levels of competition would be more difficult to enter, as the supplier would be faced with a few well-entrenched, financially strong competitors. In the long term producers in Nova Scotia and New Brunswick are in a favourable position, as long as, the Canadian dollar is valued low and low shipping costs exist. (ADI Limited 1986)

The study includes an in depth review of products used in all market areas. The study concludes:

> It is difficult for an aggregate supplier to export material for all uses because of the varying quantities and specifications required. A more efficient approach is to supply large volumes of aggregates which meet the specifications of the most commonly used categories. In addition, a supplier will find market entry considerably easier when competing for a small share of a large market segment than for a large share of a small market segment. (ADI Limited 1986)

The ADI Limited Study analyzes and reviews a number of critical factors to allow a Nova Scotia producer to target various markets in the Study Area as follows:

- BASED UPON SELLING PRICE DATA ALONE, THE MOST DESIRABLE CITIES FOR EXPORT ARE TORONTO, NEW YORK, HOUSTON, MOBILE, CHARLESTON, DALLAS, AND SAVANNAH.

- BASED UPON THE MARGIN BETWEEN SELLING PRICE AND PRODUCTION COSTS, NEW BRUNSWICK AND NOVA SCOTIA PRODUCERS COULD SELL AGGREGATES FOR PROFIT IN TORONTO, PORTLAND, BOSTON, AND HARTFORD.

- BASED UPON THE PRICE TABLES (PRICES AND COSTS OF VARIOUS AGGREGATE MATERIALS), THE MOST DESIRABLE CITIES FOR AGGREGATE MARKETING ARE: NEW YORK, HOUSTON, MOBILE, CHARLESTON, DALLAS, AND SAVANNAH.

- BASED UPON THE LEVEL OF COMPETITION ANALYSIS THE PREFERRED MARKETS (FROM NOVA SCOTIA FOR CRUSHED ROCK) WOULD BE: MASSACHUSETTS, NEW YORK, VIRGINIA, FLORIDA AND LOUISIANA.

- BASED UPON THE ANALYSIS, A NEW BRUNSWICK OR NOVA SCOTIA SUPPLIER, WOULD FIND COMPETITION TOUGH IN THE ONTARIO CRUSHED STONE MARKET BUT MODERATE IN THE QUEBEC CRUSHED STONE MARKET. (ADI Limited 1986)

The study also analyzes the trends in production in detail and concludes that:

> THE DIFFERENTIAL GROWTH IN AGGREGATE PRODUCTION AND CONSUMPTION FAVOURS THE GULF OF MEXICO AND SOUTH ATLANTIC MARKETS WHICH, ARE GROWING FASTER THAN THE MIDDLE ATLANTIC AND NEW ENGLAND MARKETS. (ADI Limited 1986)

If the differential growth in aggregate production and consumption are combined with the levels of competition, a Nova Scotia producer would target markets in Louisiana and Florida. However, corporate concentration is greater in the Gulf of Mexico and South Atlantic markets and this reduces some of the attractiveness. Large companies have large resources and influence to counter a marketing thrust by a small company but they can be vulnerable in small market niches.

9.3 MARKETS FUTURE

9.3.1 United States

Every year both Pit & Quarry and Rock Products magazines produce articles on short term forecasting aggregate demand in the United States in the upcoming year. Drake in Pit & Quarry states that producers' and economists' are forecasting growth in construction markets in 1992, after 1991 proved to be a worse than forecasted year. Economic indicators and projections point to a better year ahead including:

- ♦ 20% increase in housing starts (residential);
- ♦ 10% increase in total construction contract value; and
- ♦ 4% increase in highway construction.

This rebound in the United States is expected to occur mainly in the last two quarters of 1992. Markets for asphalt aggregates are expected to increase, base materials are expected to decrease and concrete aggregates are expected to remain stable. A boost to the United States economy also manifested itself late in 1991, with the announcement of a $151 billion, six year transportation program (highways $119.5 billion). (Drake 1991)

Rock Products indicate that the greatest construction increases will be in the South Central Region 16% (including Texas, Louisiana, Mississippi and Alabama), followed by the South Atlantic Region 12% (including Florida, Georgia, North and South Carolina, Virginia, Maryland and Delaware). (Rock Products 1991)

All this points to a turn around for the United States aggregate industry near the end of 1992 and into 1993.

9.3.2 Canada

In the January-February 1992 issue of Canadian Aggregates magazine, Consedine expects a sluggish first half of 1992 with economic revival beginning in mid-summer and continuing to the end of 1992 for the Canadian aggregate industry. There is the possibility of sustained economic activity for 1993 and 1994. The Conference Board of Canada recently predicted that Canada will post the strongest GDP growth of the G-7 industrial countries, expanding by 3.2% in 1992. The key indicators for the cautiously optimistic outlook for 1992 are lower interest rates and a sharp decline in inflation. (Consedine 1992)

9.4 CONCLUSIONS

There is a great deal of opportunity to market crushed rock from Nova Scotia to the various provinces and states in the Study Area. Marketing is a complex matter and requires detailed study and special efforts to find the most suitable markets for the specific product produced.

There are many sources of aggregate:

- local supplies;
- areas adjacent to local supplies;
- longer distance sources in the same country;
- longer distance sources from nearby countries; and
- substitute materials.

If a Nova Scotia producer wishes to sell his product in longer distance markets he must produce and sell his aggregate competitively after a detailed analysis of all the marketing factors.

10. THE FUTURE DEMAND FOR AGGREGATES IN THE STUDY AREA

10.1 THE STUDY AREA

Map 2 shows the Study Area chosen including selected Canadian Provinces and selected East Coast States. Sections 7 and 8 set out the current and historical production, populations, supply and markets for aggregate in the Study Area.

10.2 DEMAND MODELLING

Very few jurisdictions have done demand forecasting for aggregates. Ontario, the United Kingdom and the United States have all done demand modelling and the following sections briefly outline the models used in these three jurisdictions.

10.2.1 Ontario

In 1974, the Ontario Government published a report prepared by Proctor and Redfern Limited entitled Mineral Aggregate Study Central Ontario Planning Region. (Proctor & Redfern Limited 1974) The demand model was based on projecting the future value of different types of construction expenditure (residential construction, non-residential building and total road and non-road engineering) and applying input factors. This was the first time demand forecasting for aggregates had been done in a meaningful way in Ontario and it proved to be a sound method for forecasting. One weakness relates to no accounting for aggregate used for non-construction purposes. Proctor and Redfern Limited used the same forecasting methods for two further studies in Ontario covering different geographical areas--Mineral Aggregate Study and Geological Inventory Part of the Eastern Ontario Region and Mineral Aggregate Study and Geological Inventory Southwestern Region of Ontario. (Proctor & Redfern Limited 1975 1977)

In 1980, Peat Marwick & Partners and M.M. Dillon Limited undertook a Mineral Aggregate Transportation Study for the Ontario Government. This study included a demand model combining input factors, construction spending and regression analysis. Four categories of end uses were used road construction, residential building construction, concrete production and non-residential building and non-road engineering construction. This model is complicated and difficult to update. (Peat Marwick & Partners & M.M. Dillion Limited 1980)

In 1982, the Ontario Ministry of Natural Resources did an internal report on forecasting demand for mineral aggregate. E.E. Matten used construction expenditures and input usage factors. He had detailed information on road construction from the Ontario Ministry of Transportation. (Matten 1982)

10.2.2 United Kingdom

The United Kingdom Department of the Environment commission from time to time projections of aggregate demand to enable them to advise mineral planning authorities and the mineral industry on the policies that need to be followed to enable the construction industry to obtain an adequate and steady supply of aggregates at the best balance of social, environmental and economic costs.

The 1991 projections by EROTEC Research and Consulting Ltd. in Stage 1

> forecasts the future demand for aggregate minerals through the statistical modelling of assumptions about economic growth and investment (Department of the Environment 1989)

In Stage 2 the relationship between the demand for aggregates and construction activity are modelled using regression techniques.

10.2.3 United States

Currently, demand for aggregates in the United States is not forecasted on an national basis. There are some regional models but they have not proved to be reliable enough to make future projections of construction aggregate requirements.

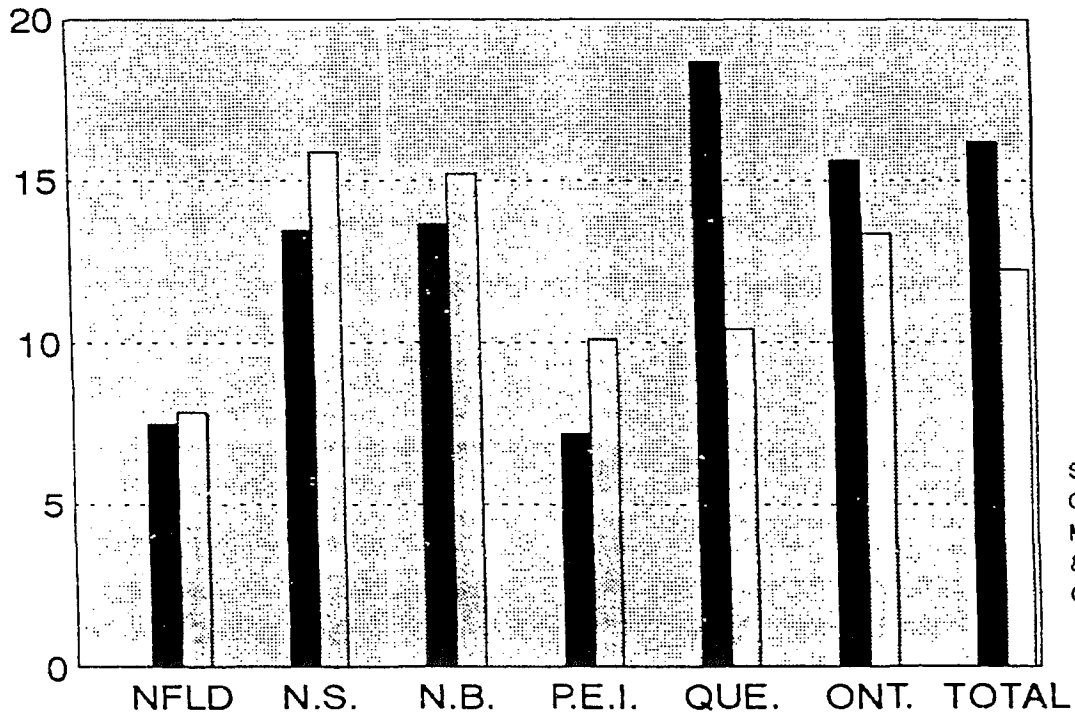
10.3 PER CAPITA USE OF AGGREGATE

10.3.1 Selected Canadian Provinces

Figure 9 gives the per capita production of aggregates in tonnes for 1980 and 1990 for selected Canadian provinces. Per capita production ranges from a low in 1980 of 7.2 tonnes per person in Prince Edward Island to a high of 18.7 tonnes per person in Quebec. In 1990 the lowest per capita production was 7.9 tonnes per person in Newfoundland and the highest per capita production was 15.9 tonnes per person in Nova Scotia. Figure 9 indicates that the per capita production of aggregates from 1980 to 1990 has increased in Newfoundland, Nova Scotia, New Brunswick and Prince Edward Island and decreased in Quebec and Ontario. The decreases in Quebec and Ontario in 1990 are largely related to the depth of the recession we are currently in. Other factors that influence the demand for aggregate at any point in time are large scale projects such as the Great Whale Hydroelectric Project or the fixed link to Prince Edward Island.

PER CAPITA PRODUCTION OF AGGREGATES (TONNES)

SELECTED CANADIAN PROVINCES *



SOURCE:
CANADIAN
MINERALS YEARBOOK
& STATISTICS
CANADA

* SEE MAP 2

FIGURE 9

10.3.2 Selected East Coast States

Figure 13 gives the per capita production of aggregates in tons for 1980 and 1990 for selected east coast states. Per capita production ranges from a low in 1980 of 1.8 tons per person in Delaware to a high of 9.9 tons per person in Virginia. In 1990 the lowest per capita was 2.6 tons per person in Rhode Island and the highest per capita production was 12.8 tons per person in Alabama. Figure 13 indicates that the per capita production of aggregates from 1980 to 1990 has increased in all of the east coast states in the Study Area except Florida, Massachusetts, Rhode Island and Texas. Florida and Texas have had very rapid population growth from 1980 to 1990, 24% and 20% respectively. This indicates continued increased demand in the coming years. There are many factors that influence the production of aggregate including sterilization of resources, depletion of resources and policies prohibiting extraction.

10.4 TEN YEAR DEMAND PROJECTIONS

10.4.1 Selected Canadian Provinces

Figure 14 is a ten year demand projection for aggregates in the selected Canadian provinces in the Study Area based on production over the twenty year period 1970-1990. Taking into consideration all the cyclical changes in production during this period the average growth in aggregate production was 1.2%. Forecasted forward the demand for aggregate in 2000 is projected to be over 261 million tonnes in these Canadian provinces.

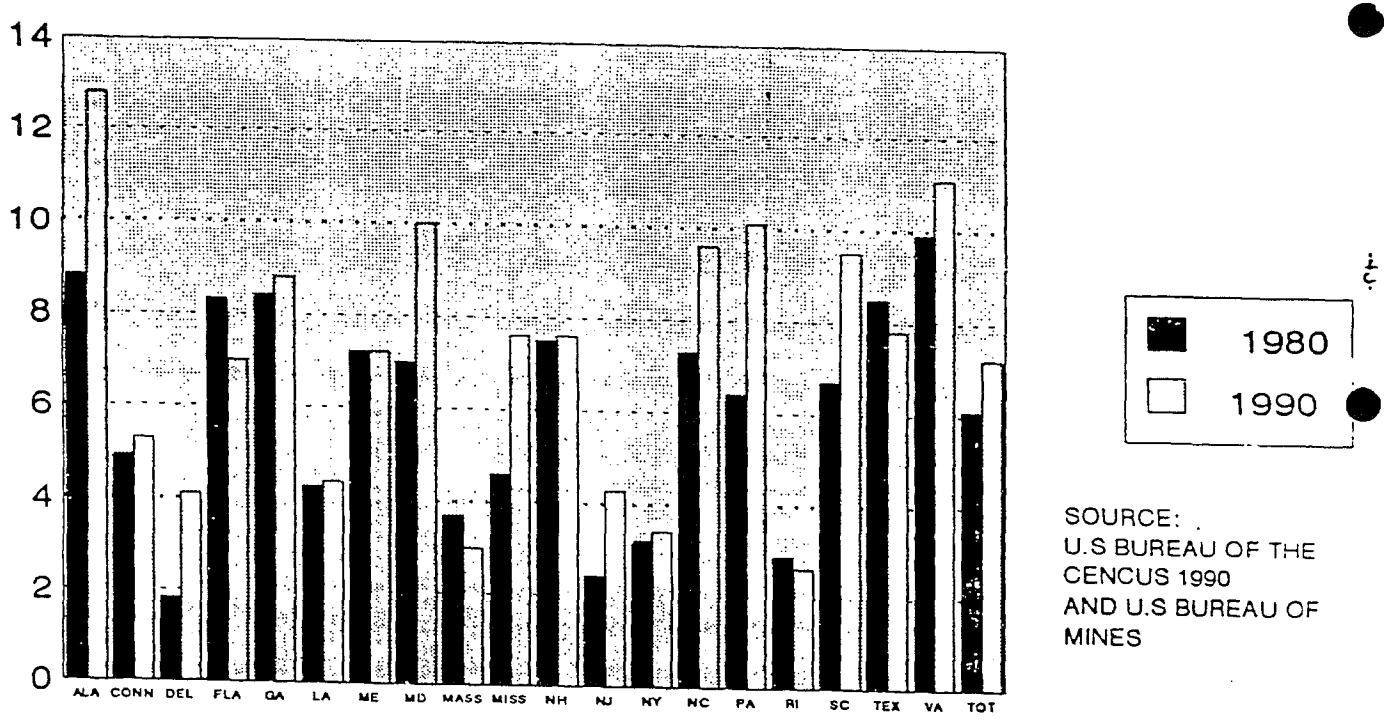
The per capita aggregate demand can also be predicted by using population changes from 1980 to 1990 and population projections to the year 2001, given in Figure 7. Combining this with the aggregate production information in Figure 4 it is predicted that the demand for aggregate in 2001 would be over 276 million tonnes.

The range of demand for aggregates in the selected Canadian provinces in the Study Area using these two methods would indicate demand in the year 2001 to be in the range of 261-276 million tonnes.

10.4 2 Selected East Coast States

Figure 14 is a ten year demand projection for aggregates in the selected east coast states in the Study Area based on production over the twenty year period 1970-1990. The average growth in aggregate production was 1.6%. The demand for aggregate in 2000 is projected to be over 1 billion tons in these east coast states.

PER CAPITA PRODUCTION OF AGGREGATES (TONS)
SELECTED EAST COAST STATES *



SOURCE:
U.S BUREAU OF THE CENCUS 1990
AND U.S BUREAU OF MINES

FIGURE 13

* SEE MAP 2

TEN YEAR DEMAND PROJECTION FOR AGGREGATES

SELECTED EASTERN PROVINCES AND STATES *

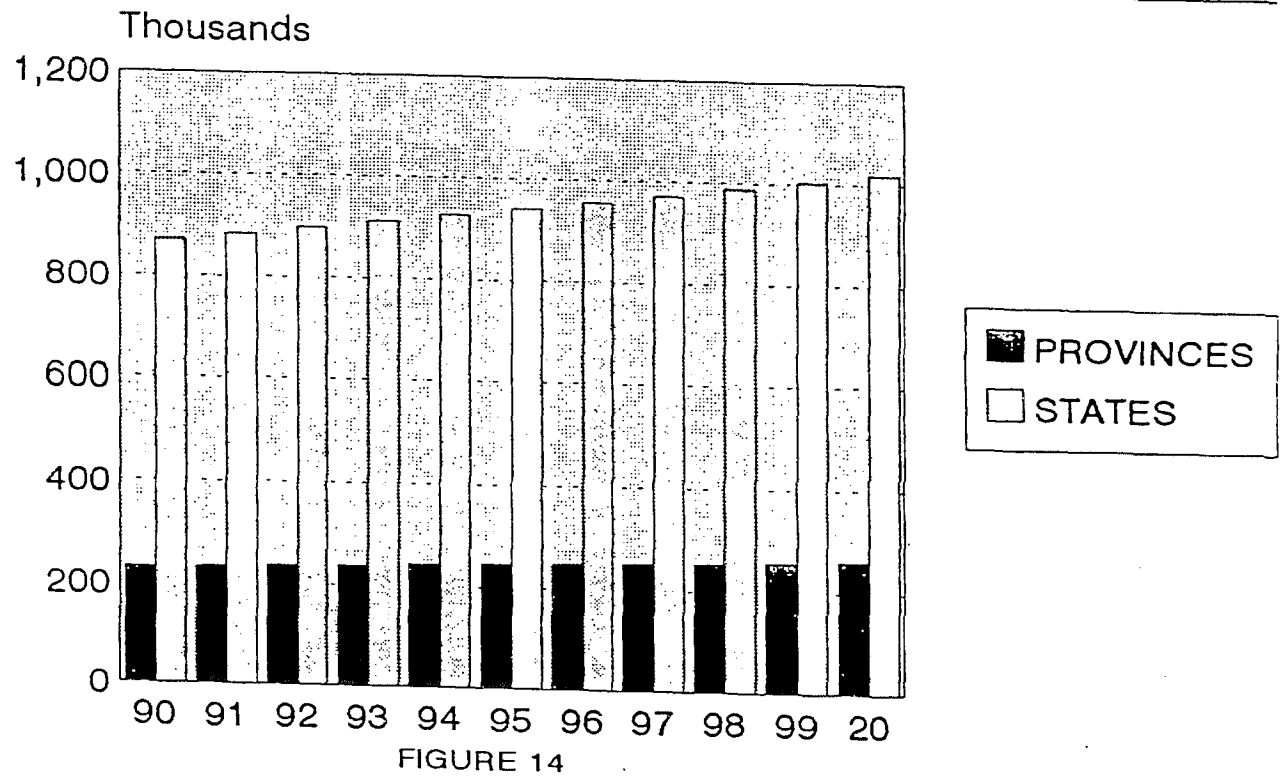


FIGURE 14

PROVINCES (TONNES); STATES (SHORT TONS)
*SEE MAP 2

Using population changes from 1980 to 1990 and population projections to the year 2000 given in Figure 12, per capita aggregate demand can be predicted. The per capita production in the selected east coast states was 6.1 tons in 1980, 7.2 tons in 1990 and is predicted to be 8.3 tons in 2000. Using the population projections from the Statistical Abstract of the U.S. 1990 the demand for aggregate in 2000 would be over 1 billion tons.

The projected demand for aggregates in the selected east coast states in the Study Area is therefore predicted to be over 1 billion tonnes in 2000.

10.5 CONCLUSIONS

There are many complicated methods of calculating demand projections for aggregates. It is difficult if not impossible to accurately predict when the economic growth and recession years will occur with any accuracy. Due to the wide range of uncontrollable variables forecasting is never totally reliable. Very few jurisdictions conduct demand forecasting for the aggregate industry. This Report has used two simple methods of predicting demand, one based on historical aggregate production and the other based on per capita use of aggregates through population projections. Figure 14 presents straight line projections for the Study Area. Between 1990 and 2000 there will be changes in demand that increase and decrease in any given year but overall these predictions give an indication of the demand for aggregates over that time frame.

11. REPORT CONCLUSIONS

In 1990, the total production of aggregates in the Study Area in both Canada and the United States was well over 1 billion tonnes. Of this 1 billion tonnes, it is estimated that over 300 million tonnes are accessible by water. Although both the United States and Canada are currently in a recession, all the economists are forecasting recovery in the last half of 1992. In 1993, there will be an increased demand for aggregate materials as the economy begins to move.

By 2000, the demand for aggregates is predicted to be 1.3 billion tonnes in the Study Area and of this, it is estimated that over 340 million tonnes would be accessible by water. This is a huge volume of aggregate and it provides an exceptional opportunity for a Nova Scotia aggregate producer to ship high quality granite to the major markets discussed in this Report.

Nova Scotia aggregate producers are physically in a position to access many markets given their strategic marine transport location. However, to be economically competitive in the market place they will have to control their production costs, transportation costs and market their products aggressively. In the short term the competition would be tough but in the long term the Study Area contains some strong, high demand markets for high quality crushed rock.

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SEY/April 21, 1992
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