

# **MINING & QUARRYING SECTOR**

*In The*

## **British Virgin Islands**

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## **INTRODUCTION**

The sector involved in quarries and sand mining operations which covers production of gravel, sand, fill and stones. This undertaking is strictly private; involving five companies which are:

1. Tortola Concrete Products
2. Sandwise Ltd.- Sand and Associated (Dredging)
3. Skelton Quarry
4. V.I. Block- West End
5. Virgin Gorda Quarry
6. BVI Pavement – Asphalt Plant.

This sector is interdependent with the construction sector, as the inputs produced by one are essential for the development of the other. This includes general construction of building, construction of roads, highways, bridges, tunnels, harbors, airports, and land reclamation, etc.

## **SITUATION ANALYSIS**

### **SAND MINING:**

In the BVI sand is mined on the beaches. During the period 1982 to 1996, approximately 13,625 cubic yards of sand was mined from the beaches. At the same time, data available showed that about 30,000 cubic yards of sand was imported into the territory annually over the last five years. Sand is being sold for about \$35.00 a cubic yard as compared to \$25-\$28 per yard for gravel. From this, it is obvious that sand is a very important resource and demands appropriate management.

Increase in construction since the 1980's have resulted in a considerable removal of sand from some beaches. Thus increasing awareness of its short-term benefits and long term damage to the environment is gradually changing public tolerance of sand mining. As we know beaches and dunes provide buffers against storm caused erosion and storm breaching. Beaches in their natural state exist in a state of dynamic equilibrium continuously expanding to waves, winds, and tides. Offshore shoals and currents as well as inshore dunes systems exert important controls on the erosion and deposition cycles of beaches.

Studies carried out by the Conservation & Fisheries Department on beach changes in the BVI between 1989 and 1992 showed that the total length of the beaches in the BVI is 79km (49 miles). In 1984 and 1994, detailed studies were carried out on 18 beaches located on the islands of Tortola, Virgin Gorda, Jost Van Dyke, Anegada, Peter Island and Sand Cay. It was then observed that there is widespread beach erosion on the eight islands studied. Table 1 and Appendix 1-5 shows the percentage change in beach areas and the rates of erosion between 1989 and 1992.

In 1996 as part of the environmental component of IDP project, the Department of Conservation & Fisheries carried out a review of sand mining permits issued by the Ministry of Natural Resources and Labor under the Beach Protection Ordinance from 1982-1996. An analysis of these findings present a very disturbing overview of the level of beach sand mining legally permitted in the BVI during this 15 year period. It must be stressed here that the quantities recorded are only for permitted sand mining activities and does not include or reflect illegal sand mining activities occurring in the BVI. Several near-shore dredging operations, which were approved for marina development or dock, also produced sand for construction. Sand mined by 8 dredging operators and one unlimited beach-sand mining permit are not a part of this total.

Results show that approximately 13,625 cubic yards of sand was legally mined from the beaches of the BVI from 1982-1996. This averages to 9,908 cubic yards a year. A total of 15 beaches have been mined, however, Josiah's Bay, Fat Hog's Bay, Brewer's Bay, and Cane Garden Bay on Tortola and Little Bay, Virgin Gorda have been mostly heavily mined, accounting for 94.4% of permitted activities. Josiah's Bay was first in mining activity with 10,051 cubic yards or 73.8%. Fat Hog's Bay was second with 1,350 cubic yards. Or 9.9%: Little Bay third with 600 cubic yards or 4.4%, Brewer's Bay fourth with 446 cubic yards or 3.3% and Cane Garden Bay fifth with 419 cubic yards or 3%. No permits have been issued for Cane Garden Bay since 1986 when 15 cubic yards were taken. Over the last 10 years, Cane Garden Bay has developed into one of the top tourism and recreational beaches in the territory and sand mining has ceased.

Table 1. Beach Changes on Tortola 1989-1992

Name of Beach	MEAN BEACH AREA (SQ. METERS)			
	1989	1990	1991	1992
Josiahs Bay	29.4	25.8	20.4	
Brewers Bay	74.8	76.9	71.8	69.7
Fat Hogs Bay	9.4	9.5	6.6	6.5
Capoons Bay	2.8	2.6	3.1	1.9
Brandywine Bay	3.3	2.6	2.4	2.5
Carrot Bay	2.8	2.6	1.5	0.9
Trellis Bay	2	3	6.8	6.3
Cane Garden Bay	30.8	32.2	29.3	30.1
Long Bay Lambert	126.4	127.8	108.8	112.6

Data Source: CFD Technical Report No.21 1993

#### QUARRYING:

There are three main quarries in the BVI, which produce and supply gravel and crushed stone to the construction industry in the territory. The companies running these quarries are forced to import some of the products in order to meet the territory's demand. Permits are required to develop quarries, but it has been observed that no stringent conditions or limits have been placed on their development. There are problems identified as associated with development of quarries, these includes:

1. Erosion of soil after heavy rainfall.
2. Lack of air pollution measures as no provisions are made for dust control or restoration of sites.
3. Vibrations/noise pollution resulting from use of explosives in blasting.
4. No provisions are made for dust control, noise or restoration of sites.
5. No environmental or ecological studies have been developed in starting these quarries.
6. No solution has been taken in connection with land degradation as a consequence of washings and sludge disposal, as well as abandoned quarries.
7. Lack of modern tools and equipment.

#### LEGAL PERSPECTIVE

Three legislations are relevant to this sector.

1. Minerals (vesting) Ordinance Cap 149 of 1981
2. Mining Ordinance Cap 150 of 1981- should address all sand mining activities
3. Beach Protection Ordinance Cap 233 of 1985

#### MINERALS (VESTING) ORDINANCE AND MINING ORDINANCE:

The above Ordinance places ownership of mineral rights in the crown, hence mining for minerals can only be done under licence to the citizens of the BVI only. Issuance of licence is done under application to the Ministry of Natural Resources and Labor. There are presently no guidelines to mitigate environmental impacts of mining activities. However, Section 72 of the Ordinance provides for preventing pollution and protecting the living resources of the sea. The ordinance requires that the operator of a quarry submit a proposal on how it wants to address the issue of environmental pollution. Guidelines are also required on the removal of topsoil during housing construction.

#### BEACH PROTECTION ORDINANCE:

This Ordinance allows the Ministry of Natural Resources to approve permits for mining sand on the beach, subject to applications. Permits may be granted on terms as deemed fit by the Minister, e.g. quantity/duration. There are significant amounts of sand mined from prior to reclamation activities. There is however insufficient monitoring and control over the removal of the sand.

It is noteworthy, that provisions is also made for preservation of beaches as the ordinance prohibits the removal of sand from the shore if sand removal is likely to cause in roads by the sea. This affords legal protection to all beaches through out the territory, from fouling of the foreshore, mining and removal of sand, stone, gravel as shingle and the removal of any natural barrier. This provision is inadequate for the effective protection of beaches from excessive sand mining as the term "inroads" is subject to many interpretations. The ordinance does not address the commercial mining of sand, thus legislative provisions need to be put in place to guide sand mining activities.

## **PRODUCTION OF CRUSHED STONE AND SAND**

The available statistics (1994) shows that a total of 65,506 cubic yards of crushed stone and sand were produced by private companies, an increase of 52.8% over the previous year. The average growth rate for the three-year period i.e. 1991 – 1994 was 11%. The increase in the BVI construction activities has resulted in an overall increase in the local production of crushed stone and sand. The value of two commodities produced in 1994 were US \$ 1590816, an increase of 36% compared with the previous year. The average growth rate for the value of two commodities produced for three-year period i.e. 1991 to 1994 was 7.8%. The table 2 below shows the production and value of crushed stone and sand from 1991 to 1994.

Table 2. Local Production Of Crushed Stone And Gravel **1991 – 1994**

	<b>1991</b>		<b>1992</b>		<b>1993</b>		<b>1994</b>	
	<b>Vol. Cu.Yds</b>	<b>Value Us \$</b>	<b>Vol. Cu.Yds</b>	<b>Value Us\$</b>	<b>Vol. Cu.Yds</b>	<b>Value Us\$</b>	<b>Vol. Cu.Yds</b>	<b>Value Us\$</b>
<b>CRUSHED STONE</b>	47,332	1,277,964	57,006	1,567,665	31,893	845,165	43,184	1,144,376
<b>SAND</b>	6,700	120,600	840	16,800	10,973	219,460	22,322	446,440
<b>TOTAL</b>	54,032	1,398,564	57,846	1,584,465	42,866	1,164,625	65,506	1,590,816

Data Source: Development Planning Unit

## **IMPORTS OF SAND AND GRAVEL**

It is generally accepted that sand is available in the territory to meet domestic demands, but exploiting it in a sustainable manner is equally important. The available data showed that an average of 32,000 cubic yards of sand and gravel was imported into the territory annually over the last five years. Table 3 shows the import (CIF) values of the two commodities from 1993 to 1995.

**Table 3. Imports Of Sand And Gravel 1993 – 1995 (Cif Value Us \$)**

	<b>1993</b>	<b>1994</b>	<b>1995</b>
SAND	1062020	852814	1087769
GRAVEL	4654	2535	6287
TOTAL	1066674	855349	1094056

*Data Source: Development Planning Unit*

The imports are due to the problems with the quality of beach sand available. It contains no silicates and is made up of coral fragments. Its fresh and angular nature makes its use limited. Thus, imported sand is used locally for building, while the coarse sand is used for concrete/block making and fine sand for plastering.

### **MINING AND QUARRYING CONTRIBUTION TO GDP**

The latest data on National Accounts (1992) shows that the Mining and Quarrying sector contributed US\$766478 to the Gross Domestic Product (GDP) or 0.22% of the total GDP of US\$ 344, 612, 096. By looking at its percentage contribution one might think it is very small, but it should be noted that the sector has strong linkages with the construction sector which contributes a lot in terms of economic development of the BVI. The importance of the construction sector to the economy has created an impact on social and economic infrastructure such as roads, houses, hotels, ports, hospitals schools office structures etc. By comparing the rate of growth between 1990 and 1992, the growth is 52%, which is a good sign of economic growth. Table 4 presents GDP contribution by industry from 1990 to 1992 in comparison with mining and quarrying sector.

**Table 4. GDP Contribution By Mining And Quarrying Industry 1990 – 1992**

INDUSTRY	1990		1991		1992	
	VALUE	%	VALUE	%	VALUE	%
	US \$		US \$		US \$	
<b>MINING AND QUARRYING</b>	504,263	0.17	547,047	0.17	766,478	0.22

### **PROBLEMS ASSOCIATED WITH MINING AND QUARRYING SECTOR**

These can be divided into three:-

1. Problems associated with production;
2. Problems associated with environmental degradation;
3. Inadequacies in existing legislation.

#### **Production Problems:**

Despite good performance, the mining and quarrying sector has been constrained by lack of capital to increase the production of construction materials, which are sand, crushed stone and gravel. Some companies have been forced to import some of these construction materials. Because of lack of enough capital some companies can not purchase essential modern tools and equipment to enhance production. Also, the sector is lacking modern laboratory services to analyze their products.

#### **Problems Associated with Environmental Degradation:**

These are-

1. Destruction of Beaches from sand mining activities. The study made has shown the occurrence of beach erosion on eight islands.
2. Land degradation as a consequence of washings and sludge disposal as well as abandoned quarries.
3. Forest removal, habitat, and water shed destruction as a prerequisite for excavation.
4. Contamination of ground water sources, coastal waters and wetlands from spillage of chemicals and petroleum products.

5. Air pollution by dust, suspended particles, odors, and noise produced during extraction, crushing and refining of raw material.

**Inadequacies in Existing Legislation:**

1. Existing legislations are limited in scope example, issues that need to be considered for sand mining are not presently addressed.
2. Sand mining is not directly included in the Mining Ordinance. The Act addresses mining of other minerals, while sand mining is not specifically mentioned as a mineral resource. This raises the question of its applicability to sand mining. The Act however has provisions for conditions that may be prescribed by the Minister.
3. The Act does not give guidelines as to mitigate the environmental impacts of general mining activities.

**FUTURE DEVELOPMENT OF THE MINING AND QUARRYING SECTOR.**

The sector is very crucial for economic development of the BVI. Improvement of its performance depends on the level of Government efforts to address the problems and constraints of the sector. The main objective of the sector in future is to increase production of crushed stone and sand, protection of the environment and increased revenue. In order to fulfill this obligations the Government should formulate policies and strategies to guide future development of the sector. The following could be considered:-

**Policy Objectives:**

Policies could be developed on:

1. Increasing production of sand, gravel, and stone.
2. Enhancing existing legislations and regulations.
3. Enhancing and improving environmental sustainability in mining areas.

**Proposed Strategies:**

1. Increasing the production of sand, gravel and stones by:
  - a. Provision of incentives to mining and quarrying companies by reducing import duties on mining equipment and tools.

- b. Assistance in securing of loans by interested companies for the development of the sector.
2. Reviewing the existing legislations and regulations by amending the Mining Act to reflect the following:
    - a. Inclusion of provision for sand mining in the legislation.
    - b. Inclusion of detailed requirements for domestic and commercial mining.
    - c. Demarcation of certain areas for mining activities.
    - d. Proposals for sand mining should include explicit indications of the type of mining to be carried out as well as provisions for restoration.
    - e. That before any building operation takes place in a sandy area, the sand must be removed. The proposals for the removal of the sand to be detailed and subject to approval of the relevant agencies.
    - f. Granting of licenses should be part of a process which include consultation with other relevant agencies
    - g. Any deviation from the above requires permission from the Minister of Natural Resources.
  3. Maintenance of environmental sustainability in mining areas by:
    - a. Instituting remedial measures in areas where environmental hazards have occurred.
    - b. Protecting ground water from pollution and arresting deforestation and degradation of mining areas.
    - c. Instituting and enforcing laws and regulations which will govern environmental protection.

### **PROPOSED MEASURES FOR IMPROVING ENVIRONMENTAL STANDARDS IN THE MINING INDUSTRY**

Mining inevitably gives rise to some disturbance. Land is removed from its former use and alterations to the landform can cause disfiguration of the landscape. The extraction of the mineral and its processing can give rise to noise, dust and the generation of traffic. However, the impact of mining can be considerably reduced by the careful management of a site during

its operation and restoration. This paper sets out the standards of good practice which the mining industry should meet. It is recognized that changes in working practices will need to be implemented incrementally.

In the BVI the procedures related to necessary mining approvals are set out in the Mining Ordinance (Cap. 150). Section 34 deals with the matters required to be included in an application for a mining licence.

- a. 34(2)(g) requires details, illustrated by a plan, of the area in respect of which an application is made
- b. 34(c)(1) requires a detailed programme for the prevention or treatment of pollution, the minimization of the effects of mining on water areas, adjoining land and the environment generally and the progressive reclamation and rehabilitation of lands disturbed by mining.

It is unclear whether any mining programmes have ever been submitted or approved in the BVI. It is suggested that some or all of the following matters be included in a mining programme in order to comply with the terms of Cap. 150.

#### NOISE:

The extraction and processing of minerals can give rise to considerable noise, which can create problems where working takes place near noise sensitive properties e.g. houses, schools. In sensitive cases it may be appropriate and necessary to specify noise levels within the quarry, for example:

1. The fitting of silencers to engines.
2. The use of rubber linings on appropriate sections of plant, e.g. chutes, hoppers.
3. The siting of plant away from sensitive properties or where the natural form of the land will help to provide a buffer.
4. The housing or cladding of plant.
5. The surfacing of internal access roads and plant areas.
6. The use of conveyors.

7. The maintenance of a minimum distance between the workings and any noise sensitive property.
8. Limiting noisy operations to the least sensitive times of the day or week.

#### VIBRATION:

The working and processing of minerals, the use of blasting and the movement of heavy plant and vehicles can give rise to problems of vibration. In general, these problems can be overcome by separating the quarry by distance from any sensitive sites. The creation of vibration as a result of blasting can be more serious. It may be necessary to set limits on the level of ground vibration allowed at the boundary of the site.

#### BLASTING:

A variety of measures can be taken to reduce or eliminate the problems associated with blasting. These include:

1. Controlling the height of the working face and the direction of working
2. Regulating the times of blasting
3. Maintaining a minimum distance between the workings and any sensitive property
4. Keeping the maximum instantaneous charge as low as possible, by for example introducing more delays into the blasting sequence, detonating blastholes individually or considering alternative methods of detonation.

Blasting should not give rise to flying rocks outside the site.

#### LORRY TRAFFIC:

Access to the quarry should be wide enough for two lorries to pass (20' minimum), junctions should be laid out with a minimum radius of 40 feet and adequate visibility splays should be provided. The layout of the quarry must allow vehicles to maneuver, park, queue, and load within the site. All loaded lorries should be sheeted and measures may need to be considered to prevent dust or mud being carried onto the public roads.

#### DUST AND FUMES:

Dust and fumes may arise from the processing, handling or storage of minerals. A straightforward standard for controlling dust emissions is that there should be no visible dust nuisance at the quarry or processing plant. The best practicable means should be employed at all times for preventing discharges to the atmosphere and for rendering emissions harmless and inoffensive. These may include:

1. Fitting enclosures to plant and conveyor belts and ensuring they are regularly maintained.
2. Locating crushing plant and stockpiles (particularly of fines) in sheltered positions within the quarry.
3. Adopting well defined routes for internal traffic, tarmac surfacing of haul roads, stocking and processing areas and ensuring their regular cleaning
4. Using storage bins or hoppers instead of stockpiles
5. Properly sheeting loaded vehicles carrying loose materials

#### VISUAL IMPACT:

Quarry working often causes a marked visual impact, over a wide area, particularly when working takes place in prominent, exposed locations, as it does in the BVI. There are a number of methods of reducing visual impact:

1. Working can be carried out in phases and progressively restored as working proceeds.
2. Buildings, plant, machinery and stockpiles should be sited inconspicuously, wherever possible on the quarry floor, and removed at the end of workings.
3. The direction of working should proceed away from the main areas of visibility, where possible.
4. Mineral wastes, fines, etc. should be used in back-filling and restoration, not tipped outside the site.
5. Perimeter mounds can screen views from important vantage points, but they should be carefully designed to a specific height and slope based on local conditions.
6. Quarry faces and working areas should be restored to encourage vegetation establishment.

Landscaping and planting can help screen views of the quarry. A landscape plan should specify the species of tree or shrub proposed, size, spacing, ground preparation and subsequent maintenance. The type of planting proposed should integrate with indigenous species and be selected on the basis of visual requirements and soil conditions.

#### RESTORATION:

It is essential that the restoration requirements for all quarries are considered before working commences and that the restoration scheme is fully integrated with the mining program. Successful restoration begins the moment mining commences and should be phased throughout the working life of the quarry. The type of mineral and method of working will affect the options for restoration and after use of a site. The depth of working, the volume of mineral waste, the potential to import solid and other in-fill materials, the topography of the site and nature of the surrounding area will all need to be considered in designing the restoration scheme.

#### LANDFORM RESTORATION:

The first stage in restoration is to create a suitable landform appropriate for the intended after use. This is then followed by ground treatment, soiling, irrigation, etc. required to establish and support the identified after use. The larger and area that can be included in a restoration scheme, the greater the scope for restoration to required landforms. A proliferation of small workings can present difficulties for restoration.

#### RESTORATION OF THE QUARRY FACE:

The quarry face is often the most visible part of a quarry because of the colour of the unvegetated rock and the unnatural landform. Restoration of the quarry face has three aspects:

1. Ensuring the quarry face is stable.
2. Developing a more natural landform.
3. Encouraging vegetation to develop.

Where there is sufficient land area at the top of the quarry face, the face can be redesigned by blasting techniques. The method of blasting will be different from normal quarry blasting,

which is designed to produce a clean, near vertical rock face. Instead it should aim to shatter the rock, leaving the upper parts of the face at a more stable angle and a screen at the bottom.

The ability of vegetation to grow on a rock face depends on its stability and on the nature of the rock. A smooth, steep rock face provides very few opportunities for plants to take hold. On the other hand, a face with many cracks fissures ledges, etc., which can accumulate finer soil forming materials will readily support vegetation. The nature of the rock face depends on the natural jointing, bedding, and fissuring of the rock itself, and on the way it is formed. Restoration should treat the quarry face in a manner, which will encourage the potential for soil accumulation and natural regeneration.

#### GROUND TREATMENT

After land forming the new ground surface may consist of spread topsoil or a prepared fill surface. Infilling with suitable materials is often necessary as part of the process of creating a suitable landform. It is important that all infill materials are properly compacted to prevent problems with subsequent settlement. However, the very fine layers, within 2'-3' of final ground surface should be carefully selected and prepared, as these will provide the soil forming material for restored vegetation. Within this layer the following requirements apply:

1. Soils should not be over consolidated or compacted.
2. Soil texture should have adequate moisture retention (a high content of fines).
3. No boulders or large stones should be present.