

# **Environmental, Health, and Safety Guidelines for Construction Materials Extraction**

## **Introduction**

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)<sup>1</sup>. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the **General EHS Guidelines** document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: [www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines](http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines)

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the

<sup>1</sup> Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

## **Applicability**

This document includes information relevant to construction materials extraction activities such as aggregates, limestone, slates, sand, gravel, clay, gypsum, feldspar, silica sands, and quartzite, as well as to the extraction of dimension stone. It addresses stand-alone projects and extraction activities supporting construction, civil works, and cement projects. Although the construction materials extraction guidelines emphasize major and complex extraction schemes, the concepts are also applicable to small operations. This document is organized according to the following sections:

- Section 1.0 — Industry-Specific Impacts and Management
- Section 2.0 — Performance Indicators and Monitoring
- Section 3.0 — References
- Annex A — General Description of Industry Activities

## 1.0 Industry-Specific Impacts and Management

The following section provides a summary of EHS issues associated with construction materials extraction that occur during the operational, construction, and decommissioning phases, along with recommendations for their management. Recommendations for the management of EHS issues common to most large projects are provided in the **General EHS Guidelines**.

### 1.1 Environment

Environmental issues during the operational, construction, and decommissioning phases of construction materials extraction primarily include the following:

- Air Emissions
- Noise and Vibrations
- Water
- Waste
- Land Conversion

#### Air Emissions

##### *Particulate Matter*

Particulate matter (PM) is generated during all phases of exploitation and processing from fugitive sources (e.g. shoveling, ripping, drilling, blasting, transport, crushing, grinding, screening, and stockpiling). The main sources of PM emissions include crushing–grinding, drilling, blasting, and transport. Impacts from PM emissions are related to its size (e.g. whether it is less than 2.5 microns in diameter), its main components (e.g. silica, silicates, carbonates), as well as to rock impurities and trace components (e.g. asbestos).

For dust emissions, the recommended pollution prevention and control techniques should take the ecological and human toxicity of the dust into account and include the following:

- Land clearing, removal of topsoil and excess materials, location of haul roads, tips and stockpiles, and blasting should be planned with due consideration to meteorological factors (e.g. precipitation, temperature, wind direction, and speed) and location of sensitive receptors;
- A simple, linear layout for materials-handling operations to reduce the need for multiple transfer points should be designed and installed (e.g. processing plants should be preferably located within the quarry area);
- Dust emissions from drilling activities should be controlled at the source by dust extractors, collectors, and filters, and wet drilling and processing should be adopted, whenever possible;
- Dust emissions from processing equipment (e.g. crushers, grinders, screens) should be adequately controlled through dust collectors, wet processing, or water spraying. Dust-control applications should consider the final use of extracted material (e.g. wet-processing stages are preferred when wet materials or high water contents would not negatively affect their final use);
- Procedures to limit the drop height of falling materials should be adopted;
- Use of mobile and fixed-belt transport and conveyors should be preferred to hauling the material by trucks through internal roads (enclosed rubber-belt conveyors for dusty materials are recommended in conjunction with cleaning devices);
- Internal roads should be adequately compacted and periodically graded and maintained;
- A speed limit for trucks should be considered;
- Water spraying and surface treatment (e.g. hygroscopic media, such as calcium chloride, and soil natural–chemical

binding agents) of roadways and exposed stockpiles using a sprinkler system or a “water-mist cannon” should be implemented;

- Exposed surfaces of stockpiled materials should be vegetated.

### *Other Air Pollutants*

Combustion by-products are emitted by vehicles and other combustion sources installed in the quarrying site. Pollution prevention and control measures to address these impacts are addressed in the **General EHS Guidelines**.

Toxic and nontoxic gases are normal byproducts generated by blasting activities, regardless of the explosive materials used. Emissions of NO<sub>2</sub>, CO, and NO are generated during the explosions.

The following pollution prevention and control techniques are recommended:

- Alternatives to blasting, such as hydraulic hammers or other mechanical methods;
- If blasting is necessary, planning of the blasting (arrangement, diameter, and depth and direction of blast holes) should be implemented;
- The correct burning of the explosive, typically composed of a mixture of ammonium nitrate and fuel oil, should be ensured by minimizing the presence of excess water and avoiding incorrect or incomplete mixing of explosive ingredients.

## **Noise and Vibrations**

### *Noise*

Noise emissions are commonly associated with all extraction activities, including construction material and dimension stone quarrying. Noise is produced during all phases of exploitation

and processing (e.g. shoveling, ripping, drilling, blasting, flame-jet cutting, transport, crushing, grinding, sizing, and stockpiling). The main noise sources are associated with drilling, breaking, crushing and handling–moving, screening, and transport. In dimension stone quarrying, flame-jet cutting<sup>2</sup> is a specific noise source, if adopted.

For noise emissions, the recommended minimization and control techniques include the following:

- Reduction of noise from drilling rigs by using downhole drilling or hydraulic drilling;
- Implementation of enclosure and cladding of processing plants;
- Installation of proper sound barriers and (or) noise containments, with enclosures and curtains at or near the source equipment (e.g. crushers, grinders, and screens);
- Use of rubber-lined or soundproof surfaces on processing equipment (e.g. screens, chutes, transfer points, and buckets);
- Use of rubber-belt transport and conveyors;
- Installation of natural barriers at facility boundaries (e.g. vegetation curtains or soil berms);
- Optimization of internal-traffic routing, particularly to minimize vehicle-reversing needs (reducing noise from reversing alarms) and to maximize distances to the closest sensitive receptors;
- The use of electrically driven machines should be considered;
- A speed limit for trucks should be considered;
- Avoidance of flame-jet cutting;
- Construction of berms for visual and noise screening.

<sup>2</sup> Flame-jet cutting is used primarily in areas difficult to access and in which mechanical drilling machines are difficult to install.

### *Vibrations*

The most significant vibration emissions are usually associated with blasting activities, whereas minor emissions are commonly associated with use of rock hammers. For blasting-related emissions (e.g. vibration, overpressure, fly rock), the following control and minimization techniques are recommended:

- Use of specific blasting plans; correct charging procedures and blasting ratios; delayed, microdelayed, or electronic detonators; and specific in situ blasting tests (the use of downhole initiation with short-delay detonators improves fragmentation and reduces ground vibrations);
- Development of blast design, including a blasting-surfaces survey, to avoid overconfined charges and a drill-hole survey to check for deviation and consequent blasting recalculations;
- Implementation of ground vibration and overpressure control with appropriate drilling grids (e.g. grid versus hole length and diameter, orientation of blasting faces) and appropriate charging and stemming process of boreholes, to limit potential issues with fly rock and air blasts;
- Hydraulic hammers or other mechanical methods should be preferred to improve rock fragmentation and minimize fly-rock risks, instead of using secondary blast (plaster blasting);
- Mechanical ripping should be preferably used to avoid or minimize the use of explosives;
- Other sources of vibrations are primary crushers and plant-screening equipment. Adequately designed foundations for these facilities should sufficiently limit vibrations.

### **Water**

#### *Consumption*

Diamond-wire cutting activities, aggregate-washing plants, and dimension stone quarrying activities typically involve significant

use of water resources. In addition to the guidance for water conservation provided in the **General EHS Guidelines**, water needs should be limited through recirculation and reuse, implementing closed-circuit systems from sedimentation ponds to the quarrying process. If water use is significant, especially in arid or semi-arid regions, a water-resource availability and impact assessment should be conducted.

#### *Hydrology*

Surface water regimes may be altered because of flow diversions, water intake, and changes to the drainage pattern. Techniques to prevent, minimize, or control impacts to the hydrologic regime caused by extraction activities include the following:

- Storm water peak runoff rate should not exceed the peak predevelopment runoff rate for a particular design storm;
- Reintroduction of treated, abstracted water into streams to maintain the ecological flow;
- Superficial infiltration of treated water to aquifers should be allowed. Alternatively, reinjection of treated water into the aquifers through injection wells or infiltration galleries may be implemented, provided potential groundwater contamination can be avoided;
- Quarry pond dredging activities should be designed and implemented to minimize drawdown with consideration of potential impacts to surface and groundwater resource flow and availability, including potential ecological impacts;;
- To the extent that it is consistent with the post-closure plan, a quarry pond should have a sufficient water depth to ensure the establishment of a stable aquatic ecosystem.

#### *Wastewater Discharge*

Dewatering of the quarrying pit, diamond-wire cutting, and surface water runoff can generate a wastewater discharge high

in suspended solids.<sup>3</sup> To prevent or minimize the suspended sediments in discharge waters the following are recommended:

- Adoption of settlement ponds, sumps, and lagoons designed to allow adequate retention time. Lagoons should be sealed with impervious material, as needed, and adequate maintenance programs of the settlement lagoons should be implemented, including side-slope stability, pipe cleaning/maintenance, and removal of settled materials;
- Recycling of processing / wire cutting waters;
- Construction of a dedicated drainage network;
- Settlement enhancement by using flocculants or mechanical means, particularly where limited space prevents or limits the use of lagoons;
- Installation of sediment traps along water drainages, including fascines, silt fences, and vegetation traps.

Where blasting is used, there is a potential for nitrate and ammonia residues, especially in groundwater. This should be managed through appropriate blasting design and procedures, including ensuring the correct burning of explosives, as discussed above, in "Other Air Pollutants".

### *Hazardous Materials*

The operation and maintenance of construction materials extraction equipment includes the use, storage and transfer of varying quantities of fuels and lubricants which should be managed according to applicable guidance provided in the **General EHS Guidelines**.

### *Acid Drainage*

Acid drainage, also referred to as Acid Mine or Acid Rock Drainage (AMD or ARD), may occur when minerals containing

sulphide and elemental sulphur are exposed to the atmospheric effects of oxygen and water. Although this phenomenon is most typically associated with metals mining activities, its potential occurrence during excavation and / or exposure of mineralized rock should be considered as part of construction materials extraction activities. Additional information on the management of acid drainage is provided in the **EHS Guidelines for Mining**.

## **Waste**

### *Solid Waste*

Rock waste and removed topsoil–overburden are the main inert wastes produced by quarrying activities. Hazardous wastes may be generated from impurities and trace components included in the exploited (waste) rocks (e.g. asbestos or heavy metals or minerals that could result in acidic runoff).

The recommended prevention and control methods to reduce wastes include the following:

- Operational design and planning should include procedures for the reduction of waste production (e.g. blending high-quality rock with poor rock);
- Topsoil, overburden, and low-quality materials should be properly removed, stockpiled near the site, and preserved for rehabilitation;
- Hazardous and non-hazardous waste management plans should be developed and adopted during the design and planning phase. Impacts associated with specific chemical and / or physical properties of extracted materials should be considered during the design phase, and impacts from waste rock impurities should be adequately controlled and mitigated by covering waste disposals with noncontaminated soil.

Management of other waste generated during extraction site operations (e.g. oily debris and contaminated soils recovered from

<sup>3</sup> Land-based hydraulic extraction should be used only in a closed circuit and with no effluent discharge.

lubricants or fuel spills, metal scraps, demolition materials) is discussed in the **General EHS Guidelines**.

## Land Conversion

Excavation activities at construction materials extraction sites often involve major topographical and land-cover changes to allow extraction activities, often including clearing of preexisting vegetation. Techniques to minimize land conversion impacts include the following:

- Selection of appropriate low-impact extraction (e.g. excavation, quarrying, and dredging) methods that should result in final site contours supportive of habitat restoration principles and final land use;
- Establishment of buffer zones from the edge of extraction areas, considering the characteristics of the natural habitats and the type of extraction activities;
- To reduce the consumption of land area and, consequently, the loss of soil, preference for extraction should be given to thicker deposits (these should be exploited as far as possible and as reasonable);
- Vegetation translocation and relocation techniques should be used as necessary. Vegetation cover, such as native local plants, topsoil, overburden, or spoils feasible for sustaining growth should be removed in separate operations and segregated for later use during site reinstatement, and materials to be used for site reinstatement should be stockpiled and protected from wind and water erosion, as well as from contamination;
- During extraction, ecological niches should be preserved and protected as far as possible;
- Smaller, short-lived extraction sites<sup>4</sup> should be reclaimed immediately, and larger sites with a useful lifespan beyond 3–5 years should be subject to ongoing rehabilitation;

- Management of further site development through routine topographical and land surveys;
- During reinstatement, affected land should be graded and appropriately scarified before soil layers are reapplied, sustaining vegetative regrowth where needed (the combined thickness of topsoil and the growth layer should not be less than that prevailing in the undisturbed areas);
- Affected land should be rehabilitated to acceptable uses consistent with local or regional landuse plans. Land that is not restored for a specific community use should be seeded and revegetated with native species;
- Test pits, interim roads (internal and access), buildings, installations, and structures of no beneficial use should be removed, and the land should be appropriately rehabilitated. Hydrological systems should be restored to predevelopment runoff rate.

Opportunities to create ecologically valuable habitats should be considered (e.g. small lakes and pools with a complex shoreline and shallow water zones, after dredging or areas for natural succession)

## 1.2 Occupational Health and Safety

Occupational health and safety hazards occur during the operational phase of construction materials extraction projects and primarily include the following:

- Respiratory hazards
- Noise
- Physical hazards

Management of exposures to other physical and chemical hazards is described in **the General EHS Guidelines**.

<sup>4</sup> Such as borrow pits.

## Respiratory Hazards

Occupational exposure to dust and fine particulates is associated with all phases of quarrying activities (e.g. shoveling, ripping, drilling, blasting, flame-jet cutting, transport, crushing, grinding, screening, and stockpiling operations). Specifically, exposure to nuisance dust (particles not otherwise classified, known as PNOC) and silica dust is considered relevant to construction materials extraction activities. Workers with long-term exposure to fine particulate dust (e.g. PNOC) are at risk for benign pneumoconiosis, emphysema, bronchitis, and fibrosis. Long-term exposure to silica dust may cause silicosis. In addition to the prevention and control measures for dust described in section 1.1 of this document, the following measures are recommended:

- Excavators, dumpers, dozers, wagon-drills, and other automated equipment that requires an operator should be equipped with air conditioned, dustproof, and soundproof cabs;
- Use of personal breathing protection (e.g. masks, respirators), as described in the **General EHS Guidelines**.

## Noise

Workers may be exposed to excessive noise levels during quarrying activities (e.g. shoveling, ripping, drilling, blasting, flame-jet cutting, transport, crushing, and grinding, among others). Guidance on the management of noise is provided in the **General EHS Guidelines**.

## Physical Hazards

Physical injuries may occur during construction material quarrying operation and maintenance activities (e.g. slips, trips and falls, falling rocks, impact with moving machinery such as front loaders, drillers, crushers, and belt conveyors).

Recommended prevention and control measures include the following:

- Implementation of specific personnel training on work-site safety management;
- Implementation of geological–geotechnical monitoring programs;
- Accurate assessment of the work site by rock scaling of each surface exposed to workers to prevent accidental rock falling and /or landslide, especially after blasting activities;
- Adoption of natural barriers, temporary railing, or specific danger signals along rock benches or other pit areas where work is performed at heights more than 2 m from ground level;
- Maintenance of yards, roads, and footpaths, providing sufficient water drainage and preventing slippery surfaces with an all-weather surface, such as coarse gravel.

## *Machine / Equipment Use & Safety*

Hazards related to dimension stone and other quarrying include exposure to vibration from portable drilling machines; hand / arm injuries from tools commonly used for block cutting–splitting (e.g. hammers and chisels); flying rock associated with plaster blasting (refers to the secondary blasting of rock that has not been adequately fragmented by the primary blast, to reduce the volume of poor-quality blocks that have to be removed / rejected); and whiplash related to diamond wire breakage during cutting operations.

Prevention and control measures for hazards related to machine / equipment use include the following:

- Use of proper drill benches or wagon drills, avoiding the use of portable and hand-held drilling equipment;
- Use of hydraulic jacks and cushions for block splitting or block shifting;
- Use of hydraulic breakers or hammers to avoid plaster blasting;

- Use of properly protected wire cutting machines and / remote-control devices.

### *Explosives*

Occupational safety hazards may be related to blasting activities resulting in accidental explosions. Prevention and control measures for explosion hazards include the following activities:

- A consistent blasting schedule should be adopted, minimizing blast-time changes;
- Specific warning devices (e.g. horn signals and flashing lights) and procedures should be implemented before each blasting activity to alert all workers and third parties in the surrounding areas (e.g. local communities). Warning procedures should include traffic limitation along local roadways and railways;
- Specific personnel training on explosives handling and safety management should be conducted;
- Blasting-permit procedures should be implemented for all personnel involved with explosives (e.g. handling, transport, storage, charging, blasting, and destruction of unused or surplus explosives);
- Blasting sites should be checked post-blast by qualified personnel for malfunctions and unexploded blasting agents, prior to resumption of work.

## **1.3 Community Health and Safety**

Community health and safety issues related to construction, operation, and decommissioning are common to those of most industry sectors are addressed in the **General EHS Guidelines**. Community health and safety issues specific to construction materials extraction projects primarily include the following:

- Land instability

- Water
- Explosives safety
- Decommissioning

Additional potential risks to community health and safety include risks from uncontrolled access to construction sites, exposure to waterborne, water-washed, and water-associated diseases from creation of water impoundments, and exposure to increased traffic of materials transport vehicles. Guidance on the prevention and control of these types of risks is presented in the **General EHS Guidelines**.

### **Land Instability**

Large-scale spoil-material disposal, water ponds, or mined land areas may be susceptible to landslide or collapse that could cause catastrophic incidents in surrounding populated areas. Prevention measures to minimize community risks should primarily include the following:

- Geological and geotechnical control programs in large areas, specifically focused on long-term land stability;
- Geotechnical monitoring of slopes, disposal sites, and water drainage, if possible by remotely controlled monitoring systems.

### **Water**

Construction materials extraction projects can significantly alter surface and groundwater regimes that are used by local communities for potable water supplies, raising of fish and other edible materials, irrigation, stock watering, and source water for small businesses and industries. The health and well-being of communities can be affected by changes in water quality as a result of discharges from dewatering activities, stormwater discharges, reduced water availability from water diversion, and lowering of groundwater supplies due to dewatering. These effects are often difficult to predict and can change over time as extraction facilities expand their operations.

Construction material extraction operators should understand the nature and extent of community use of water resources, and potential impacts to its quality and availability as a result of dewatering or other hydraulic diversion activities.

## **Explosives Safety**

Blasting activities may cause accidental explosions and affect surrounding populated areas. In addition to the prevention and control measures discussed in section 1.2 of this document, the following measures are recommended:

- Particular attention should be given to all explosives handling phases to prevent theft / improper use;
- Blasting should be conducted according to a consistent timetable. If changes to the blasting timetable occur, nearby communities should be immediately informed of those changes;
- Community awareness and emergency preparedness and response planning should be undertaken, including control of third-party access to blasting areas;
- Vibrations caused by blasting have potential community impacts. Monitoring (e.g. preconstruction surveys of buildings, infrastructure, and structures, including photographic and video image recording) should be implemented to ensure that potential household damages caused by the project activities can be adequately identified and managed.

Community health and safety impacts caused by air emissions from dust; uncontrolled access to dangerous sites; exposure to waterborne, water-washed, or water-associated diseases; and exposure to increased local traffic are addressed in the **General EHS Guidelines**.

## **Decommissioning**

Extraction site reclamation and closure activities should be considered as early in the planning and design stages as possible. Sponsors should prepare a reclamation and closure plan that considers factors such as production phasing and overall site life, but all sites will need to engage in some form of progressive restoration during operations. While plans may be modified, as necessary, during the construction and operational phases, plans should include contingencies for temporary suspension of activities and permanent early closure and meet the following objectives:

### *Physical Integrity*

All structures should remain stable such that they do not impose a hazard to public health and safety as a result of physical failure or physical deterioration. The structures should continue to perform the function for which they were designed. They should not erode or move from their intended location under extreme events or perpetual disruptive forces;

Physical hazards such as unguarded roads, quarries, and other openings should be effectively and permanently blocked from all access to the public until such time that the site can be converted into a new beneficial land use based on changed conditions at the site, as well as alternative uses by local communities or other industries for roads, buildings and other structures.

### *Chemical Integrity*

Surface water and groundwater should be protected against adverse environmental impacts resulting from excavation and processing activities. Leaching of chemicals into the environment should not endanger public health or safety or exceed water quality objectives in downstream surface water and groundwater systems.

### *Ecological Habitat Integrity*

While ecological habitat integrity is partially determined by the above factors (e.g., physical issues such as slope stability) and chemical issues (e.g., such as metal contaminants), it is also addressed with consideration towards replacement of habitat that is beneficial for future ecological use.

## **2.0 Performance Indicators and Monitoring**

### **2.1 Environment**

#### **Emission and Effluent Guidelines**

Construction materials extraction operations do not typically generate point sources of effluents or emissions with the possible exception of dewatering effluents which may contain suspended solids. The implementation of total suspended solids (TSS) prevention and control strategies should target concentrations of 50 milligrams per liter (mg/l) at the point of discharge. Stormwater flows should be managed through the application of stormwater management guidance provided in the **General EHS Guidelines**.

The objective of dewatering discharges or stormwater runoff controls should be the prevention of impacts to ambient water quality as described in the **General EHS Guidelines**. The principal source of air emissions is fugitive dust from earth works and materials handling and transport activities. The objective should be their prevention and control as described in the **General EHS Guidelines**.

Combustion source emissions guidelines associated with steam- and power-generation activities from sources with a capacity equal to or lower than 50 MWth are addressed in the **General EHS Guidelines** with larger power source emissions addressed in the Thermal Power EHS Guidelines.

### **Environmental Monitoring**

Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment during normal operations and upset conditions. Environmental monitoring activities should center on the application of management practices to prevent the sources of impacts.

Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the **General EHS Guidelines**.

## **2.2 Occupational Health and Safety**

### **Occupational Health and Safety Guidelines**

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®) published by American Conference of Governmental Industrial Hygienists (ACGIH),<sup>5</sup> the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),<sup>6</sup> Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United

<sup>5</sup> Available at: <http://www.acgih.org/TLV/> and <http://www.acgih.org/store/>

<sup>6</sup> Available at: <http://www.cdc.gov/niosh/npg/>

States (OSHA),<sup>7</sup> Indicative Occupational Exposure Limit Values published by European Union member states,<sup>8</sup> or other similar sources.

## Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. Facility rates may be benchmarked against the performance of facilities in this sector in developed countries through consultation with published sources (e.g. US Bureau of Labor Statistics and UK Health and Safety Executive)<sup>9</sup>.

## Occupational Health and Safety Monitoring

The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals,<sup>10</sup> as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents, diseases, and dangerous occurrences and other accidents. Additional guidance on occupational health and safety monitoring programs is provided in the **General EHS Guidelines**.

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<sup>7</sup> Available at:  
[http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=9992](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992)

<sup>8</sup> Available at: [http://europe.osha.eu.int/good\\_practice/risks/ds/oe/](http://europe.osha.eu.int/good_practice/risks/ds/oe/)

<sup>9</sup> Available at: <http://www.bls.gov/iif/> and  
<http://www.hse.gov.uk/statistics/index.htm>

<sup>10</sup> Accredited professionals may include certified industrial hygienists, registered occupational hygienists, or certified safety professionals or their equivalent.

### 3.0 References and Additional Sources

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## **Annex A: General Description of Industry Activities**

### **Construction Materials Extraction**

Extraction activities for construction materials (e.g. limestone, clay, gypsum, and feldspar) typically involves quarrying and mining, site transport and storage of raw material, crushing, milling, grinding, and shipping to final users including cement plants, other manufacturer industries, and the construction industry. In the case of aggregates (e.g. gravel and sand) the extracted material is commonly divided into size classes, stockpiled, and directly shipped to consumers (e.g. concrete mixing plants).

To minimize transportation cost, exploitation sites of limestone, sand, and gravel are commonly located close to processing plants and the final markets. Because of their relatively higher value and lower availability, other materials such as feldspar, silica sands, clay, and gypsum, may be economically extracted at greater distances from their intermediate processing facilities and / or final markets. If an exploitation site is located on or near a riverbank and transportation can be accomplished with barges, materials can be shipped for a long distance.

Construction activities associated with construction material extraction typically include the removal of topsoil, overburden ground, trees, and vegetation. Stockpiles of these materials are stored in stable, protected, and monitored areas for use in reinstatement activities. Other preparatory work leading up to exploitation activities includes design and construction of water drains and ditches, access and internal roads, benches, and preparations for use of explosives. Upfront planning is undertaken during this phase to ensure acceptable pit slopes during operational and rehabilitation phases.

Activities characteristic of the operations phase include excavation by means of mechanical methods such as shoveling, ripping, dredging and / or drilling and blasting, in addition to

transport, crushing, grinding, milling, and stockpiling of materials.

Management and monitoring of drilling and blasting, including minimization of impacts caused by dust, noise, vibrations, and flyrocks is necessary during the construction and operation phases. Continued planning and implementation of site rehabilitation is conducted during operations activities.

Activities associated with site closure and reinstatement / rehabilitation include the demolition of building structures, removal of aboveground and underground utilities, and ensuring the closure and reinstatement of internal and access roads. Slope stabilization and recontouring of surface ground are typically undertaken, in addition to topsoil reinstatement, revegetation, including seeding with commercial seed mixes and / or preferably native species. Opportunities to create ecologically valuable habitats should be exploited. Restoration of the local hydrological network is necessary. Dredging or excavation below the local water table should generally be reinstated, including appropriate creation of water ponds.

### **Dimension Stone Quarrying**

Dimension stone extraction involves quarrying using explosives and / or diamond wire cutting, site transport and storage of raw blocks, sorting, cutting and shipping to consumers for direct use, or cutting and polishing. Most of the issues relevant to the design, construction, operations, and decommissioning phases of construction materials extraction are applicable to dimension stone quarrying. Basic operations include quarrying by means of mechanical methods (e.g. wire / diamond cutting and sawing) or drilling and blasting (e.g. smooth blasting and cushion blasting), block splitting, sorting, block moving by lift rigs, and block transport.