REPUBLIC OF CYPRUS

Ministry of Agriculture,
Natural Resources and Environment
Geological Survey Department

Strategy for Sustainable Quarrying and Mining Development of Cyprus 2001 - 2025

Final Report

May 2004

A.L.A Planning Partnership

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Contents

Acknowledgments

The success of this project was dependant on the help and support of many people both in Cyprus and the UK. In particular the project directors gratefully acknowledge the support and assistance provided by following: G Petrides, L. Morisseau, S. Nicolaides, Chr. Hadjigeorgiou, E Anastasiades, C. Hadjipanayiotou, Ch. Thrassou, Mr. Ch.Ktorides and Mr. M. Kareklas

Executive Summary

Minerals can only be worked where they occur. Society demands an economically and environmentally sustainable supply of minerals for construction and other beneficial uses, essential for economic growth and quality of life. This means:

1. identifying mineral resources and reserves with the required quantity and quality, the extraction of which is technically and economically feasible;
2. exploiting these resources where they are sufficiently close to the market that the cost to the consumer is acceptable (this applies particularly to the supply of construction aggregates);
3. locating and managing the process such that environmental and social impacts are acceptable.

Achieving these aims usually means that a balance has to be struck between competing interests, often involving compromises. None of these competing interests should be considered mutually exclusive, however the compromises are much easier if mineral extraction is well managed with respect to environmental and social impacts and to proper closure and reclamation.

The objective of this project is to develop a strategy for the sustainable quarrying and mining development of Cyprus, to ensure that the mineral wealth of the island is exploited sustainably and that sufficient essential minerals are available or accessible for a period of 25 years. This was undertaken in 4 phases:

1. Gathering of geological data, inspection of all major active and abandoned sites and assessment of their operational and environmental circumstances, mineral reserves, mine closure planning. This information is compiled in an extensive GIS database.
2. Assessing national and regional current and future demand and supply for construction and related minerals, including the quality of the minerals. This phase also considered environmental impacts and relevant environmental policies.
3. Considering future prospects, planning policy, social participation and emerging technologies for the minerals industry in Cyprus. This includes mine and quarry heritage and restoration.
4. Development of a strategy for mineral demand and optimum usage, including environmental planning and management.

Principal findings

The minerals industry has been examined and the legal framework and authorities that control the industry have been considered in detail. The following principal findings have emerged:

1. Cyprus has substantial resources of essential minerals to meet the development requirements of the Island.
2. In the short term there will be a need to source reserves clay for brick manufacture and additional hard rock for aggregate production, to serve the Paphos area. Existing reserves of essential minerals elsewhere are sufficient to allow a proposed review of mineral workings without jeopardising the supply of raw materials for future development.
3. There are considerable concerns in regard to the effect of minerals operations on amenity and the environment and there are shortcomings in the way the mineral industry is both operated and regulated.
4. The current legislation sets out an elaborate system for the control of mineral operations but it is becoming excessively bureaucratic and the lack of resources and expertise within the regulatory bodies is a significant weakness in the monitoring and enforcement of regulations.
5. There is a lack of any forward planning both from the Government and the commercial sector promoted by current legislation that fails to acknowledge the long-term nature of the industry.

The way forward

The consultants recommend that actions be focussed in six main topic areas:

1. ***Institutional changes and organisation***, particularly in land use planning. The consultants believe that the Department of Town Planning and Housing should play a key strategic role in minerals planning, in both managing demand for minerals and zoning, and controlling mineral operations through the planning system. Ideally this would involve the establishment of a dedicated multidisciplinary minerals planning team, which would have three functions: strategic planning for minerals, development control and enforcement. It would work alongside other departments/agencies responsible for licensing and inspection of mines and quarries, pollution control and waste management.

   As an immediate action the consultants recommend that a Minerals Commission should be established by Council of Ministers Decision. The Minerals Commission would be an interdepartmental body comprising representatives from the Department of Town Planning and Housing, Environmental Services, Mines & Quarries Service, Geological Survey Department and the Department of Labour Inspection. Its key role in the short term would be to implement the other four action areas below, to direct the relevant departments' activities towards this. In the long term the Minerals Commission would maintain a policy and co-ordinating role between the various Ministries and Departments involved in managing the mining and quarrying sector. The Commission could also be the lead agency for dealing with the legacy dereliction and pollution from past mining and quarrying.
2. ***Legislative and regulatory adjustments***, particularly the use of temporary planning licenses for quarries. The quarry industry must be subject to much longer term planning, with licenses that reflect the nature of mineral operations. Longer term planning licenses will enable conditions to be imposed ensuring that working methods and post-working reclamation avoid short and long term environmental liabilities. The way in which forthcoming EU legislation will be transposed into Cyprus law will have a wide effect on mineral working; these include the IPPC Directive and the Mine Waste Directive. The latter, in particular, will necessitate the adoption of a longer term licensing regime for mines and quarries.
3. ***Training and consistency of approach***, to raise awareness and standards of mineral planning and environmental management, including the proper conduct of environmental impact assessment and mine closure planning. This applies to both the industry and to the regulatory agencies / departments. This should include the preparation of codes of practice and/or guidelines, which can be based on the models presented in previous interim reports.
4. ***A strategic framework and planning for quarry zones***, adopting systematic tools for land use planning and strategic environmental assessment, combined with more precise prediction of mineral demands and mineral reserves. Maintaining a 'minerals bank' of at least 7 years is considered prudent, based on regional demand and supply within 50km. A meaningful strategic plan can only be achieved if there is a move away from the use of temporary 2-year planning permits for mines and quarries.
5. ***A programme of remediation of pollution and reclamation of land affected by past mining***, involving the mining and quarrying industry, where existing companies still retain responsibility. However, it is inevitable that dealing with the extensive legacy will have to be funded largely by the Government. Means of raising additional revenues to fund a programme of reclamation need to be explored, and could include an additional levy on mine

and quarry production. The nature and extent of existing environmental liabilities from past mining and quarrying are identified in the Phase 2 Report, and a framework for reclamation to beneficial use is given.

6. ***A commitment to implementation and enforcement*** of the control of mineral working, both from land use planning and environmental control. This requires a greater level of resourcing than is currently available to the departments involved. In particular, the proposed Minerals Commission will require resourcing in order to carry out its function.

1. Introduction

1.1. Objectives of the Study

1.1.1. The Project commenced in February 2002; the objectives of the study were defined in the Terms of Reference as follows:

- To formulate a Strategic Plan for the sustainable and rational development of the mineral wealth and the quarrying industry of Cyprus.
- To conserve minerals as far as possible, whilst ensuring an adequate supply to meet needs;
- To ensure that the environmental impacts caused by mineral operations and the transport of minerals are kept, as far as possible, to an acceptable minimum;
- To minimise production of waste and to encourage efficient use of materials, including appropriate use of high quality materials and recycling of waste;
- To encourage sensitive working, restoration and aftercare practices so as to preserve or enhance the overall quality of the environment;
- To protect areas of designated landscape or nature conservation value from development, other than in exceptional circumstances and where it has been demonstrated that development is in the public interest;
- To prevent the unnecessary sterilisation of mineral resources.

1.1.2. The Study programme was divided into 4 phases each of six months duration.

1.1.3. They were approximately divided into the following task areas:

- Phase 1 – Data gathering and management
- Phase 2 – Assessment of the current situation
- Phase 3 – Future prospects
- Phase 4 – Conclusions and recommendations

These are expanded as follows.

Phase 1

1.1.4. A Geographical Information System (GIS) and a Microsoft Access database were set up, for storing and analysing data. Archive sources, mainly within the Geological Survey Department and the Mines Service, were searched. Operational and closed mines and quarries were visited and topic papers on the mineral resources of Cyprus were prepared.

1.1.5. A programme of site visits was undertaken and sixty of the major operational sites were visited, observations were made on the site conditions and operators were interviewed. Fifteen typical abandoned mines and quarries were also visited. The results of the field surveys were recorded in the GIS and Access database. Individual records were prepared for each operational site, covering key technical and

environmental features and similar records were prepared for each of the abandoned mines and quarries visited. In parallel with the other data gathering exercise, topic papers comprising a synopsis of each mineral product were prepared from published and archive data.

1.1.6. The main preparation and compilation of the GIS (using MapInfo software) database was also undertaken during Phase 1. Available Government-held GIS data were gathered from the GSD and the Forestry department. Copies of plans and licence details of all 250 operational sites were obtained from the GSD and digitised into the GIS together with quarry zones and planning zone data obtained from the Department of Town Planning.

Phase 2

1.1.7. Phase 2 looked at the current situation with regard to reserves and resources, the impact of mining operations on the environment, the background legislation controlling mineral working and the effectiveness of the authorities in regulating the industry. Revisions to the GIS and Access databases were also made following comments from the Steering Committee. Comparisons were made between Cyprus and the UK and the methods of minerals control of UK and its historical development were discussed.

Phase 3

1.1.8. This phase considered the future of the minerals industry in Cyprus. The sufficiency of existing mineral reserves to meet demand to 2025 were analysed and the potential effects of changes in demand, the use of materials, recycling and new technology in the industry were reviewed.

1.1.9. Possible changes in the licensing procedures were discussed as were the increasing importance given to consultation and social participation. The termination of minerals working was considered in the light of the historic record of dereliction and abandonment worldwide that has created a change in outlook of the industry and has introduced the concept of closure planning. The importance of mining heritage was considered and a programme for the planned restoration and conservation of abandoned mine sites was proposed.

Phase 4

1.1.10. This was the concluding Phase that brought together the findings and results of the earlier studies but also included a discussion on environmental management systems and offered a procedure for identifying New Quarry Zones as a replacement for the current quarry zone designations.

1.2. Format of this Report

1.2.1. This final report provides a summary of the data previously presented as the four separate interim reports, corresponding to the phases described above and presented to the Steering Committee over the two-year period of the project. Where a significant amount of detail has not been reproduced in this report reference is made in the text to the original scripts of the interim reports. The layout of the report is

generally in the sequence of tasks identified in the order set out in the original Terms of Reference for the project.

1.3. Data Presentation and Storage

1.3.1. A large part of the effort of this project was spent in the collection of data and the preparation of an inventory of the mineral resources and the environmental impacts of the minerals industry in Cyprus. These data are held on the GIS and Access databases referred to above. Also included, as part of the data gathering exercise, were the collection and storage of all readily GIS data and physical and environmental constraints mapping. This could form the basis of an integrated land-use planning tool for the preparation of a Mineral Local Plan. These data are stored as vector and raster format within the GIS database. Production data for the past five years were obtained from the Mines Service and have been compiled together with various additional data such as aggregate quality. However it should be noted that they represent only a snapshot in time. Most of the data were accumulated in 2002 and relate to the year 2001; these data will need to be continually updated if they are to remain of value and not become of historic interest only.

2. Geology, Mining and the Environment

This chapter provides a summary of the data gathered at the beginning of the project and which formed the foundation for subsequent discussion, conclusions and recommendations. It includes an outline of the geology of Cyprus and its mineral resources and reserves and a discussion of effects of the minerals industry on the environment.

2.1. A Summary of the Geology and Mineral Resources of Cyprus

2.1.1. Geology dictates the location, types and availability of specific minerals, but it also has a fundamental bearing on topography, water, soils, vegetation and land use. Cyprus can be divided into four geological zones:

(a) Pentadaktylos (Kyrenia) Zone,

(b) Troodos Zone or Troodos Ophiolite,

(c) Mamonia Zone or Complex, and

(d) Zone of the autochthonous sedimentary rocks.

2.1.2. ***The Pentadaktylos*** (Kyrenia) ***Zone*** forms the Kyrenian mountain area of northern Cyprus. It is mainly composed of allochthonous, massive and recrystallised limestones, dolomites and marbles of Permian-Carboniferous to Lower Cretaceous age (350-135 Ma). These have been overthrust and now lie above younger autochthonous sedimentary rocks of Upper Cretaceous to Middle Miocene age (67-15 Ma).

2.1.3. ***The Troodos Zone*** dominates the central part of the island as an elongated dome structure outcropping in the main mass of the Troodos mountain range and in the Limassol and Akapnou Forests areas. It comprises a distinctive assemblage of mafic to ultramafic rocks that represent part of an oceanic crust that has been thrust to the

Figure 5.1
The Troodos Ophilite Sequence

Formation and Rock Units		Economic minerals
Perapedhi Formation		Umber
Mafic volcanic complex. Pillow lavas dominant in Upper Pillow lavas with less than 5% dykes. Dykes comprise 20 to 50% in Lower Pillow Lavas. Diabase dykes are abundant in Basal Group and are gradational down into the Sheet Dyke Complex.	Upper Pillow Lavas	Massive sulphide deposits
	Lower Pillow lavas	
	Basal Group	
Diabase - mafic Sheeted Dyke Complex		Aggregates
Gabbroic complex ordinarily with cumulus textures and commonly containing peridotites and pyroxenites and usually less deformed than the ultramafic complex		Sulphide mineralisation
Ultramafic complex consisting of varying proportions of harzburgite, lherzolite and dunite usually with a metamorphic tectonite fabric and more or less serpentinised		Chromite Asbestos

surface. The sequence of rocks found in the Troodos is illustrated in Fig. 5.1 and the commonly occurring economic minerals are also indicated.

2.1.4. This rock sequence is referred to as an ophiolite and as such the Troodos is regarded as the most complete and studied ophiolite in the world. It was formed in the Upper Cretaceous (90 Ma).

2.1.5. ***The Mamonia Zone*** occurs in the Pafos district in the south-western part of the island. It is a series of igneous, sedimentary and metamorphic rocks, ranging in age from Middle Triassic to Upper Cretaceous (230-75 Ma). They have generally been intensely deformed and mixed with rock fragments of the Troodos ophiolite. They are regarded as allochthonous both in relation to the overlying autochthonous carbonate successions and the Troodos ophiolite.

2.1.6. ***The autochthonous sedimentary rocks***, range in age from Upper Cretaceous through to Pleistocene (67 Ma to recent) and cover the area between the Pentadaktylos and Troodos Zones (Mesaoria) and also occur in the southern part of the island. They mainly comprise carbonate sediments as illustrated in Fig 5.2 that also shows the main rocks and minerals of commercial interest.

Figure 5.2
The Autochthonous Sedimentary Rocks

Age (Ma)			Formation	Lithology	Economic minerals
	Pleistocene		Fanglomerate	Conglomerates and sandstones	
2			Apalos	Calcarenite, sandstone, conglomerate	
	Pliocene		Kakkaristra		
			Anthalassa		Sand for mortars and clay for bricks
5.2			Nicosia	Marls, silts, muds, sandstone, conglomerate	
	Miocene	Upper	Kalavasos	Evaporites	Gypsum
			Koronia Member	Reefal and bioclastic limestone	Aggregates
		Middle	Pakhna	Pelagic chalks, marts, calcarenites, conglomerates	Dimension stone
23.3		Lower	Terra Member	Reefal and bioclastic limestone	Aggregates
35.4	Oligocene		Upper Lefkara	Pelagic chalk and marls	Chalks for cement production
56.5	Eocene		Middle Lefkara	Massive pelagic chalks	
65	Palaeocene			Pelagic chalk, replacement chert	
74	Maastrichtian		Lower Lefkara	Pelagic chalks	
83	Campanian		Kannaviou	Volcaniclastic sandstone, bentonitic clays	Bentonite
90.4	Turonian		Perepedhi	Umbers and radiolarites	Umber

Stratigraphic break

adapated from Gass I.G. et al 1994

2.2. The Minerals Industry of Cyprus

2.2.1. About 250 quarries were in operation in 2002 producing aggregates, building stone, clay, gypsum and sand and gravel. Limestone and clays were won for cement production for the domestic construction industry and for export. Bentonite, gypsum, umber and minor quantities of dimension stone were also mined for export.

2.2.2. During the past few decades historically important mineral export commodities, such as asbestos, chromite, copper, and iron pyrite, have effectively ceased apart from the one remaining copper recovery operation at the Skouriotissa site.

2.2.3. Although the mining and quarrying sector contributes only a small proportion of the Cyprus GDP (0.3% in 2000 – Department of Statistics) the importance of the minerals industry in Cyprus is still substantial. The total export value for minerals in 2001 was in excess of CY£11 million and turnover in the minerals and directly associated industries was in excess of CY£93 million.

Raw materials for Aggregates

2.2.4. Minerals for the construction industry account for the major proportion of the minerals won in Cyprus. Crushed aggregates are primarily obtained from diabase and reef limestones with a lesser quantity of fine aggregate (sand) obtained from crushed calcarenites.

Diabase

2.2.5. Diabase is mainly extracted from the Sheeted Dyke Complex and locally from the, generally poorer quality Basal Group. It forms a major part (of the order of one third – see Figure 2.3) of the Troodos Ophiolite complex and represents a very competent material for the production of aggregate for the domestic construction industry. The total resources of rock suitable for aggregate production are huge.

2.2.6. Aggregates produced from the diabase are generally stronger and more durable than those from the limestones. However the diabase gives rise to the steep mountainous topography. This in turn gives rise to the forested areas of the island that are given a high degree of protection from development pressures.

Reef limestones

2.2.7. The reef limestones of the Koronia and Terra members of the Pakhna Formation are the main source for limestone aggregates with smaller quantities also won from the layered limestone of the Ayios Photios Group within the Mamonia Complex. The reef limestones provide a better quality crushed aggregate although porosity can adversely effect durability and strength. The geological outcrop of suitable limestone resources is restricted (see Figure 5.3) and potential development areas are limited. It might be anticipated that reef limestones will have to be replaced by resources from the diabase as the limestone become exhausted or unobtainable.

Calcarenite for sand

2.2.8. Substantial quantities of sand, that meets Cyprus standards for aggregates, is obtained from crushed calcarenites or weakly consolidated sands from the Nicosia and Athalassa Formations. They contribute significantly to the crushed aggregates market providing principally a fine calcareous sand used in mortars and concrete.

Production Reserves

2.2.9. The ability of existing reserves to meet projected demand has been assessed. Table 2.1 shows the production and reserves remaining for each of the main aggregate mineral groups (i.e. diabase, limestone and calcarenite for sand) allowing for:

(a) no production increase,

(b) an annual production increase of 3% and

(c) an increase of 10% p.a.

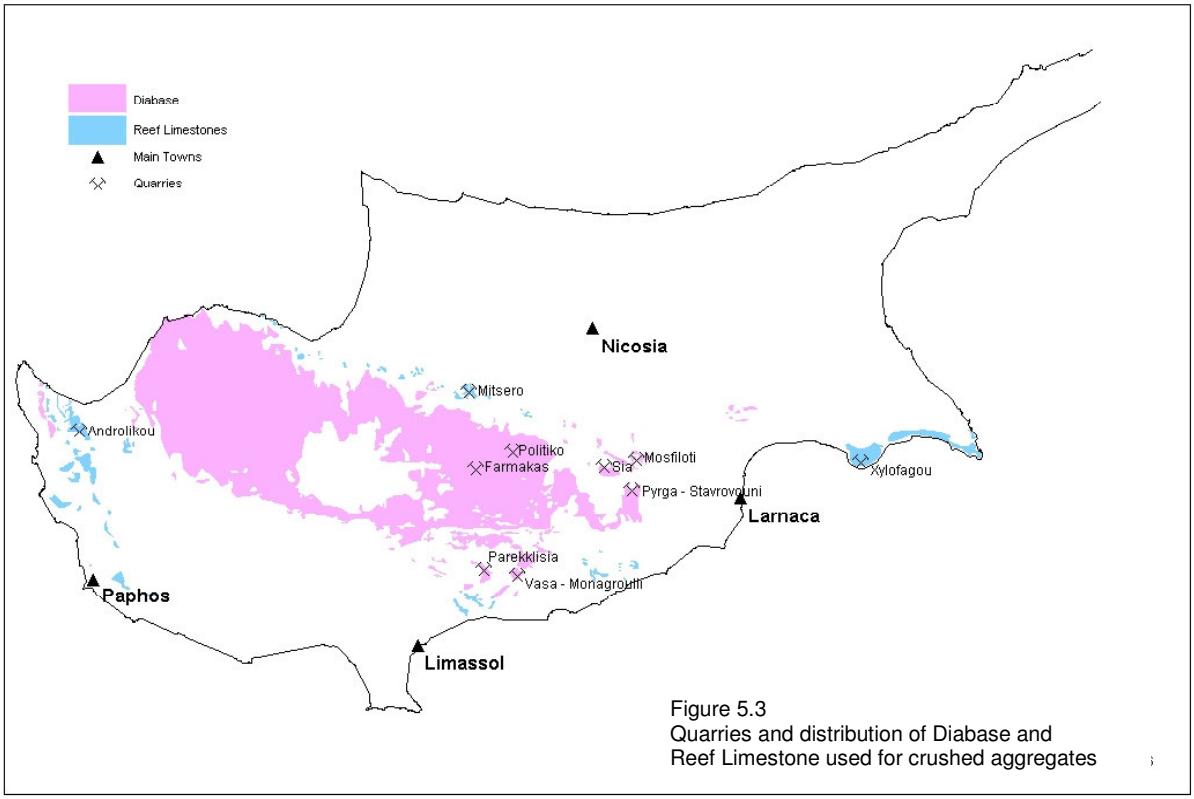

Figure 5.3
Quarries and distribution of Diabase and
Reef Limestone used for crushed aggregates

2.2.10. The 3% annual increase in production accords with the anticipated increase in construction levels for the next few years. However the trend in production over the past 5 years indicates an annualised increase in production of the order of 10% and a projected increase in demand of 10% per annum has also been calculated. The reserve land banks for the various projected demand levels are also shown in Table 5.1.

Table 5.1
Aggregate output and reserves by rock type

Rock type	Production 2001 (million tonnes)	Reserves (million tonnes)	Years at 0% increase per year	Years at 3% increase per year	Years at 10% increase per year
Calcarenite and sand for crushed sand	1.1	10	9	8	6
Limestones for crushed aggregates	2.6	33[1]	12	10	8
Diabase for crushed aggregates	5.3	117	22	17	12
Grand Totals	9.0	160	17	14	10

[1] if new licence applications are included the limestone reserves increase to 95 mt.

2.2.11. Total remaining reserves of aggregate mineral are sufficient to maintain existing or projected demands at least for the next 10 years. However aggregate minerals are high-volume low-cost commodities and a large part of the cost is transporting the product from the point of production to the user. It is therefore desirable both economically and from sustainability principles to keep production as close to markets as is practicable taking into account other planning constraints.

2.2.12. The distribution of reserves and production units has therefore also been considered. For convenience the various districts of Cyprus were adopted as consumption areas and the distribution, quarry output and reserves considered for each of the following four district areas:

- Nicosia
- Larnaca (including Free Famagusta area and the S.B.A. areas)
- Limassol
- Paphos

2.2.13. The results area presented in Table 5.2.

Table 5.2
Aggregate production and reserves by District

District	Production (million tonnes)	Reserves (million tonnes)	Reserves (years) at 3% increase p.a.	Reserves (years) at 10% increase p.a.
Nicosia	2.4	37	12	9
Larnaca and S.B.A. etc	3.1	44	12	8
Paphos	1.2	11	8	7
Limassol	2.3	68	21	14

Note - these data relate to 2001

2.2.14. As can be seen, only in the District of Paphos is there a shortfall of reserves that might be of immediate concern. Nevertheless within the project timescale (i.e. to 2025) additional reserves will have to be released to maintain supply either by extending existing quarry zones or by allowing quarry development in hitherto unscheduled areas.

Quality

2.2.15. A quality control system to ensure that quarry products meet with Cyprus Standards is implemented by the Mines Service and the Geological Survey Department. The effectiveness of this system was investigated by analysing government laboratory testing data over a one year period and an assessing the extent to which the products meet or fail to meet the required criteria. A suite of over 1000 analyses was appraised.

2.2.16. The number of samples that were outside of the specification was small and those that did fall outside were, in almost all reported cases, only marginally outside the specification. Quality control at the quarries and the government regulating system was therefore considered to be satisfactory.

2.2.17. It was noted that for most uses limestone and diabase are both suitable for producing high quality concreting aggregates but where higher strength products are required diabase has significant strength advantages.

Rock armour and dimension stone

2.2.18. Significant quantities from one or more hard layers of calcarenite within the Pakhna Formation are utilised for block-work for building or as rock armour for marine works; some 55,000 tonnes were marketed for these purposes in 2001. Significant quantities are also exported for cutting as a dimension stone providing foreign earnings in excess of CY£ 0.5 million in 2001.

2.2.19. The Pakhna Formation is extensive but the suitable calcarenite layers are limited, laterally variable and hence resources cannot be readily estimated. The exploitation of relatively thin layers of rock give rise to extensive areas of shallow workings and there is a large production wastage typical of dimension stone operations. These both give rise to considerable environmental problems that need to be ameliorated if this sector of the industry is to continue or expand. The export market has also been challenged from a sustainability viewpoint as the resources are limited and it is considered important as a traditional architectural building stone in Cyprus.

Marble

2.2.20. Small quantities of marble from the recrystallised limestones and dolomites from the Petra tou Roumiou Formation are crushed for use in mosaic tiles and other minor decorative purposes. All known deposits are small and restricted to exotic blocks within Mamonia Complex. Future development and exploitation of the marble resources is only likely to supply decorative marble chippings rather than compete within the regional, highly competitive dimension stone market.

Natural aggregates

2.2.21. There are numerous deposits of sand and gravel in the valleys of the Troodos Mountains and more importantly on the periphery of Troodos in the Fanglomerate Formation. Marine terrace sand and gravel deposits and Lower Pleistocene sands have also been exploited. They are usually poor quality materials used as general fill and predominantly in the construction and repair of minor unsurfaced roads.

2.2.22. Total production in 2001 was around 1.5 million tonnes. Future production of sand and gravel will be completely dependent on the local construction sector and road building strategy.

2.2.23. For environmental and quality reasons the exploitation of these materials is being discouraged but there will nevertheless be a continued demand for poor quality aggregates for common fill that can be met by weathered and loose surface materials that are widespread throughout the Island. Although there are no specific data concerning reserves there is no reason to believe that there will be a shortage unless it is expedient to limit usage for planning or environmental reasons. A broad estimate of total resources of potentially suitable surface materials has been put at 1000 million tonnes.

Chalk, Marls and Clays for cement production

2.2.24. Chalk occurs within the Lefkara and Pakhna formations with $CaCO_3$ contents of around 80% to 95%. Marls and clays, suitable for use in the cement industry, occur extensively in the Nicosia Formation. The resources are considerable.

2.2.25. Cypriot cement has previously found a market in the Middle East and North Africa, particularly in Egypt and Syria, however competition is now very strong from Greece, Turkey, Romania and Bulgaria resulting in very competitive pricing to win foreign contracts. Total production in 2001 was 1.4 million tonnes.

2.2.26. Cement is essential to meet the needs of the construction programme in Cyprus and the export of cement is also important to the national economy. Future production will have to rely on strong demand from the local construction industry supplemented where possible with exports to specific Eastern Mediterranean markets.

Gypsum

2.2.27. Gypsum is quarried for plaster production and as a cement additive. It occurs within the Kalavasos Formation and extensive resources at the main outcrop north of Paphos. The mineral occurs as crystalline selenite, as massive rock gypsum and also in a laminated form known locally as 'marmara'.

2.2.28. Gypsum has been traditionally used as a building material with exploitation of the 'marmara' for flooring stone and calcined gypsum for plaster. A plasterboard factory was in operation between 1956 and 1962 but the industry languished until recently when it received a new impetus with the production of variety of plasters both for local use and export. Of the estimated 250,000 tonnes of gypsum mined in 2002 approximately half was processed for use domestically, mainly by the cement industry, and half exported.

2.2.29. Gypsum is widely available and considered a low cost commodity and must be mined in a very economical manner close to markets. The market is heavily reliant on the building and construction industry where it is used either as an additive to cement clinker (Portland cement) or as gypsum plaster or wallboard. Mined gypsum will face increasing competition from gypsum produced as a by-product from a number of industrial processes, particularly flue gas desulphurisation (FGD) at coal fired power plants.

2.2.30. Reserves, within licensed areas, in Cyprus are substantial at around 6,400,000 tonnes. This would be sufficient to support the domestic market (current level of 125,000 tpa) for the next 30 years. The export market for gypsum is becoming increasingly competitive and although gross gypsum resources in Cyprus are very substantial (of the order of 1,000 million tonnes) increased production for export is considered unlikely. There are therefore ample reserves to meet the domestic market but additional reserves may need to be released if there is an upturn in the raw gypsum or cement industry requirements.

Bentonite

2.2.31. Bentonite clays occur in the Kannaviou and Moni Formations. The bentonite is generally a poor quality calcium montmorillonite clay although a few deposits with quality high calcium material are found. The poorer quality materials can however be

readily improved by sodium activation. The main outcrop is to the to the north-east of Limassol and reserves are substantial although subject to significant environmental constraints. Further prospects occur in Paphos and one in the Famagusta area.

2.2.32. Reserves of Bentonite are substantial standing at approximately 24 million tonnes although a single site in the Finikaria-Armenochori area accounts for a large part of this reserve. Nevertheless with production standing at 145,000 tonnes for 2001 (down from 190,000 tonnes in 2000) the available reserves are substantial.

2.2.33. Bentonite is currently won almost entirely for export. However with the forthcoming requirement to line all the landfill sites in Cyprus that accept non-inert wastes the domestic demand for bentonite clay as a lining medium may increase substantially.

2.2.34. Bentonite has a wide variety of uses. The largest single use for bentonite is as binder in green sand foundry moulds for metal casting and although Na rich bentonite dominates (more stable at higher temperatures). Ca-rich material, such as the natural Cypriot bentonite, can be used at lower temperature processes where it enhances the production of detailed and intricate castings. This market is largely influenced by the automobile and construction sectors that are currently in a slump following the recent synchronised global Industrial Production (IP) downturn. This market sector is also vulnerable to competition from alternative casting methods and moulding/binding systems. However, with increased control of foundry emissions, bentonite is returning to favour compared to polymer-based binders.

2.2.35. The oil well drilling sector is the next biggest market for Na bentonite (or the Cypriot Na exchanged bentonite) and Cyprus's own *Bentocyp*® well drilling series (produced by Pelitico) exceeds OCMA specifications. This market is however influenced by global oil drilling activity and drilling technology that have given rise to a fall in European bentonite prices (for drilling muds) resulting in a decline in the demand from Europe and the Middle East.

2.2.36. Bentonite is also used as a binding agent for animal pelleted feeds and active supplements and has the added benefit of imparting a number of medicinal and nutrient related benefits. Currently only a small proportion is exported to Israel for the manufacture of animal feeds (chicken food pellets).

2.2.37. It is also widely used in civil engineering for diaphragms, retaining wall construction, bored piling, cassion sinking, pipejacking, cement additives, grouting, tunnelling/ shaft sinking support, electrical earthing, solids transportation and waste containment.

2.2.38. The hygroscopic nature of bentonite makes it suitable for a variety of applications including pet litter, pesticide carrier, industrial absorbents and spillage control. The popularity of pet litter has boosted bentonite consumption to the point where it now exceeds drilling muds and demand in this sub-sector is expected to grow and this is likely to be the most important sub-sector for Cypriot bentonite and further market research should be a priority

2.2.39. Through competent market research and a thorough understanding of the variety of client and product specifications Cypriot bentonite exploitation and processing could be further developed leading to increased exports and added value use within Cyprus. The multi-sectorial nature of bentonite reduces the dependence on a single industrial market or the influence of specific economic factors and could present Cyprus with a real opportunity for investment and development for increased local use and export.

Clay

2.2.40. Clay used in the production of bricks and tiles is sourced mainly from the sedimentary rocks of the Nicosia Formation which are blended with weathered lava to provide a suitable brick-making feedstock. The most extensive residual deposit occurs in the Arakapas valley (north of Limassol) whilst sedimentary deposits are more widely distributed in the Nicosia district. The Geological Survey has also identified resources in the Pliocene clays north of Dhali and near Aredhiou, Pissouri and Mari. Holocene/Pleistocene deposits also yield clays suitable for firing but they are generally of low quality and suitable material can also be sourced from weathered igneous rocks where the quality is good but the occurrences are localised. The calcium carbonate content is also high which can give rise to firing problems.

2.2.41. Clay brick and tiles made from locally won brick clay are used extensively in the local construction industry and future production of brick clays will be completely dependent on the local construction sector requirements. In 2001 approximately 300,000 tonnes of clay were won for the heavy clay industries. Reserves at permitted sites in 2002 were estimated to be of the order of 1,200,000 tonnes, which gave a remaining life of only 4 years. It is however understood that permits for additional reserves have been granted since although clay reserves are still at a low level.

2.2.42. Potential clay resources have been assessed based on the distribution of mapped clay-bearing geological units. This suggests that resources could be substantial and in the order of 1,000 million tonnes. However details of the distribution of economic reserves are still far from certain. The GSD is aware of this and there are provisional moves to further explore clay reserves.

Umber and Ochre

2.2.43. Umber typically occurs at the base of the Perapedhi Formation (Campanian) but outcrops are extremely irregular and lateral changes in the deposits are usual. It is therefore extremely difficult to assess reserves and resources. Most of the known large deposits have been worked to their economic limits but other medium and smaller sites are still being worked periodically. Extensive reserves are however believed to be located under younger sedimentary rocks. All production is exported for use as an industrial pigment.

2.2.44. The exploitation of umber has been undertaken since early last century and has continued almost uninterrupted. There are numerous surface mines throughout the country with the main ones being in the areas of Troulli, Lymbia, Mathiatis, Paraklishia and Skouriotissa. About 80% of Cypriot product is supplied to the paint industry with the remaining being supplied to other sectors including pigments for cement, plaster, bricks, roof tiles, chemical fillers and in pet food colouring (the latter having no competition from toxic synthetic alternatives).

2.2.45. Although Cyprus has the potential to increase production, and attempt to revive past export levels, the current market is not buoyant and there is continued competition from synthetics. Opportunities may exist if the Cypriot products could be tailored and marketed for specific applications.

2.2.46. Ochre only occurs at a single location at Skouriotissa and the reserve is almost exhausted.

Massive sulphides, chromites and asbestos

Copper and base metals

2.2.47. The cupriferous massive sulphide ore bodies that have been historically exploited in Cyprus varied in size from around 50,000t to 20Mt grading between 0.3 and 4.5% Cu with varying amounts of Zn, Ni and Co erratically distributed. The primary mineralogy is simple with pyrite dominating followed by variable amounts of chalcopyrite and, less commonly, sphalerite.

Copper

2.2.48. Copper is the only base metal currently being exploited in Cyprus and this from a single site at Skouriotissa operated by the Hellenic Copper Mines (HCM) and utilising bio-leaching, solvent extraction and electrowinning (SX-EW) technology.

2.2.49. Although the underlying trend in world production is still upwards with many predicting a growth in mine output, all existing and planned operations are focusing on increasingly larger and higher grade ore bodies and the use of SX-EW technology. This does not bode well for the future of Cypriot copper production that currently exploits low-grade deposits at a very low production capacity by world standards. Also the use of leaching followed by SX-EW, to create a premium product, will cease to be a great advantage as other producers are increasingly adopting this process. Unless current exploration activity can locate a near surface high Cu grade and large volume deposit (or a polymetallic deposit) it is unlikely that any new Cu mines will be developed.

Pyrite

2.2.50. Pyrites mineralisation occurs in the pillow lava series of the Troodos Ophiolite complex and is the main constituent of the Cypriot volcanogenic sulphide deposits. The best grade (40-50% sulphur) ore is located in the higher parts of the deposits (top 30m) and the grade diminishes with depth with potentially mineable grades extending generally down to a maximum depth of 100m. The past mining of pyrites in Cyprus closely followed world demand for this mineral and until around 1970 export figures were high and represented the primary raw material exported. However almost all known commercial reserves of pyrite are now effectively exhausted and it is generally held that the potential for the discovery of major deposits is small.

Chromite

2.2.51. The chromite of Cyprus occurs as an essential accessory mineral and also as low grade podiform ore bodies within the ultramafic rocks of the Troodos igneous complex. Extensive borehole drilling programmes have failed to raise the reserve base above 200,000 tonnes and other investigations have not been encouraging. Although of historical interest, given the small size and low-grade nature of the Cypriot chromite deposits and their environmentally sensitive location, it is highly unlikely that they could be economically developed and successfully exported to penetrate the highly concentrated and competitive market.

Asbestos

2.2.52. The main chrysotile asbestos deposits in Cyprus are confined to area of highly fractured plutonics on the eastern slopes of the Troodos bastite-serpentinite outcrop.

2.2.53. Cyprus was once one of Europe's most important producers of chrysotile asbestos. Past production came exclusively from the Amiandos open pit mine that opened in 1904. Following the decline in use of asbestos the mine was forced to close in 1988. The only other sizeable deposit occurs around 4km north-west of the Amiandos mine and due to environmental reasons its development was never permitted.

2.2.54. Although there are substantial asbestos resources remaining in Cyprus the reduced world demand and the environmental degradation from previous operations make future exploitation of this mineral exceedingly unlikely.

Celestite and Magnesite

Celestite

2.2.55. The Maroni deposit represents the only significant occurrence of celestite (associated with gypsum) located near Vassiliko. The mineralisation occurs in veins and minor disseminations in the Koronia Limestone (Pakhna Formation) and reserves of 200,000t of celestite (56% SrSO4) have been recovered. Cyprus was only a small player in the global market and any future development will depend on the discovery of new resources, as the known site at Maroni is exhausted.

2.2.56. The strontium market is dependent on sales of cathode rays tubes (CRTs) for use in televisions and VDUs which utilise 80% of all production. Demand for CRTs may in the long term decline with the increased use of alternative display technologies.

Magnesite

2.2.57. Magnesite deposits are found in the ultramafic rocks of the Troodos igneous complex located in the Akamas area and Limassol Forest area. The deposits are of reasonable quality (MgO 47.3%, CaO 4.4% and SiO_2 0.8%) suitable for the refractory industry but known reserves are extremely limited and in locations where minerals development would be resisted for environmental reasons.

2.3. Quarrying and Mining Development and the Environment

2.3.1. Data concerning the environmental effects of mining operations were gained from visits to active and abandoned sites and discussions with the government officials. Sixty (60) of the 250 operational and licensed quarries were visited that included the majority of the larger operational units and a selection of smaller sites. The sample was distributed among all districts and covered various topographic conditions and land cover types. The following principal environmental circumstance at each site were noted:

- Visual impact
- Impacts and sensitivity
- Environmental protection and monitoring
- Ecological value
- Constraints to further expansion

2.3.2. The data were recorded in the GIS system and the Access database, a summary of which follows.

Landscape impact

2.3.3. Planning Regulations require that sites should, where possible, be concealed from public view and landscape measures and visual impact assessments should be undertaken. It was evident from the survey that landscape mitigation or remediation measures are seldom carried out. Certain mineral developments had greater impact than others and the dimension stone were notably intrusive due to their large waste volumes, large land-take and prominent locations. However erosion and natural re-establishment of vegetation on abandoned mineral workings have helped to disguise the visible signs of human activity and only where large-scale mining or mineral extraction has been carried out are the effects permanent.

Impact on the water environment

2.3.4. The majority of operations at working quarries do not present a significant threat to surface or ground water. However a number of examples of potential surface water pollution incidents were noted and oil spills were noted at several sites. Processing and storage facilities were generally not equipped with bunds or measures to prevent pollutants leaving the site; run-off from mineral processing and washing plants could also be a cause for concern potentially introducing flocculants and other contaminants to surface and underground waters. Disposal of waste rock and overburden into or adjoining rivers and streams, adversely affecting watercourses, were noted.

2.3.5. Surface watercourses near to abandoned metalliferous mines are at significant risk from contaminated runoff from mine dumps. Almost all of the abandoned mines visited showed the effects of erosion and transport of sediment into adjoining watercourses and also onto agricultural land.

2.3.6. The LIFE project (Mining Waste Management in Cyprus) looked in detail at the impacts of mining wastes on the water environment. They noted that run-off from mine dumps and overflow water from shallow pits has caused serious pollution of immediately adjoining surface waters and wells. Groundwater contamination was only significant in close vicinity to the mines, and then not at hazardous levels, but this could be equally attributable to naturally occurring high levels of heavy metals.

Atmosphere (Noise, vibration and dust)

Noise and vibration

2.3.7. Noise from mineral operations is not a major environmental issue due to the relative remoteness of most sites from dwellings. Although vibrations from blasting and movement of heavy vehicles are a perceived or potential threat to structures no such threats to the built environment were identified during the survey. However the impacts on communities of heavy goods traffic are sometimes significant. Roads bypassing communities have been constructed but there is still potential to improve the situation by, amongst other things, the introduction and enforcement of speed limits, lorry routing agreements and regular maintenance of road surfaces.

2.3.8. Noise and vibration from blasting has been an issue but advances in blasting techniques and introduction of delay fuses, which reduce the maximum instantaneous

charge, have effectively solved this problem. Some complaints about blasting noise however still occur.

Dust

2.3.9. Dust from quarries is considered to be a nuisance rather than a health hazard and routine mineral operations do not give rise to significant airborne fine particulate matter (PM_{10}). Dust-fall however can have a negative affect on vegetation immediately surrounding a mineral working. Although no monitoring of airborne dust is undertaken, from observations it is expected that concentrations may, on occasions, exceed legal standards in communities that are situated very close to quarries.

2.3.10. The main source of dust is vehicle movement over unmade roads and as a result many operators have paved their access and approach roads. Crushing and screening plants were a significant source of dust emissions and the initial site surveys identified many cases where dust arrestment systems were inadequate, where material fall heights were unnecessarily large or where stockpiles and loading operations were giving rise to excessive dust release.

2.3.11. Many of the quarries implement basic dust control measures such as spraying water on stockpiles and service roads and use of sheeting over lorries. However these measures are not universally adopted or enforced. More sophisticated dust control methods, such as foam technologies, are being introduced which provide better dust control and also use less water than conventional water spray systems.

Flora and Fauna

2.3.12. Many mineral operations are located in areas of biological value or interest that are inevitably degraded as a result of quarrying activities. There is a total loss of vegetation cover where soils are removed to access minerals or locate plant and equipment and where overburden or quarry waste is dumped. However impacts beyond the operational area are relatively minor although, as indicated above, there is evidence of adverse effects of dust deposition on plants close to some operational quarries.

2.3.13. As a direct result of quarry activities several habitats with characteristics comparable to those identified in Annex I of the Habitat Directive (92/43/EEC) have been degraded. The habitats that are most affected are:

- "5420: Sarcopoterium spinosum phrygana". *Degradation of well-conserved phrygana vegetation was evidenced in more than 25 sites.*
- "6220*: Pseudo-steppe with grasses and annuals (Thero-Brachypodietea)". *This habitat type occurs in several sites (around 10) and especially on limestone substrates at the lowlands. According to the Habitat Directive, 6220 is a Priority Habitat Type that is "in danger of disappearance, and for their conservation the Community has particular responsibility in view of the proportion of their natural range which falls within the European territory".*
- "5220* Mattoral with Ziziphus ". *This habitat type generally occurs within the habitats above and is of particular importance as it is in decline in as being identified as a Priority Habitat Type.*

- "9540 Mediterranean Pine forests". *Pinus brutia forests in good conservation status were affected in more than 12 quarrying sites.*
- *Maquis vegetation consisting mostly of* "9320 Olea and Ceratonia forests" *and/or Genista fasselata scrub (subtype of 5330 habitat type have been degraded in several (more than 15) locations.*

2.3.14. At least five quarries are located in areas identified as of importance for avifauna (SPAs). Several quarries also lie partly within or adjacent to areas that have been proposed for Natura 2000 Network designation as Special Areas of Conservation (SACs).

2.3.15. The location of dimension stone and diabase quarries were of particular concern. In the case of dimension stone suitable strata are only a few metres thick and quarrying tends to utilise large surface areas. Indiscriminate overburden and waste tipping and the apparent lack of resource management or restoration exacerbate environmental impacts. These quarries are also typically located in elevated areas with rich maquis vegetation. Diabase quarries are generally deep and take up less land in proportion to the amount of material quarried. However they are generally located in forest areas that are cleared before quarrying activities commence. There is the perception that larger areas than is necessary are cleared in advance of operations.

Social Impacts

2.3.16. Although complaints regarding the operation of quarries have decreased in recent years, they still are an issue in several areas. Concerns raised by the public include safety issues and environmental degradation due to dust, noise and traffic. Blight is also of concern reducing the development value of land near or along access roads to quarries.

2.4. Conclusions

2.4.1. This chapter is intended to set the background and context for subsequent discussion about the processes of mineral supply and planning policies in Cyprus. The chapter also provides background information on the scale of mineral production and emphasises the increasing importance of industrial and construction minerals that contrasts with the decline in metalliferous mining in the last century.

2.4.2. The following main conclusions, relating in particular to the sustainability of the minerals industry, may be drawn from the minerals and environmental survey data:

Reserves and Resources

- There are substantial resources (i.e. minerals that are economically or potentially feasible to extract) of essential minerals to meet the development requirements of Cyprus in the long term and also, in the case of bentonite, substantial resources that could provide long term export revenues
- In the short term (i.e. in the next 5 years) there will be a shortfall in reserves (i.e. minerals resources that have been confirmed to be commercially producible) of clay for brick manufacture.
- In the short to medium term there will be a shortfall of aggregate reserves to meet demand in the Paphos area.

- In the medium term, apart from the circumstance above, there are adequate reserves of all essential minerals although additional reserves will need to be identified and released (i.e. granted permits) within the time-frame of the project (i.e. up to 2025).
- In the case of aggregates the quality control mechanism in place ensures that quarry products meet the Cyprus standards.
- For most uses limestone and diabase are both suitable for producing high quality concreting aggregates but where higher strength products are required diabase has significant strength advantages.

Environmental issues

2.4.3. A detailed scrutiny of planning conditions relating to specific sites was not undertaken. However the overall impression is that many of the planning or licensing requirements concerning amenity or protection of the environment are generally disregarded and only weakly enforced.

- There are no significant attempts to minimise visual impact of the operations at almost all of the mineral operations on the Island
- Operations at the majority of sites do not pose a threat to the water environment but there was a noticeable lack of measures in place to provide protection from potential pollution accidents
- Noise from plant and vibration from blasting has been an issue in the past but is now generally well controlled
- The movement of heavy traffic is a perennial problem
- Although many quarries are located in areas of biological importance there was no indication that this was ever taken into account in the operational practices of sites.

2.4.4. There is an evident need to improve the conditions and controls relating to environmental effects of mineral operations.

3. The Principal Legislative Controls

3.1. Mineral Development - Issues and the Environment

3.1.1. The process of mineral exploitation involves six basic stages of development:

(d) Survey and reconnaissance

(e) Detailed exploration

(f) Site Planning and authorisation

(g) Extraction

(h) Processing/Refining

(i) Restoration and aftercare.

3.1.2. Environmental issues may be raised at all stages in the development of mineral resources, and the principal areas of concern are reviewed below.

Survey and Reconnaissance:

3.1.3. This activity is undertaken in most European countries by the relevant national geological survey agency. These bodies are increasingly being operated as semi-independent commercial enterprises, although most began as government offices. Large-scale reconnaissance is also undertaken by international mineral companies, especially for metalliferous ores and hydrocarbons. The techniques used for geophysical survey and reconnaissance rarely have any significant impact on the environment, although when seismic testing and isolated test drilling are proposed in very sensitive areas there may be a need for special protection measures. The primary concern prompted amongst environmental organisations by preliminary surveys relates more to the prospect of potential damage from development operations if mineral working is subsequently permitted.

Detailed Exploration:

3.1.4. Once an area of search has been identified for a specific type of mineral detailed exploration of the reserves is usually undertaken by individual mineral operators. Extensive test drilling is required in order to prove the extent, nature, and preferred method of working for most mineral deposits. Care needs to be taken in such circumstances to avoid surface and groundwater contamination from spillage of drilling mud, oil, and fuels, and accidental damage to vegetation through the transport and operation of drilling rigs.

Site Planning and Authorisation

3.1.5. This stage is invariably the most time-consuming and demanding on the mineral operator, in terms of the number of applications that need to be made for permits and licences to develop a mine or quarry.

3.1.6. Review of the procedures adopted in Cyprus in regard to landuse planning and environmental protection during the permit application stage and thereafter has been

one of the more critical parts of this research study. Issues which need to be considered include:

- potential loss of forest areas, agricultural land, other designated areas and effects on other landuses,
- visual intrusion
- adverse effects on community welfare
- effects on employment
- disruption to traffic and increased traffic loading
- noise and vibration
- potential disturbance/pollution of watercourses/aquifers
- damage to nature conservation interests
- effects on archaeology and other cultural resources
- potential for air pollution.

Extraction

3.1.7. Geological conditions have a critical influence on the type of mineral extraction process with the most basic distinction being between surface quarrying and underground mining. Even where exploitation takes place at the surface, local geological conditions can play a major role in determining the method of working. For example, minerals maybe extracted under water or worked dry, depending upon the height of the water table.

3.1.8. European countries operate their own environmental regulations for controlling day-to-day mineral extraction although, increasingly, these are being set within directives and guidelines established by the European Community.

Processing/Refining

3.1.9. Some minerals require very little processing before they can be used. Natural sand and gravel, for example, may only need washing and separation into different sizes. Other materials like ornamental stone must be cut and polished, while metalliferous ores may undergo a series of processing operations including crushing, gravity or chemical separation, concentration, and ultimately, smelting or electro-winning of the basic ore. Each stage of these processes is likely to have its own particular environmental effects that need to be carefully controlled. This study has not considered the environmental or planning issues associated with refining minerals.

Restoration and Aftercare

3.1.10. The final stage in any mining or quarrying process involves the reinstatement or restoration of the former surface workings, and removal, where appropriate of structures and buildings. Major differences in practice occur between individual member states reflecting geological, landuse and climatic conditions. There are also significant differences between the treatment of metalliferous mineral workings

where changes in world economic conditions can lead to temporary abandonment of workings and other minerals that are worked until the site is exhausted.

3.2. An outline of the Legislative Framework in Cyprus

Exploration and Prospecting permits

3.2.1. The Mines and Quarries Laws and Regulations require that Prospecting Permits be obtained before any detailed mineral exploration can take place. The purpose of Prospecting Permits is to exercise control over the exploration and systematise the quantification and identification of reserves.

3.2.2. Permits Applications are made to the Mines Service and fall into two categories

- Class A Permits - including minerals consisting of or containing copper, iron, manganese, nickel, cobalt, chromium, zinc, lead, sulphur, cadmium, gold, silver, platinum, selenium, tellurium and asbestos.
- Class B Permits - materials consisting of or containing umber and ochre, magnesite, sand, stone, slate, granite, gypsum, limestone, marble, marl or clay.

3.2.3. Applications for prospecting permits are submitted to the Mines Service and the applicant is also required to submit any results of the investigation.

3.2.4. The Director of the Mines Service is responsible for granting Prospecting Permits. Applications are subject to a consultation process that includes the Town Planning Department, the Forest Department, the Environment Service, the Geological Survey Department, the Department of Agriculture and the Local Authorities. Subject to positive consultation responses, Prospecting Permits are issued for one year and are renewable for six-month periods up to a maximum of three years for Class A Permits and one year for Class B Permits.

3.2.5. There appears to be no concerns in regard to Prospecting Permit administration. However the need for a specific procedure for exploration and the current review of applications by a committee would appear to be unnecessarily cumbersome and may be worthy of review. The system could be replaced by the simple requirements:

- to notify Mines Service or GSD of intention to prospect
- to provide results of exploration
- to reinstate land back to original condition – i.e. backfilling of boreholes; removal and reinstatement of hard standings, roadways etc.

3.2.6. Care needs to be taken to avoid surface and groundwater contamination from spillage of drilling mud, oil, and fuels, and accidental damage to vegetation through the transport and operation of drilling rigs but this could be covered by other existing legislation.

3.2.7. Exploration *per se* would not be considered as development and, as indicated above, the primary concern from environmental bodies relates more to the prospect of the development of mineral operations if the exploration works are successful. Pollution prevention and control could be covered by existing legislation.

Principal Legislation - Site Planning and Authorisation

3.2.8. The purpose of the principal legislation is to determine whether extraction should or should not go ahead. Most other relevant legislation is concerned with environmental protection although it may be referred to by the principal legislation.

3.2.9. This stage is invariably the most time-consuming and demanding on the mineral operator, in terms of the number of applications that need to be made for permits and licences to develop a mine or quarry. A review of the procedures adopted in Cyprus towards landuse planning and environmental protection has been an important part of this research study.

3.2.10. In many European countries mineral operations are controlled through separate Mining or Excavations Laws while in the United Kingdom they are largely controlled through the Planning System. In Cyprus the principal legislation is a combination of Mining Laws and Planning Laws together with other general legislation that controls the environmental and social effects of operations.

3.2.11. Throughout Europe the principal legislation governing mineral extraction is largely determined by historic factors and Cyprus is no exception. Prior to the Turkish occupation of 1974, the Government of Cyprus controlled the quarrying and mining activity over the whole of the Island. Legislation controlling the exploitation of minerals was based on Laws dating from the late 1950's when Cyprus was under British control. These included ***The Mines and Quarries (Regulation) Laws 1953 and 1956 and the Mines and Quarries Regulations 1958***.

3.2.12. The Laws and Regulations covered the whole range of mining and quarrying issues. These Laws form the basis of the current Law as administered by the Mines Service. It mainly covered the permitting arrangements and obligations that operators had to comply with, before they were allowed to commence a mineral operation, and the powers of the Government to control the operations thereafter. The Laws include the following provisions:

- General Provisions – mineral ownership, exclusions and royalties;
- Prospecting – permits, rights and duties, mineral ownerships, cancellation of permits;
- Mining – leases, rights, pollution of water, power of inspectors to enter land, powers to close a mine, requirement to produce mine plans on closure;
- Quarrying – quarrying permits and licenses, powers to inspect or close quarries
- Miscellaneous – appointment of mine officers, offences and penalties.

3.2.13. These Regulations cover the procedures that should be adopted during prospecting or operating a mineral working:

- Applications for prospecting permits;
- Prospecting – obligations, plans, blasting, felling of trees construction of roads retention of samples;
- Mining and Quarrying – obligations, plans, boundary markings, water usage, construction of buildings;

- Rents fees and royalties;
- Safety regulations – machinery, explosives, slope stability and subsidence, underground safety, winding and shaft safety, personnel safety, hygiene and first aid, responsibilities, fire prevention, mine plans;
- Accidents – notification;
- Miscellaneous – prohibition of fires in forest areas, offences and penalties.

3.2.14. They included a wide range of provisions that now fall into other areas of legislation particularly pollution control and health and safety at work. Notably, however, there is very little that might now be considered as falling into the ambit of Town and Country Planning.

3.2.15. Following the events of 1974 there was a desperate need for materials and since this was prior to the introduction of the Planning Law, which was enacted in 1990, quarrying activity took place on an *ad hoc* basis generally where suitable material was readily accessible. Permits were issued by the Mines Service primarily on geological and economic criteria, depending on the availability of materials and minerals and on their importance to the development and building industry of the Island. A number of the quarries, formed in the mid 1970's, became established and clusters of large quarries developed in favourable areas.

3.2.16. In 1990 the ***Town and Country Planning Law*** and new planning regime was introduced, including additional controls over the mineral sector. Planning consents were required for mineral development and amongst other things the presence of the clusters of quarries was endorsed with the introduction of ***"Quarrying Zones"*** as part of the Town and Country Planning Law. Since then a mechanism for the control of the environmental effects of mineral operations has evolved which is outlined as follows.

3.2.17. A planning permit must be obtained from the relevant Planning Authority. A formal Planning Application is required for any minerals development proposal and information must be supplied concerning the development which include in general the following:

- Name and address of applicant
- Site location and characteristics including a description of the development and the type of material to be quarried including, available reserves, production output, anticipated life, area of quarrying activity, number of employees and vehicle generation.
- Description of any building or mechanical installations needed for the quarrying activity.
- Description of the restoration methods to be used.
- Proposed mitigation measures for avoiding water, air or noise pollution
- Existing land use and nature of proposed access to the quarry area.

3.2.18. Planning permits are issued usually for a period of two years after which they have to be renewed and are subject to conditions covering the following general areas:

- The excavation should be as shallow as possible so as to minimise any adverse effect on the landscape (although this is not applicable to diabase quarries).
- The cutting of trees, the creation of waste or any other kind of nuisance to the surrounding area should be kept to a minimum.
- The area and especially the access road should be sprayed with water regularly so as to avoid dust formation.
- In certain cases explosives are not allowed. Where they are allowed, these should be controlled and conducted at specific times.
- Excavation shall have a minimum stand-off distance of 4m from the borders of adjacent plots. Operational faces can be vertical but the overall slope of the excavation, taking into account intervening benches, shall not exceed 45 degrees.
- A separate planning application is required for any buildings or fixed plant or machinery.
- The operation of the quarry cannot start before the approval of the Environmental Impact Study and the acquisition of a quarry license.
- A phased restoration plan should be submitted to the Planning Authority for approval.

3.2.19. Quarry zones are preferred areas for mineral extraction. They are initiated by the Geological Survey Department and the Mines Service and are then evaluated by a committee whose recommendation is passed to the Minister of the Interior before being formally adopted into the Development Plans. The zones are revised on a five yearly cycle. New zones are based principally on geological criteria and demand.

3.2.20. Mineral developments outside the quarry zones are controlled through the provision of published Development Plan designations and detailed policies; mining and quarrying activities are not generally allowed in the areas designated for alternative uses in the Local Plans.

3.2.21. ***"The Statement of Policy for the Countryside"*** regulates Planning and Development Control in the rural areas and comprises maps identifying various designated planning zones and other protected areas and also detailed policies that minerals applications are tested against. Issues identified in the policies include, amongst others, the following:

- potential loss of forest areas, agricultural land, other designated areas and effects on other landuses,
- visual intrusion
- adverse effects on community welfare
- effects on employment
- disruption to traffic and increased traffic loading
- noise and vibration

- potential disturbance/pollution of watercourses/aquifers
- damage to nature conservation interests
- effects on archaeology and other cultural resources
- potential for air pollution.

3.2.22. The ***Environmental Planning Law*** enacted in April 2001 requires that Environmental Statements and Environmental Impact Assessment must be submitted with applications for the following developments:

- Open mines
- Underground mines
- Quarries with an area greater than 3 hectares
- The treatment of mineral wastes
- The treatment of mineral wastes that contain metals

3.2.23. Environmental Impact Studies are the primary means of controlling the effects of the mineral industry. The submissions must include a detailed description of the processes and procedures proposed and the intended restoration methods and must be approved by the relevant Local Authority and the Ministry of Agriculture, Natural Resources and the Environment. The Planning Authority may impose very strict planning conditions regarding the quarry operation and restoration. Proposals for quarries of less than 3 hectares are required to submit a preliminary EIA.

3.2.24. This is repeated every 2 years when the planning (and licensing) permits are renewed. The EIA should also include any related or secondary on-site processing. The EIA requirements are discussed in greater detail in the following chapter

Other legislation

3.2.25. The Law for the ***Removal, Minimization and Control of Water and Soil Pollution: 2002*** provides the framework for the controlled release of pollutants to the environment. It unifies previous environmental protection laws and provides water quality standards, classification of water resources, testing methods, defines protected areas and implements a regime for controlling discharges to the environment.

3.2.26. The ***Law for the Protection of Potable Water Resource*** similarly provides of potable water resources.

3.2.27. Law for the ***Removal, Minimization and Control of air Pollution from Industrial Sources: 2002*** integrates previous laws and regulations regarding the protection of the environment from atmospheric pollution. The Law prescribes emission levels and monitoring and reporting mechanisms and also defines procedures for emission permit applications. The law applies to specified industries including the production of plaster (from gypsum), cement and bricks but not quarrying and mining processes. The Department of Labour is responsible for implementing the Law, for setting emission rates and for monitoring conformance criteria.

3.2.28. The Cyprus Ministry of Labour has set a maximum allowed noise level of 90 dB for noise in work environments but neither Cyprus nor EU legislation set maximum levels for environmental noise. There are however generally accepted guidelines on

noise limits, such as those from the from the World Health Organisation (WHO), based on the following:

- Levels above 35 – 45 dB cause sleep disturbance.
- Noise levels above 55 dB during the daytime cause disturbances in oral communication and psychological aggravation. .
- Noise levels above 65 dB during the daytime may produce psychological stress, hypertension etc.

3.2.29. The Island's ***Flora and fauna*** are protected through a number of laws as well as conventions ratified by Cyprus. Relevant regulations include the Forests Law, The Mines and Quarries Regulations, the Bern Convention (Convention on the protection of wildlife) and the Rio Convention (for the protection of Biodiversity).

3.2.30. Operational quarries are required to pay an ***"Environment Levy"*** which provides significant funds for use in environmental protection and restoration activities. Of the total money raised, 75% is allocated to the local communities affected by the quarrying or mining activity, which must be uses for development projects in the area. The remaining 25% of the funds are used for environmental projects and currently most of the money raised is used for the rehabilitation of the Amiandos Asbestos mine.

3.2.31. The ***Health and Safety Framework Law*** forms the basis of regulations for health and safety in the workplace and covers personnel as well as third parties. At present Health and Safety in Quarries and Mines is controlled both through the Mines Law and the Health and Safety Law. In accordance with the new Health and Safety Regulations responsibilities for health and safety in the workplace will be transferred to the Labour Inspection Department. Specific regulations pertaining to ***"Health and Safety in open and underground quarrying industries"*** are prescribed in Directive 89/391/ EC which will affect Cyprus following accession.

3.3. Commentary

3.3.1. To be effective, the legal framework must reflect the needs and constraints of the industry and the nature of minerals development. It should assist in the establishment of a sustainable and vibrant industry which, in order to comply with the requirements of the Law the industry, needs to be stable and secure.

3.3.2. The current legislation sets out an elaborate system for the control of mineral operations. However several aspects the Laws and their implementation have become convoluted and appear to be counterproductive to the promotion of good environmental practice and in enforcing high environmental standards.

3.3.3. In considering whether to recommend changes to the current legal system for controlling mineral working, the following questions need to be put:

- What are the objectives of legislation?
- Is the current Law necessary and appropriate? This depends on the objectives that Law is attempting to meet, their worth and whether these could be met more effectively or efficiently in other ways or by other Laws and whether they are duplicated by other Statutes

- Is there duplication of effort and convolution of legislation?
- Is the Law as it stands user friendly and can the current system be simplified without loss of value?

Prospecting permits

3.3.4. It is recommended that the current system for issuing prospecting permits be reviewed to determine whether it is still relevant and to what extent the actions it is intended to control are covered by other legislation.

Principal Legislation

3.3.5. The purpose of the principal legislation is to determine whether extraction should or should not go ahead. This is very much a land-use issue and hence rightfully within the realm of Planning Law and Planning Controls. Most other relevant legislation is concerned with environmental protection where laws tend to focus on the limitation of possible harmful effects resulting from extraction either externally or within the workplace.

Integration of control functions

3.3.6. The integration of land use planning and other consent procedures is an issue of some concern throughout the EU. With regard to mineral extraction, three main streams of legislation are relevant: mining law, land-use planning law and environmental protection law.

3.3.7. In much of Europe the planning and mining administrative systems are distinct and they require operators to secure two separate permits, i.e. a mining permit and planning permit. One of the exceptions to his general rule is the U.K. where mining permits do not exist except for energy minerals.

3.3.8. The relationship between mining and planning control and other aspects of environmental control raises similar issues. Again there is generally a requirement for more than one permit, although there is a trend towards greater integration and the issuing of a single permit to cover all legislative aspects. No country has achieved this for mineral extraction to date.

The Mining Laws

3.3.9. The requirement for a mining permit is an established part of the control of mineral operations in Cyprus. Initially the Mining Laws were the principal means of controlling mineral operations. However the introduction of a planning regime and environmental and occupational health legislation has duplicated significant areas that were once the province of the Mining Laws.

3.3.10. There is evident duplication in current legislation that controls other industries but which could equally be used to control the minerals industry. These include health and safety at work, surface and groundwater pollution and the protection of fauna and flora. This duplication is already recognised in so far as the Laws relating to health and safety in the workplace will soon become the responsibility of the Labour Inspection Department and Health.

3.3.11. There also is an evident duplication in procedures whereby a planning permit is first obtained and then a similar procedure is repeated to obtain a mining permit.

3.3.12. It is believed that a review of mine legislation is warranted to see what is still relevant, what is redundant and what has been overtaken by other legislation. Also to what extent the mining legislation has taken account of changes in technology and the mining regime itself.

3.3.13. Nevertheless there is still a clear role for mining legislation in the control of site stability, the use of explosives and the collection of levies, that are not covered by other legislation.

Planning Law

3.3.14. The central concerns of the planning system are to determine what kind of development is appropriate, how much is desirable, where it should best be located and what it looks like. All the fundamental requirements for addressing these issues are already in place within the existing planning laws.

The "Two-year" Rule

3.3.15. However the key procedure that is inhibiting many aspects of the control of the industry is the requirement for mineral operators to re-apply for planning permission every two years.

3.3.16. The purpose of the current procedure is clearly to provide a powerful control mechanism over the industry. If an operator fails to comply with the terms and conditions of its permits then he runs the risk of closure. However there are fundamental flaws to this approach.

- If the quarry fails to comply and there are breaches of conditions serious enough to refuse a renewal of permits then substantial damage to the environment will already have been done.
- If the operator is no longer on-site he no longer will have a revenue stream that will allow him to finance any remedial works. If the site closes it will be very difficult to ensure that the site is restored even if a substantial bond has been deposited for such an event. It is far more cost effective for the operator to undertake work while he is on-site and with his own plant and equipment rather than for it to be done subsequently and with third-party operatives.

3.3.17. The requirement to renew permits and licences every two years also has other ramifications. It does not explicitly recognise the continuous and long-term nature of minerals development. In particular the following problems have been recognized:

- Mineral operators do not have the incentive to produce long-term operational and reinstatement plans notwithstanding that these are likely to provide considerable financial and environmental benefits.
- The regulatory authorities do not have the option of imposing long-term planning and restoration conditions or effective (but potentially costly) environmental mitigation schemes.

- The frequency of submission and assessment of reports and applications for permits produces a significant bureaucratic burden both on the quarry operators and the regulators.
- The two-yearly review procedure relies substantially on the results of the Management Reports that are prepared by the quarries or their consultants but is generally not verified by the relevant Authorities.
- The Regulatory Authorities cannot reasonably assess long-term availability of essential mineral resources without long-term plans and resource evaluation from the industry.

3.3.18. Also, and fundamentally, the threat of losing a permit is demonstrably ineffective. Many cases are noted where poor practices have been established for many years and where the threat of closure has provided no incentive to operators towards improving their operational regime.

3.3.19. It is therefore strongly recommended that the Law be changed so that permits are granted for the life of the site. The implications of this on the control of the minerals industry are discussed in the following chapter.

Permit withdrawal or surrender

3.3.20. Present legislation in Cyprus does not allow for the retention of licences, or licence obligations, beyond the life of the mine or quarry; also the operator can surrender his licence at any time and with it the obligations assigned to the permission. Furthermore the withdrawal of a site's permit as a final recourse when an operator has infringed planning or other regulations may be counterproductive as any remedial actions that may need to be taken will become the responsibility of the land owner or may be left to the Government.

3.3.21. Consideration might be given to changes in the Law that require the site to be in a satisfactory state and that restoration or other conditions are met before permits can be surrendered by an operator. Site release would be achieved when a monitoring programme demonstrates that the objectives of a closure programme have been met.

3.3.22. Comparable legislation has recently been introduced into the landfill-licensing regime in the UK. A site licence is retained and the site managed (and an annual fee paid) until it meets certain rehabilitation criteria, which may be long after the site has closed.

3.4. Recommendations.

3.4.1. The current Mining Laws should be reviewed to see if they are still appropriate to the modern mineral-operating regime and to what extent they unnecessarily duplicate other legislation.

3.4.2. Consideration be given to amending the Law so that control of mineral operations is the responsibility of a single department.

3.4.3. The Planning Law and Environmental Assessment laws should be changed so that planning permits are for the full life of the site including restoration. However a mechanism within the law should be included to allow the periodic review the

planning circumstances at each site; in the UK this is currently at intervals of 15 years.

4. Authorisation and Control of Mineral Operations

4.1. Current procedures

4.1.1. To obtain planning consent, an application is submitted to the Planning Authority generally with an accompanying Environmental Impact Statement. The EIS is initially evaluated by the Technical Committee of the Environmental Service, which is made up of representatives of various other departments, which reports its observations to the Planning Authority for further consideration.

4.1.2. The Planning Authority obtains observations from various other interested bodies that include amongst others the Local Authority, Geological Survey Department and Department of Agriculture. All comments and observations are evaluated against the requirements of the relevant Development Plan and, if successful, a planning permission is then issued with various conditions normally for a duration of 2 years.

4.1.3. Following the granting of the planning permission the applicant submits a second application to the Mines Service to obtain a quarry license that is issued, again for two years, and with the same conditions as the planning permission but including additional technical conditions. Following the granting of the quarry license the operator then submits a site management study that is again evaluated and monitored by a committee

4.1.4. The above procedure is repeated generally every two years. The application for planning permission renewal is required to be submitted 3 months in advance of the expiry of the extant planning permission.

4.2. An Outline of the Proposed Changes

4.2.1. Current procedures appear to be unduly cumbersome. Several different departments and two committees consider each planning submission. This is then repeated every two years for each operational site so the number of applications being processed at any one time by the various Departments and Committees is considerable. This produces a significant bureaucratic burden both on the quarry operators and the regulators. In turn this gives rise to delays in processing applications. The requirement to re-submit minerals planning applications every two years often results in operators working without all the required licenses; this situation is clearly undesirable.

4.2.2. In the previous chapter on legislation the proposal to extend the consent period for the life of the quarry, rather than renewal every two years, was introduced. If this is accepted it will relieve the system of a substantial administrative burden. However this will result in two significant implications.

- A far more detailed planning application submission will be required covering the development, operational life and restoration of the mineral working area so that all parties have clear idea of the whole-life implications of the proposals
- It will be necessary to scrutinise applications to a higher technical level than has hitherto been undertaken. There will not be the opportunity later to change

a planning consent except by agreement between the operator and the authorities.

4.2.3. It is also proposed that the current system of assessment is consolidated. A single department, the Minerals Planning Team, would deal with all technical aspects of minerals planning applications. These are currently the held mainly between the Planning Department, the Mines Service and the Geological Survey Department.

4.2.4. The Minerals Planning Team would advise and guide a single committee that would be responsible for the determination and ratification of submissions. This Committee would replace the various committees currently responsible for assessing and determining the various aspects of mineral planning applications and would comprise or at least include elected representatives (politicians).

4.2.5. The team and its committee could be designated as The Mineral Planning Authority (MPA).

4.2.6. To ensure that the interests of all Government and other agencies are included in the decision-making process a rigorous consultation process would need to be put into place. To this end, a list of Statutory Consultees could be established that would include amongst others those Departments that were formerly represented on one or more of the current determining committees.

4.3. The Minerals Planning Team

4.3.1. The Department of Town Planning is the competent authority for issuing planning permits but employs no staff specialised in minerals planning or the minerals industry. Moreover they are not adequately resourced or have specialist planning, mining or environmental personnel to provide a routine system for the inspection of mines and quarries. If an improvement in the control over mineral working is required then increased resources must be made available.

4.3.2. The following discussion and recommendations are based on experience in the UK, where the system of mineral planning control is well established, but it takes into account the current circumstances in Cyprus and also practices adopted elsewhere in Europe. In the UK most of the main minerals planning control takes place at the County level, which is the second tier of Government. Most counties that have a significant minerals industry have a dedicated team, the Minerals Team, responsible for all aspects of minerals planning control. The historic background to this is detailed in the Phase 2 Interim Report and is not repeated here.

4.3.3. Although the size of Cyprus is somewhat larger than a major mineral-producing County in the UK the kind of staffing levels that are adopted for mineral teams in the UK have been used to provide a guide for the level of establishment that might be desirable in Cyprus. However it should be noted that any Cyprus minerals planning team would also have to undertake those functions currently carried out by Central Government in the UK, i.e. the development of minerals policy guidance.

Responsibilities

4.3.4. An enhancement of government services is an essential consequence of changes proposed above. The proposed minerals planning team would have amongst others the following tasks and responsibilities:

- Development control
    - Authorisation - assess the practicability and accuracy of the permit submissions, negotiate with mineral operators and report to the authorisation Committee
    - Day-to-day control - to ensure that the development is implemented as proposed
    - Community liaison
- Forward planning
    - Data collection
    - Preparation of local plan policies.
    - Preparation of minerals local plan
- Advice
    - Provision of guidance to the government, the mining industry and the public.
    - Preparation of Codes of Practice for minerals development
    - Familiarity and promulgation of international law.

Development control

4.3.5. The team would be responsible for assessing the planning submissions of mineral operators and reporting their comments to a planning/authorising committee. It would ensure that the development proposals meet the requirements of the Laws and that the planning application and environmental statement accurately reflected the impacts of the operations. In the case of large mining developments extensive discussions would normally take place before submission to ensure that the best practical proposal was formulated.

4.3.6. The day-to-day control of operations would also be the responsibility of the minerals planning team. Regular inspections of operations would be carried out and any breaches of planning conditions dealt with appropriately. Enforcement of planning conditions should be fair but rigorous. Complaints from the public would be investigated.

4.3.7. Most problems would be solved through a combination of regular monitoring and discussion with operators. A good working relationship would be established between the operator and staff of the minerals planning team. The public would be involved through liaison committees promoted by the minerals planning team. Failure to comply with conditions would be, as a last resort, pursued through the courts.

Forward Planning

4.3.8. The minerals planning team would build up a comprehensive picture of the minerals industry in Cyprus and be able to advise Government and the Public on issues relating to the planning control over operations of the industry. It would also become familiar with the best methods for reinstating land despoiled by quarries and mines and if such

a team is established in Cyprus it might be expected to play a major role in the identification, scheduling and restoration of past derelict mineral workings.

4.3.9. Medium and long-term planning for the mineral industry would also be the responsibility of the minerals planning team. The long-term requirements for raw materials in Cyprus would be accurately assessed by gathering and analysing data on reserves and outputs from operational sites and updating and improving upon the database developed as part of this study.

4.3.10. The results of this project provide the foundations for the forward planning of the minerals industry upon which a more detailed and explicit Strategic Plan would be prepared.

Provision of Advice

4.3.11. The minerals planning team would also be responsible for the preparation and publishing of various guidance documents that would include:

- Guidance notes
- Codes of Practice

4.3.12. Guidance on operational practices and interpretation of legal obligations is widely available in the UK and other EU member states and in some instances has a statutory status. The preparation and adoption of similar guidance documents would be helpful to both industry and officers enforcing the Regulations and would help in clarifying the expectations and objectives of the government.

4.3.13. Codes of practice are commonly prepared by Minerals Planning Authorities in the UK that give detailed advice, for example, on procedures and content of planning applications or environmental statements.

Staffing

4.3.14. As discussed in the Phase 2 interim report, staff engaged on mineral planning control should:

- have a wide range of professional and technical skills
- exercise continuous supervision over mineral workings
- be wholly employed on minerals work over long periods

4.3.15. Adequately skilled staff should be available. Specialists within the teams commonly include, amongst others, geologists, mineral surveyors, town and country planners, environmental scientists and landscape architects.

4.3.16. It is also considered important that the regular monitoring of operations is carried out by senior staff who have the skills, ability and integrity to advise and pass judgements in what can be a robust environment.

4.3.17. The choice of senior personnel may well be determined by what expertise is currently available within the Government Services or can be recruited within Cyprus. Employing external experts, except as a short-term expediency or initial training, is not desirable as the continuity and the accumulation of experience in minerals planning is a very important facet of the "minerals planning team" proposal.

4.3.18. It is however essential to have experienced personnel at a senior level in both planning and minerals fields. The head of the team must have a good working knowledge of the mineral industry and the planning system and desirable, although not essential, be qualified in one of these two disciplines.

4.3.19. Using typical UK County Minerals planning teams as a guide the following would be considered at the minimum team complement as shown in Figure 5.4 over-page.

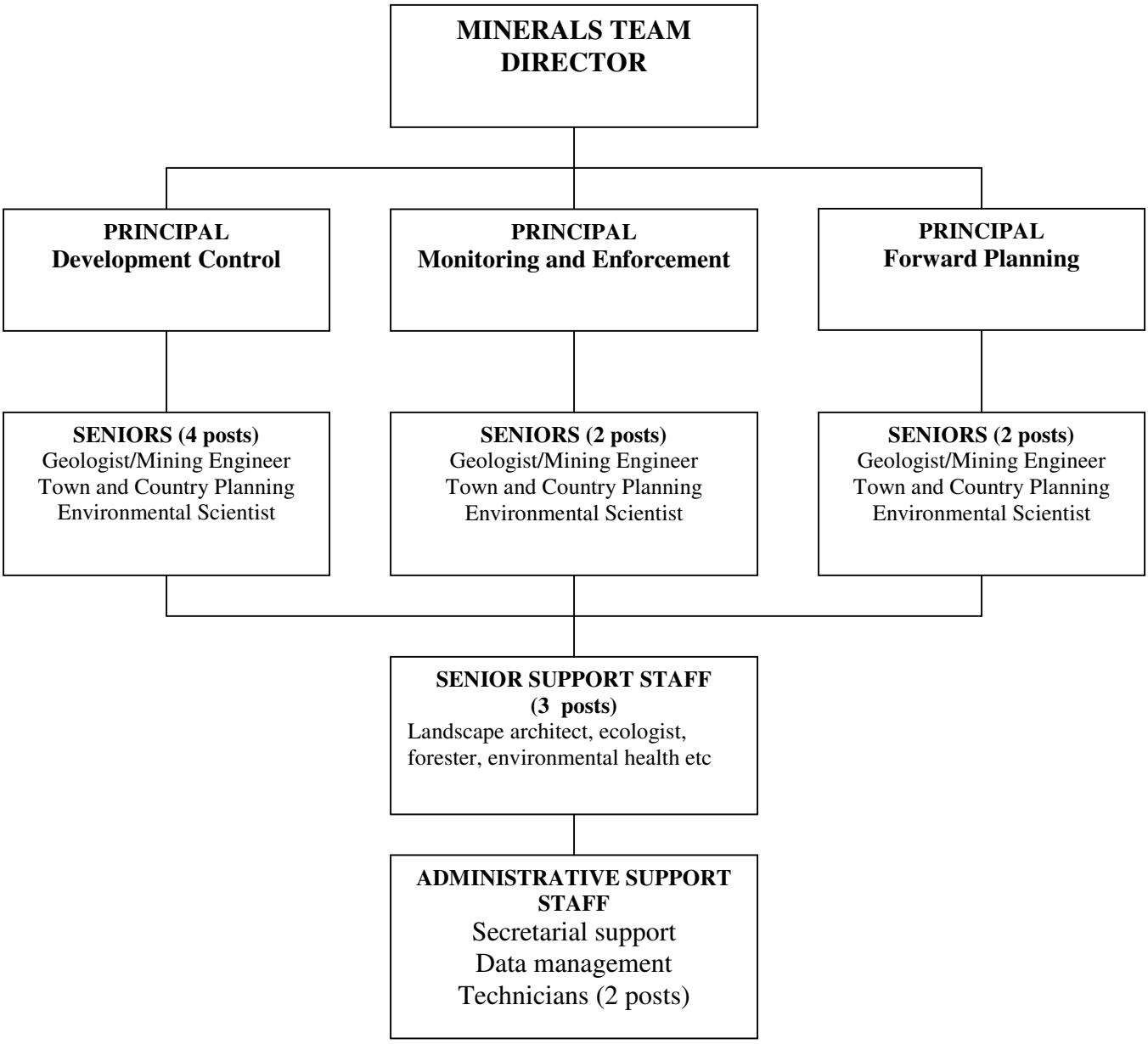

Figure 5.4

Proposed Mineral Team

Location

4.3.20. Two fundamental issues should be taken into account when determining where a minerals planning team might be located within the Government organisation:

- Mineral policies are of national, strategic importance.
- The task of the minerals planning team is fundamentally that of land-use planning.

4.3.21. Whereas in most European countries day-to-day minerals authorisation and control is with second tier authorities, the size of Cyprus would allow for a single authority to administer the mineral permitting system; there would be no advantage to be gained from decentralisation. The team should therefore be located at the highest level of the government.

4.3.22. Since the team's function is primarily landuse planning it would ideally be within a Strategic Planning Department within the Department of Town Planning and Housing.

4.4. Establishment of a Minerals Commission

4.4.1. A Minerals Planning Team within Department of Town Planning and Housing will play the key role in strategic planning, development control and enforcement of mining and quarrying legislation. However this may take some time to be put into effect and there is a need for an interim body with authority to commission the various recommendations within this report.

4.4.2. It is therefore recommended that the Ministry of Agriculture, Natural Resources and Environment apply to the Council of Ministers for a Decision to establish a Minerals Commission. This would be interdepartmental body comprising representatives from the Department of Town Planning and Housing, Environmental Services, Mines & Quarries Service, Geological Survey Department and the Department of Labour Inspection. It would also be expected to consult and seek advice from other Departments include Water Development Department, Department of Agriculture, Department of Forests, Ministry of Commerce, Industry and Tourism and the Law Office of the Republic.

4.4.3. Its key roles would be to implement the following:

- Legislative and regulatory adjustments including
  - Implementing a review of mineral operations
  - The phasing out the use of temporary planning licenses for quarries and replacing them with long term licenses
  - Transposing forthcoming EU legislation into Cyprus law including the IPPC Directive and the Mine Waste Directive.
- Prepare a strategic framework including New Quarry Zones
- Training and consistency of approach and to raise awareness and standards of mineral planning and environmental management including:
  - The proper conduct of environmental impact assessment

- Mine closure planning
- Preparation of codes of practice and/or guidelines.

- Implement a programme of remediation of land affected by past mining
- Establishment of a Minerals Planning Team within the Department of Town Planning and Housing

4.5. Applications, Permissions and Conditions

4.5.1. The following procedures are based on current practices in the UK and it is suggested that they might be adopted as a starting point to replace the current procedures in Cyprus.

Pre-application consultations

4.5.2. The level of detail required in any new planning submissions is discussed in the following Chapter. However it might be considered as very substantial, in comparison with current submissions, almost amounting to a "Workshop Manual" for the life of a proposed operation.

4.5.3. No quarry operator would be expected to "get it right" first time and, as is commonplace in the UK, the mine/quarry design and accompanying EIA could be formulated over a period of several years for a major development with numerous modifications or changes discussed and agreed with the Minerals Planning Authority prior to a formal submission. These consultations could involve the mineral operator describing the proposed development and showing draft drawings possibly illustrating the various ways the site could be developed. During such consultations the MPA may be able to help the applicant by providing the following guidance:

- Details of policies for the type of development proposed.
- Whether the proposal is in accordance with the development plan.
- An indication of the nature and extent of extra information that will be required to enable them to determine the application, including whether or not formal Environmental Assessment is likely to be required.

4.5.4. A clear understanding by all concerned of the proposed development and its impact on the environment will help in the preparation of plans for the operations and subsequent reclamation of the site and could avoid delays at a later stage. However, each party will need to ensure that such consultations do not prejudice the later planning procedures. Consultation should be as free and as open as possible.

4.5.5. The applicant may wish to illustrate the case for the development using information that is commercially confidential and the MPA should treat it accordingly. Similarly, applicants should accept that views expressed by officers in informal discussions are not binding.

4.5.6. When a proposed development is likely to have a large impact, in economic or environmental terms, operators may find it useful to give publicity to their proposals, and to meet representatives of the community to explain them and listen to local concerns.

Environmental Assessment

4.5.7. The EC Directive 85/337 sets down that Environmental Impact Assessment is mandatory (a Schedule 1 Development) for quarries with a surface area of more than 25 hectares and discretionary for smaller operations (Schedule 2 Developments). In the UK guidance regarding Schedule 2 thresholds indicates that an EIA is likely to be required for sites greater that 15 hectares or with an output of more than 30,000 tonnes per annum. For the majority of minerals applications a formal EIA is most likely to be required. Whether or not a particular minerals development proposal will warrant Environmental Assessment can nevertheless be discussed and will depend upon such factors as the sensitivity of the location, size, working methods, proposals for disposing of waste, the nature and extent of processing and ancillary operations, and the arrangements for transporting products away from the site and proposals for restoration and aftercare.

Content of Planning Applications

4.5.8. An application for planning permission should be made on forms specifically designed for mineral operations. The Cyprus Government may find it helpful to use the Standard Minerals Application Form produced by the UK Government. This details the range of information that will probably be necessary for a satisfactory appraisal of most proposals for minerals development. This is discussed in more detail in the next Chapter.

4.5.9. The complexity of detail required by the MPA will depend on the circumstances of the particular case. However it should be possible for an MPA to direct an applicant to supply further information but any request for extra information should comply with the following guidelines:

- Not to request more information than is required to determine the application and ensure that working is carried out in accordance with modern restoration and environmental standards.
- When asking for additional information to give the applicant a clear and comprehensive list of questions and the reasons why the information is required.
- Not, without good reason, to ask applicants to commission expensive data collection or redesign-work, especially at a late stage.

Advertising and Period of representations

4.5.10. The application should be advertised and sufficient time allowed for members of the public and persons with an interest in the land to make representations to the MPA concerning the proposed development.

Consultations

4.5.11. Before reaching a decision on a planning application it is necessary for the MPA to notify or consult other interested parties and to take their views into account. All consultees, whether statutory or voluntary, have a role to play.

Planning Determination

4.5.12. Following the scrutiny of the application, the Environmental Statement and the receipt and analysis of the various consultations, the MPA would prepare a report for the determining committee. This report would contain a summary of the proposals and detail all of the received consultations. A recommendation would be provided that would be based on the technical merits of the proposal and the extent to which it complies, or otherwise, with the policies or designations within the Development Plan. A schedule of recommended conditions (if approval is to be recommended) would accompany the Officer's Report and Recommendation or conversely the reasons why the application should be refused.

4.5.13. In the UK the committee would consist entirely of elected members who would be advised by Government officers; the officers would not formally be party to the decision whether or not to grant planning approval.

Planning permissions: Principles

4.5.14. Before granting consent the MPA should discuss with the applicant the terms under which a permission might be granted. This will ensure that both understand the implications of the terms and consider them practicable.

4.5.15. It is important that there should be no chance of ambiguity or confusion about the area for which permission is granted. Where it is desired to restrict the area of working this can best be achieved by negotiating a formal amendment to the application. Alternatively, a condition can be imposed to restrict the working area so long as it does not make the development permitted substantially different from that comprised in the application.

Planning permissions Conditions

4.5.16. The imposition of conditions on a planning permission can enable many development proposals to proceed where it would otherwise be necessary to refuse permission. With regard to minerals development, conditions serve the additional purpose of securing the environmental acceptability of proposals during and after the period of extraction. The sensible use of conditions can improve the quality of development control and enhance public confidence in the planning system. Conditions should be used in a way which is clearly seen to be fair, reasonable and practicable

4.5.17. In applying the principles of planning conditions to minerals development, the topography and the geological structure of the site, the method of excavation and reclamation and the buildings and equipment to be used are among the important factors to be considered. Conditions should reflect the programme of working and should be designed to accommodate the operator's needs while at the same time minimising the effect on the environment both during and at the end of the development.

4.5.18. Conditions should be soundly conceived on a long-term basis. The MPA will need to assess the likely impact of the mineral working and to establish from the outset what is required so that all parties have a clear picture of how the conditions will apply throughout the life of the development and in relation to the afteruse of the land.

4.5.19. Conditions should deal with points of major importance, including issues that are likely to arise during the lifetime of the permission. However, conditions should avoid imposing a multitude of minor obligations to cover every conceivable contingency. The obligations or limitations on a developer must be confined to those that are related to land use.

4.5.20. The requirements for the reinstatement of land following minerals development should be framed with the possible future use of the restored land in mind, although the conditions cannot legitimately regulate that use if it is one for which planning permission will subsequently be required.

4.5.21. Planning permissions for minerals development must be subject to a condition limiting the duration of the development and enabling the imposition of aftercare conditions.

4.5.22. Particular attention must be paid to the wording of conditions; they must be expressed precisely to avoid ambiguity and any possible misinterpretation. As a condition is binding on the land, and hence successive owners, it is important that the mineral operator and those with an interest in the land should know exactly what their obligations are. Moreover, a condition that is framed in ambiguous terms will be difficult, if not impossible, to enforce. Where a condition refers to particular areas of land, these should be precisely defined, preferably by reference to a plan, in order to avoid later dispute.

Permission subject to further approval

4.5.23. In some circumstances the MPA may be prepared to grant permission before a final decision is made on certain points of detail such as, for example, methods of screening workings. Where this is so and the mineral operator can begin work to take such preliminary steps as ordering plant or equipment without a final decision on these points, conditions may be imposed requiring such details to be submitted subsequently for the approval of the authority.

4.5.24. The MPA should bear in mind that once permission has been granted for the working of minerals over a specified area only in exceptional circumstance would they be able to modify the agreed methods of operation or the conditions attached to the planning consent without the running the risk of have to pay substantial compensation costs.

Matters Covered by other Legislation

4.5.25. Planning is concerned primarily with the development and use of land, and conditions that are not strictly relevant to this purpose should not be imposed. Where it appears that the control of certain matters is not adequately provided for in other legislation, the test is whether the matter is essentially one of land use. If it is not, conditions should not be imposed.

4.5.26. A condition which duplicates the effect of other enforceable controls will be unnecessary, and one whose requirements conflict with those of other controls would generally be considered as *ultra vires* i.e. outside the Law.

4.5.27. However the MPA should not decline to exercise planning powers solely on the ground that other powers are available where those powers do not adequately address wider planning issues that need to be dealt with. Also the imposition of planning

conditions can be a preventive measure designed to ensure that any undesirable effect of development is mitigated or forestalled, whereas alternative legislation will often be corrective, with action possible only after the event.

Enforceability

4.5.28. In imposing conditions particular attention should be paid to the possibility of enforcement. This makes it necessary to consider:

- The ease of detecting the breach of a particular condition;
- Whether, in the event of a breach of the conditions, enforcement action will be practicable, bearing in mind that it may involve the mineral planning authority in taking steps themselves to secure compliance with the conditions and to recover the cost from the owners of the land.
- Generally, if a condition can only be worded in a positive form it is likely to be difficult to enforce unless some specific act is required as part of the initial development, such as the provision of an adequate access or fencing. Even in these circumstances such a condition is best framed in a negative way by a provision that the working of the site is not commenced until after the required act has been carried out.

Production of an Annual Report

4.5.29. In a number of countries in the EU mineral operators have to provide an annual report for each of their extraction sites in a similar fashion to the Management Reports currently produced every two years by the quarries in Cyprus. The scope of these reports includes the quantity extracted that year, the planned extraction for the following year and the programme of restoration works. In practice, companies in most Member States prepare similar reports regardless of whether the authorities require them by statute. Annual reports detailing extraction rates, restoration, compliance with legal standards, etc. help companies to regulate their own activities, although they are rarely made public because they contain commercially sensitive information.

4.6. Monitoring and enforcement

Current situation - Environmental Controls

4.6.1. Monitoring planning and mining authorisations and recourse to enforcement action when necessary are important in ensuring that the overall objectives of planning policy are met.

4.6.2. After a mining license is granted, environmental control of the mining operations is undertaken primarily through two mechanisms:

- The implementation of the recommendations of the Environmental Impact Assessment and the terms specified on the quarry permit and license; the Mines Service monitors these.
- The Environment Service has the authority to inspect the facilities and to withdraw discharge permits if solid or liquid discharges do no conform with

Environmental and Health and Safety Regulations or the conditions of their permits

4.6.3. Additional measures for the protection of the environment include closure of the operation that can be authorised by the Mines Service Committee if significant non-conformance to the licence conditions is found, or significant impacts on the environment arise.

4.6.4. Additionally, staff from the Mines Service undertake regular monitoring of production quality. This procedure is demonstrably effective in ensuring the products meet with the required standards.

Weaknesses

4.6.5. From discussions with members of the Steering Group and from field observations it is apparent that the level of compliance, in particular with planning conditions, is often less than satisfactory.

4.6.6. It would appear that there is a lack of resources and clearly defined responsibilities for monitoring and enforcement of environmental conditions or a system of punitive measures such as fines or recovery of costs if the authorities undertake essential remedial works themselves.

4.6.7. Although there are occasional inspections and investigations by environmental and planning officers this is believed to be generally in response to complaints rather than part of a methodical inspection programme. There are no formal inspections to determine whether planning conditions and policies are being observed.

4.6.8. There are two main issues here.

- Firstly it is the operator's responsibility to comply with the terms of his license. It would seem that there is a culture of non-compliance that needs to be changed by education and enforcement.
- Secondly a systematic monitoring of conditions is required so that all operational mines and quarries are regularly inspected and working conditions at the sites checked against the terms of their planning permits and licenses. It also needs to be demonstrated that non-compliance with conditions will result in enforcement or penalty.

Responsibility for Enforcement

4.6.9. The current procedure of enforced closure of a site if permit conditions are disregarded is superficially a powerful control mechanism over the industry. However as indicated previously it has drawbacks. It would only be implemented in extreme circumstances when substantial and possibly irretrievable damage to the environment has already have been done. Also in these circumstances the operator is removed from the site and therefore cannot as easily undertake any remedial works. It then falls to the Government to reinstate the site often with inadequate resources. It would clearly be far better to prevent damage before it occurs rather than closing operations when circumstances have got out of hand.

4.6.10. The proposed minerals planning team would be responsible for ensuring that mineral operations comply with the terms and conditions of the site's planning consent and

the Rules and Regulations imposed by the Country's Planning Laws. Unless specifically required to do so, it would not be responsible for monitoring other areas such as, for example, health and safety in the workplace that are already the responsibility of the Labour Inspection Department.

4.6.11. The frequency with which mineral extraction sites are inspected will vary depending on the size of the site and to an extent on the performance history of the operator. Around Europe quarries are generally visited for compliance from between four and twelve times a year.

4.6.12. The wilful breach of planning law cannot be condoned. Where the MPA's initial attempt fails to persuade the operator of a site to remedy any harmful effects of unauthorised development, enforcement action may be required to make the operations acceptable on planning grounds, or to compel it to stop.

4.6.13. The MPA has a general discretion to take enforcement action, when they regard it as expedient. They should be guided by the following considerations:-

- The MPA has the primary responsibility for taking whatever enforcement action may be necessary, in the public interest;
- It could be held that that there is "mal-administration" if the MPA fails to take effective enforcement action which was plainly necessary;
- In considering any enforcement action, the decisive issue for the MPA should be whether the breach of control would unacceptably affect public amenity or the existing use of land and buildings meriting protection in the public interest;
- Enforcement action should always be commensurate with the breach of planning control to which it relates (for example, it is usually inappropriate to take formal enforcement action against a trivial or technical breach of control which causes no harm to amenity in the locality of the site)

4.6.14. Throughout Europe sanctions used to enforce planning and environmental standards include the imposition of fines, and may extend to imprisonment. Permits can be suspended or revoked in a number of countries; this may occur if conditions or a restoration programme are not adhered to. In some European countries imprisonment for up to two years can be imposed in cases of deliberate infringement or gross negligence and if the infringement has entailed:

- damage to the environment:
- a person achieving, or intending to achieve, financial gain through cost reductions.

Effectiveness of Monitoring and Enforcement Procedures

4.6.15. Sites should be regularly monitored for observance of conditions and mechanisms need to be in place to enforce compliance. In general the system of control involving regular site visits and a wide range of sanctions works effectively although its effectiveness depends amongst other things on:

- Adequate numbers of personnel and resources.
- A coordination between various authorities with monitoring and enforcement responsibilities to avoid gaps and overlaps.

- The political will to penalise errors where these are noted

4.6.16. The importance monitoring and enforcement to the planning process cannot be overstated and sufficient resources (both financial and human) must be allocated to avoid failure of the system as a whole.

5. Mineral Permits

5.1. Planning Application Requirements

5.1.1. The previous chapters have recommended significant changes to the current Law and procedures for controlling mineral operations and these changes will also need to be reflected in the level of detailed required for mineral permission applications.

5.1.2. One of the fundamental changes that are proposed is to grant permits for the life of the site rather than the current two-year period. Any planning or licence submission will therefore accordingly have to be sufficiently comprehensive to allow the permitting authority to adequately assess the affects of the proposals for what could be an extended period of time.

5.1.3. To provide a structure for the preparation and introduction of a revised minerals planning application it is proposed that all submissions should be accompanied by the following:

- The Working Plan
- The Environmental Assessment
- The Mine Closure Plan

The Working Plan

5.1.4. A Working Plan (WP) that details the way that the site will be engineered, operated and restored should accompany any new minerals proposal. It should be sufficiently detailed to allow the permitting and regulatory authorities to determine the application and thereafter monitor its compliance and also for the public to fully appreciate the long-term implications of the development throughout the life of the site.

5.1.5. The level of detail in the WP needs to be sufficient to demonstrate that the developer can operate the site as proposed. Essential elements that need to be included would be:

- A detailed geological analysis of the site identifying the disposition and quantification of reserves and overburden and any problems or constraints; it would be accompanied by supporting investigation reports. Details of anticipated production would be included along with the proposed life of the site.
- A phased development of the site detailing how the site will be managed over its entire life including phasing of excavations, management of overburden and waste and how progressive restoration procedures will be implemented. Detailed phasing plans should be provided illustrating the anticipated disposition of operations and restoration at regular intervals throughout the life of the site. A description of the development should also be included that demonstrates the rationale behind the design and how a balance between operational practices and environmental considerations has been achieved.
- Infrastructure plans showing details of essential plant and equipment.

- Proposals external to the site that are to be implemented to reduce the impact of the operations on its surroundings.

5.1.6. Other issues that would require specific consideration would include amongst others:

- The present use of the site;
- The need for the mineral;
- Measures taken to maximise the potential for re-use and recycling of materials on site;
- Methods of extraction with depth, direction and phasing of working;
- Surface drainage and hydrogeology;
- Layout and design of buildings and operational areas (including haul roads);
- Soil survey and soil conservation measures;
- Transport arrangements (including access, traffic generation and routeing);
- Hours of operation;
- Employment;
- Measures to minimise pollution and environmental disturbance;

5.1.7. The Working Plan (WP) would need to be agreed with the Regulatory Authorities before development is allowed to commence and would be used as the basis for future control. No changes to the proposals would be allowed without consent. The WP could however be reviewed every 5 years if both the regulators and the operator considered this necessary. Officers might also be allowed some discretion to allow minor changes to the WP without a formal application.

5.1.8. In the case of existing sites a programme of review should take place. Each operation should be required to submit an application for renewal of consent to the same level of detail as would be required for a new application. Details of how quarry operations would be revised to bring them up to an acceptable standard would be provided. The current legislation that requires planning consent to be renewed every two years could provide a vehicle for the introduction of the new system to existing operational sites.

5.1.9. The above procedure would encourage a change in operational practices and culture. It need not place a financial burden on the operator and indeed may be beneficial in the long term. At many sites visited during Phase 1 of the project it was apparent that there was little planned site development leading to evident inefficiencies. This was particularly notable in regard to the management of spoil and overburden with unnecessary double handling of materials or the poor siting of mounds. Since the operator will be required to plan ahead he will also be able to identify the most efficient way of managing the operations, which could lead to significant long-term cost savings.

5.1.10. To assist in the design of mineral working and restoration proposals and preparation of planning applications a number of Minerals Planning authorities in the UK have

prepared Codes of Practice (CoPs) for Mineral Development. The implementation of these helps to secure high standards of planning submission, site operation, restoration and aftercare. Operators of existing sites are also urged to implement the provisions of the CoPs and take the recommendations on board when applying for planning permission to extend or modify their operations. These CoPs are detailed and discussions on their content and implementation are outside the scope of the current project. However a similar Code of Practice for Cyprus could be relatively easily prepared based on those already prepared in the UK.

5.2. Environmental Assessment

5.2.1. The term "Environmental Impact Assessment" (EIA) is used to describe the whole process whereby information about the environmental effects of a project is collected, assessed and taken into account in reaching a decision on whether the project should go ahead or not. An "Environmental Statement" is a document setting out the developer's own assessment of a project's likely environmental effects, which is prepared and submitted by the developer in conjunction with the application for consent.

5.2.2. Environmental impact assessment (EIA) is an important procedure for ensuring that the likely effects of new development on the environment are fully understood and taken into account before the development is allowed to go ahead. The EIA procedure should be rigorously implemented, as part of the planning process and the study should assess the consequences of the development over the whole life of the site.

5.2.3. According to the Cyprus Environmental Planning Law, passed in April 2001, an Environmental Impact Assessment should be undertaken and Environmental Statements be submitted together with applications for certain developments; most mineral development would fall within the criteria.

5.2.4. Since any planning applications will be for the full life of the site the supporting EIA will necessarily consider impacts from the initiation of operations through to the final reinstatement or after use, rather than being repeated every 2 years according to current legislation. A further EIA would only be undertaken if there were substantial changes in the development proposals and would normally accompany a supplementary planning application.

5.2.5. The distinction between large and small quarries (i.e. greater or less than 3 hectares) is likely to diminish when the whole-life size of a site is required to be submitted. Also it is considered that even the smaller sites should be subject to an EIA although the level of detail required might be reduced at the discretion of the permitting authority.

5.2.6. When Cyprus gains succession to the EU it will be subject to the extant EIA requirements as laid out in the European Council Directive and Regulations. Submitted EIAs are likely to be substantially more rigorous than currently prepared and, as previously stated, would need to consider the full duration of the mineral operation and the impacts after closure. The main legislation is the Directive 97/11/EC, (that amended the original Directive 85/337/EEC) which was adopted on 3 March 1997 and came into effect on 14 March 1999.

Content of the environmental statement

5.2.7. The requisite scope of an environmental statement is set out in Schedule 4 to the EU Regulations. The statement must include at least the information listed below and such other information as is reasonably required to assess the environmental effects of the development and which the applicant can reasonably be required to complete.

(a) A description of the development comprising information on the site, design and size of the development.

(b) A description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects.

(c) The data required to identify and assess the main effects which the development is likely to have on the environment.

(d) An outline of the main alternatives studied by the applicant or appellant and an indication of the main reasons for his choice, taking into account the environmental effects.

(e) A non-technical summary.

5.2.8. Developers and authorities should discuss the scope of an environmental statement before its preparation is begun and the range of other issues, which may need to be considered, should be determined. A checklist of issues that might appropriately be covered in an EIA was included as Appendix 2 to the Phase 4 Interim Report (reproduced from Appendix 5 of *"Environmental impact assessment: guide to procedures"* - published by the Office of the Deputy Prime Minister, UK Government).

5.2.9. All environmental statements should cover every conceivable aspect of a project's potential environmental effects at the same level of detail. They should be tailored to the nature of the project and its likely effects. Whilst every environmental statement should provide a full factual description of the project, the emphasis should be on the main or significant effects to which a project is likely to give rise. In some cases, only a few of the aspects set out in the checklist will be significant in this sense and will need to be discussed in the statement in any great depth. Other issues may be of little or no significance for the particular project in question, and will need only very brief treatment, to indicate that their possible relevance has been considered.

5.2.10. The environmental effects of a development during its construction and commissioning phases should be considered separately from the effects arising whilst it is operational. The effects of decommissioning or reinstating the land should also be considered separately.

5.2.11. Guidance could be provided by the Government. There are a substantial number of existing guidance documents published by various organisations that could readily be modified for adoption by the Cyprus Government. It is suggested that this is one of the responsibilities of the Minerals Planning Unit.

5.2.12. It should be noted that, in accordance with the new EU Regulations, developers are now required to include in the environmental statement an outline of the main alternative approaches to the proposed development that they may have considered, and the main reasons for their choice. It is widely regarded as good practice to consider alternatives, as it results in a more robust application for planning

permission. Also, the nature of certain developments and their location may make the consideration of alternatives a material consideration. Where alternatives are considered, the main ones must be outlined in the environmental statement.

5.2.13. The developer is responsible for the content of the statement that is finally submitted. However it should be borne in mind that the mineral planning authority should have powers to call for additional information and would be expected to use those powers if they consider that aspects of a submitted environmental statement are inadequate. It should also be noted that in any submission an adequate number of copies must be made available to the public

5.2.14. The legislation is in place in Cyprus and guidelines on the content and preparation of mineral planning submissions and supporting EIAs have been published (2001). It is apparent however that there are shortcomings in the evaluation procedures for EIAs and also the mechanisms for ensuring that the operational conditions in them are implemented in practice. This would appear to stem to some extent from the number of departments variously involved in the evaluation process and the division of responsibilities both in the determination process and the follow-up control procedures.

5.2.15. It is considered important that an appropriately qualified team of specialists undertakes the EIA and similarly the Government has the resources, preferably within a dedicated mineral team, to fully evaluate the submission's content and thereafter enforce the approved development strategy. In this way standards can continually be improved.

5.3. The Mine Closure Plan

Mine Closure Planning

5.3.1. It is evident from the legacy of mine dereliction on Cyprus, both historically and arising from more recent mine closures, that a more rigorous mine closure regime is desirable. Government funded restoration implemented to avoid environmental damage or health risks, such as at the Amiandos asbestos mine, are an unwanted burden on the public purse.

5.3.2. The principal that the polluter must pay is both ethically and economically sound. A closure programme devised, managed and implemented by the mine operator is responsible good practice and also more cost effective than any retrospective remediation and restoration works. It also accords with the principals of sustainability.

5.3.3. Mine closure planning is becoming an increasingly important and integral part of planning, feasibility studies and environmental assessments for all new mines and quarries. A quarry or mine is one of the few industrial enterprises that are known in advance to have a finite duration. Its lifespan can be forecast with some degree of certainty, although this is often modified during the life of the site as further reserves may be found, new technologies evolve or market demand changes. At some point, a mine or quarry will close due to exhausted reserves or uneconomic operations. In the past, at this stage, many mines have simply been abandoned but heightened environmental awareness means that this is no longer acceptable. Closure should now

be considered at the outset (in the case of new operations) or well before the mining ceases in the cases of operating units.

5.3.4. Early planning for closure will be attractive to the regulatory authorities in Cyprus who are only too aware of the legacy of long-abandoned mines that are giving rise to contemporary problems. Timely identification of closure issues can reduce overall closure costs. It is also essential to identify and prioritise issues so that adequate financial provision is made for the closure programme.

5.3.5. Progressive rehabilitation will result in considerable cost savings if works can be planned and progressively executed. This is particularly important from the operator's viewpoint as designing for closure allows development to proceed in the knowledge that there will (or should) be no significant unforeseen costs associated with site closure. The primary concern of the Regulators is that site closure is successfully implemented without imposing financial liabilities on public funds.

Closure Plan contents

5.3.6. Designing for closure is an essential element in mine design and should also figure highly in any proposed or implemented changes or extensions to mine operations.

5.3.7. An **Initial Closure Plan** should be developed during the preliminary stages of project feasibility and should constitute an integral part of environmental permit procedures giving clear perspective of final rehabilitation targets. It should encompass the following:

- Objectives
- Criteria and performance standards
- Environmental characteristics of the area
- Mine components
- Closure plan implementation
- Monitoring programmes
- Finance
- Release of sureties.

5.3.8. **Interim Closure Plans** will be developed as the project proceeds and would be formulated in discussion and consultation with the regulatory authorities. It would arise from operational changes that might include:

- Mine development and expansion
- Changes in technology
- Extent and success of progressive rehabilitation
- Results of monitoring programmes
- Revised financial projections

5.3.9. A **Premature Closure Plan** should be prepared to take account of a situation where the mine or quarry is forced to close prematurely. Such a closure plan could include for total closure or temporary closure for a period during which a care and

maintenance programme would need to be included. This would include *inter alia* for the maintenance of the mine workings, the process plant, the continued management of water and wastes and the monitoring and control of any ensuing slope instability.

5.3.10. The **Final Closure Plan** would discuss in detail the closure and rehabilitation measures to be taken. It would comprise a working document discussing in detail the following:

- Methodologies and practicalities
- Technologies
- Decommissioning and demolition programmes
- Closure and after-use measures
- Compliance with legislation
- Local community consultations
- Monitoring programmes

Financial Aspects of Closure

5.3.11. Mining companies have the financial obligation for ensuring funds are available for decommissioning, rehabilitation and closure programmes. Mine closure imposes significant but predictable costs upon the operator.

5.3.12. A detailed schedule of operations needs to be prepared so that it can be accurately costed using standard rates and measured quantities. This will result in the optimum mine development and allocation of resources. Such a schedule could include:

- Definition of elements to be rehabilitated (tailings dams, spoil heaps etc.)
- Identification of demolition activities required
- Definition of rehabilitation activities (re-profiling, capping, re-vegetation etc.)
- Quantification of activities
- Establishment of unit costs
- Summation of costs for each activity

5.3.13. It is important to note however the cost of works utilising the mining companies' own resources can be significantly lower than estimates for costs obtained from outside contractors. Bonds or other sureties required by authorities may therefore be significantly higher than actual costs incurred if the work is undertaken by the company as part of a managed closure programme. Closure Planning is cost effective and if operations are adjusted to meet closure objectives as part of the mining programme closure-costs can be met while there is still a revenue stream.

5.3.14. Specific legislation relating to mine closure is, as yet, adopted in only a few countries around the world. It nevertheless would be a desirable complement to any legislative changes in Mining Law that might arise from the current Project.

6. Other Issues

6.1. Forward Planning

6.1.1. The planning system has a positive role to play in making adequate provision for future development and at the same time take account of the need to protect the natural and built environment.

6.1.2. Minerals are an important national resource. However they can only be worked where they occur. Although they are not permanent feature in the landscape the nature of mineral working is such that extraction can have more impact on the environment than almost any other form of development and the effects can be long lasting.

6.1.3. Minerals are a finite resource and in this context the principle of sustainability is becoming an important planning consideration. Mineral development is also becoming increasingly constrained by many factors such as resource quality, access, built development, the environment and other development pressures. The protection of the environment is a growing public concern and the balancing of competing interests is becoming increasingly difficult and controversial.

The National Framework

6.1.4. Cyprus generally adopts a plan-led approach to development stating that development control decisions should accord with the Development Plan unless material considerations indicate otherwise.

6.1.5. Development Plans provide the primary means of reconciling conflicts between the need for development and the need to protect the built and natural environment. They are intended to provide a firm basis for rational and consistent decisions on planning applications and appeals and provide residents and amenity bodies, developers and other business interest with a measure of certainty about what types of development will and will not be permitted.

6.1.6. In regard to minerals the Development Plan should:

- Provide development control criteria that will be applied in considering applications for mineral working, and requirements for restoration and aftercare of such sites.
- Carry forward policies that provide for the supply of minerals and for ensuring the required degree of environmental protection,
- Indicate those areas where provision is made for mineral working and the disposal of mineral wastes and those areas where mineral resources are to be safeguarded for future working;

6.1.7. The Planning Authority has drafted policies against which to test any proposed mineral development. Also policies have been drafted to protect certain important areas from minerals development.

6.1.8. Quarry Zones are areas identified in the Development Plan where there is a presumption in favour of mineral working. This is now an established part of the

Development Plan system and has been adopted as a useful means of confining a potential proliferation of quarries in the countryside. The quarry zones are reviewed every 5 years.

Minerals forward planning

6.1.9. The exploitation of the mineral wealth of Cyprus is very important for the economy of the country but quarrying and mining activities can irrevocably affect the environment and quality of life. The availability of minerals is crucial to support our modern way of life, sustain our built environment and for many other products upon which society depends. The working of minerals also makes an essential contribution towards the local and national economic prosperity.

6.1.10. The provision and adoption of planning policies and criteria that ensures adequate provision of raw materials for development was discussed in detail in Chapter 5 of the Phase 3 Interim Report and is not repeated here.

6.1.11. An important facet of any Development Plan is to discourage or prevent development that is incompatible with mineral working in areas affected by existing or anticipated mineral developments. For example housing development in proximity to a quarry or along access roads to quarries may be inappropriate and should be discouraged to avoid future conflicts.

6.1.12. The long term planning of minerals development and its incorporation into the Development Plan is an essential element of the planning framework for the Island. Part of this process is to identify land:

- where essential mineral resources are likely to occur,
- that meets meet with identified policies and
- which can be protected so as to ensure the long-term and sustained provision of essential raw materials

6.1.13. There is currently no forward planning of mineral in Cyprus with the explicit objective of sustaining the industry and ensuring the provision of raw material from mineral resources. The current system of quarry zoning and policies is primarily to control the industry and to either sanction the presence of existing quarries or to control the proliferation of quarries into areas that would be unsuitable or unacceptable.

Mineral banks

6.1.14. A mineral bank is a stock of valid permits that can assure a continued supply of essential raw materials for an identified period of time and the available landbanks for economically important minerals in Cyprus have been discussed in Chapter 1 of this report.

6.1.15. The maintenance of landbanks for minerals is an important aspect of minerals planning. New sites should be identified and commissioned such that as reserves are worked they are replenished within a rolling programme of new permits. For aggregates and raw material for the cement or brick industries the size of the landbank would be linked to the scale of capital investment at the mine, quarry or associated plant so that security of supply can support the high costs of investments

and the long amortisation period; at least 7 years reserves might be considered appropriate.

New Quarry Zones

6.1.16. An essential element of the project's Terms of Reference is the development of a strategy for sustainable mining and quarrying to ensure the long-term supply of essential minerals. As indicated above the current Quarry Zones appear to be viewed more as a means of regulating the industry rather than providing security of resources. It is suggested that the current Quarry Zone procedures and designations are modified to meet the objective of sustainability as well as control.

6.1.17. New Quarry Zones need to be identified where commercial mineral deposits are likely, but remain to be proved, and where there are no insurmountable environmental constraints that would preclude mineral development; i.e. areas where planning permission for mineral development might reasonably be anticipated. Detailed assessment of reserves and assessment environmental issues would be addressed during the preparation of any detailed proposals.

6.1.18. Sufficient areas need to be identified to meet the agreed objectives of a sustainable mineral planning policy.

6.1.19. No area proposed for minerals development will be without constraints and in many areas where the mineral resource may well be geologically suitable for exploitation there could also be major physical, environmental or amenity limitations. A procedure needs to be established that can identify areas that are least constrained and where the development will have the least impact on issues of acknowledged importance.

6.1.20. Any methodology needs to be logical, verifiable and transparent. In this way all interested parties will be able to see and understand the process and even if strong objections are raised to a New Quarry Zones, the decision makers will be able to choose an option that is based on sound planning and environmental principles

6.1.21. The traditional approach to identifying acceptable sites for mineral working is through a procedure known as "sieve analysis" which is ideally suited to GIS manipulation. This methodology was detailed in the Phase 4 Interim Report and is described in outline as follows.

6.1.22. The **first step** is to identify the mineral resource area that, for example, in the case of diabase aggregates, would be the Diabase and Basal Group outcrop as delineated on the published geological maps.

6.1.23. **Step 2** would be the identification of Absolute and Partial Constraints. *Absolute constraints* relate to land that is designated or has properties that effectively prohibit mineral extraction; an obvious absolute constraint would be the development boundaries of towns or villages within the resource area. *Partial constraints* are locations where mineral working would be undesirable but not prohibited. The weight given to various constraints would be agreed between the various relevant departments or organisations involved.

6.1.24. **Step 3** would identify preliminary New Quarry Zones by eliminating *Absolute Constraints* from the search area where mining or quarrying could not reasonably be justified except under exceptional circumstances. If the total area identified is unnecessarily large then additional potential constraints, of lower levels of

importance, can be used to reduce the search areas. If the land identified is too small then the sieve process and criteria used will need to be reviewed.

6.1.25. **Step 4** would be to analyse the preliminary New Quarry Zones individually to determine if there are any constraints not previously identified that need to be taken into account. This would include consultation and thorough field survey that could include an environmental capacity assessment of each area.

6.1.26. **Step5** would grade the preliminary New Quarry Zones identifying those that would generate the least environmental impact and these would be put forward as the preferred options for mineral development.

6.1.27. A formal public participation exercise would normally follow the identification of "New Quarry Zones" where issues can then be raised by the public or private sector (the quarry operators) that may not have been considered. The New Quarry Zones would then be incorporated into the Development Plan.

6.1.28. It would then be for the operators to submit planning applications for quarry development within the New Quarry Zones and each submission would be judged on its merits and against minerals planning policies.

6.2. Environmental Management Systems

Introduction – Mining, EMS and Best Practice

6.2.1. Environmental management is a systematic approach to environmental care in all aspects of business. For the mineral industry it can offer a structured and systematic method for incorporating environmental care into all aspects of the business and ensure that environmental management considerations are integrated into decision-making processes and are continuously reviewed and updated over the life of a project.

6.2.2. As the scale of mining activity has increased, as well as the infrastructure to support it, so has the level of impact upon the environment. Since the 1960s, more enlightened attitudes about the values of the environment to social and economic health have brought many older types of mining practice into direct conflict with the standards now required by regulators and the general public.

6.2.3. Regulatory requirements have evolved to reflect these concerns and demanded changes in mining practices. Present-day attitudes to environmental protection are represented in the development of the concept of sustainable development, of cleaner production, of life-cycle assessment to assess potential impacts, of the precautionary principle and of environmental impact assessment to advise decision-makers and the broader community on the potential negative as well as positive outcomes of a proposed development. All of these are relevant to the mining industry, and extend from the pre-mine planning phase, through construction, mining, and mine closure to post-mine stewardship.

6.2.4. The benefits of best practice include preventing harmful environmental and social impacts, improved access to land for mineral exploration, greater certainty of outcomes in the project application stage, lower risk of non-compliance, greater acceptance/less resistance from key stakeholders (in particular local communities and

land owners), lower financial burdens in the mine closure and rehabilitation phases, and lower risk of significant liabilities post-closure.

6.2.5. Best practice methodologies are generally considered make up about 5 per cent of the capital and operating costs for new mining projects. However, these costs can commonly be offset against the many benefits that best practice brings. For example the cost of cleaning up a major spill for example can exceed the annual budget for good environmental practice at a site by a very large factor. Moreover, best practice energy and water management can routinely yield significant financial savings.

ISO 14000

6.2.6. There are no specific International or European environmental management systems for the quarrying and mining industry. The 'systems' approach is enshrined in the ISO14000 series, which some mining companies are adopting, but certification in Europe is not yet widespread. No country has legislated for EMS in the mining or any other sectors; it is left entirely to the ISO certification process driven by market forces, supply chain pressure and Corporate Social Responsibility (CSR).

6.2.7. ISO 14000 comprises a series of more than 20 standards developed by the International Organization for Standardization of which ISO 14001 is an international standard adopted by many countries as the template for environmental management systems and sets the specifications for an EMS.

6.2.8. This International Standard specifies requirements for an environmental management system, to enable an organization to formulate a policy and objectives taking into account legislative requirements and information about significant environmental impacts. It applies to those environmental aspects that the organization can control and over which it can be expected to have an influence. It does not itself state specific environmental performance criteria.

6.2.9. ISO 14001 is applicable to any organization that wishes to:

- Implement, maintain and improve an environmental management system;
- Assure itself of its conformance with its stated environmental policy;
- Demonstrate such conformance to others;
- Seek certification/registration of its environmental management system by an external organization;
- Make a self-determination and self-declaration of conformance with this International Standard.

6.2.10. The continued development of the mining and quarrying industries in accordance with the principles of ecologically sustainable development is important for the maintenance of the environment and economy of Cyprus. The Government plays a critical role in providing legislative and regulatory frameworks that encourages or demand best practice. Best practice, as a minimum, must be grounded on a set of clearly defined, rigorous and monitorable environmental principles and standards with which industry must comply, and it is the role of government to set those standards and monitor performance against them.

6.2.11. Self-regulation and beyond-compliance initiatives by industry will in themselves not guarantee best practice environmental protection if the regulatory base is weak.

6.2.12. In Europe mining companies conduct their environmental management planning either in response to regulatory requirements or to address their main environmental issues. Operations that have implemented either a formal (with ISO 14001 certification) or informal (without formal certification or self-declared) EMS have found real and valuable benefits. Positive outcomes in terms of improved environmental performance, assured legal compliance and energy and material efficiencies can be expected by EMS implementation. A sound EMS also helps a mining company to identify its responsibilities beyond simple compliance.

Environmental Policy

6.2.13. A company's environmental policy should be a concise public statement of its intentions. It is a valuable reference for the company, its employees and the community. It can bring into focus an organisation's culture and procedures which before had been unrelated and uncoordinated which can introduce greater efficiency and effectiveness.

6.2.14. The environmental policy should set out for the community, and for the company's own employees, the standards which the organisation intends to maintain and would identify *inter alia* the following objectives:

- Compliance with all regulations or the minimisation of impacts beyond regulatory requirements
- Long and short-term environmental targets and objectives and how these will be monitored
- Ways the company consults with the community and involves them in the decision making process
- Whether the monitoring program will comply with or exceed all legislative requirements and whether monitoring results are made public
- The resources and level of practical commitment to be committed to its environmental performance
- Commitments on site rehabilitation.

6.2.15. The organisation should distribute the policy widely and it should be endorsed by the board and by senior management.

Benefits of EMS Implementation

6.2.16. EMS implementation allows a mining company to anticipate the changing expectations of the public as well as constant changes in environmental laws and regulations. An effective EMS adopts new ways of providing continuous improvement in a mining company's efforts to manage environmental compliance and performance.

6.2.17. Any mining company faced with the decision of whether or not to implement an informal EMS or a formal ISO 14001-based EMS will need to estimate the potential benefits and costs. The benefits and costs relate directly to the size of a mining

company and/or facility and the environmental impacts of its activities. An equally important factor is the extent to which a mining company and/or facility already has the elements of an informal EMS or ISO 14001 EMS in place.

6.2.18. An effective EMS can show that a mining company operates a management system that meets measurable standards of quality and demonstrates environmental regulatory compliance. ISO 14001 registration is seen by some mining companies as a direct way of demonstrating environmental performance to stakeholders, such as regulatory authorities, insurance companies and community groups.

Goals and Targets

6.2.19. The EIA, audit recommendations and regulatory requirements will set the baseline for overall environmental goals and targets for the mine or quarry. Goals which a company works towards over the longer term and targets are normally specific actions with clearly defined achievement dates. These would include amongst others meeting obligations specified in the EIA and complying with regulatory limits.

Public Participation

6.2.20. Community consultation is vital before, during and after a quarry or mines operational life and an essential element of any EMS.

6.2.21. Any community faced with a new mining project will have concerns whether they are real or perceived.

6.2.22. The developers have to reassure the community that they can manage the project in the community's interests and be able to demonstrate good performance. This will result in a decrease in public criticism, easier passage of planning and environmental applications and less prescriptive regulatory controls.

6.2.23. As a minimum a company should put its case and seek community views before a project is established, during the operational phase, during expansion projects or changes in operations, and during any conflict. Contact with the community however should also be maintained throughout the project's operational life and not just during periods of establishment, expansion or controversy.

6.2.24. A register of public concerns, complaints and inquiries should be kept that will be made available to senior management who must be aware of any public concerns and the company's response.

Environment Management Plan

6.2.25. The environmental management plan spells out how the company intends achieving its targets and objectives, it must also identify the environmental performance indicators used to measure progress towards achieving these targets and objectives. It need not be detailed, but it should have sufficient information for people to understand their duties and responsibilities.

6.2.26. Targets, objectives and regulations should be summarised and people responsible nominated. Regular updates should record the status of the program, showing progress on achieving the target or objective, or compliance with the regulations.

Documentation and Environmental Manual

6.2.27. Environmental procedures, responsibilities, policies and strategies should be documented. Records of programs and initiatives that are part of the EMS should be kept. This will demonstrate to regulators, concerned citizens and shareholders of the company's commitment to environmental management. An environmental manual can provide a convenient way to record the various components of the EMS. It can be used as a reference for site personnel and be provided to regulatory authorities or community groups as evidence of the company's efforts to manage the environment.

Integration of the EMS

6.2.28. The EMS should not become just another layer of requirements and controls but should become part of a company's ethos. Commitment and training will be important elements of the success of an EMS.

6.2.29. Any conflicts between EMS and production requirements should be resolved but environmental procedures should, as far as possible, work within existing procedures rather than becoming a new layer of controls. Any formal environmental procedures and reporting systems should be designed in a way that causes minimal disruption to operations.

Review Audits

6.2.30. Environmental audits identify existing and potential problems and determine what action is needed to comply with regulatory requirements and company targets. These audits are a crucial element in the development of a competent and effective EMS.

6.2.31. Most mines require EIAs, or an equivalent, during the planning stage and ideally, mines are developed, operated and eventually rehabilitated in accordance with the EIA. However conditions will vary from those anticipated and departures in the anticipated mine development will take place. Strategic plans and company practices will need to be reviewed and modified as required. An EMS must cater for these changes and incorporate procedures to review each stage of the mine's development, from inception to closure.

EMS and the Cyprus Minerals Industry

6.2.32. At the time of the survey no mining companies in Cyprus had implemented a comprehensive or properly documented an Environmental Management System and only a few had implemented operational procedures on environmental issues. For example monitoring for emissions at mines and quarries is at present almost absent; there is therefore a priority for generic guidelines and models for monitoring, to assist with preparing site and company specific monitoring plans.

6.2.33. Implementation of improved environmental management will require some form of system. ISO14001 sets out the basis of an Environmental Management System (EMS) and, even though full certification to this standard may be too large a step for many companies, it provides a good framework that is applicable to the mining sector. A company EMS should follow this general framework as a model.

6.2.34. An essential part of any EMS is procedures for:

- organisation and responsibilities for environmental functions;
- monitoring and reporting of environmental performance and compliance with action plans, standards and norms;
- operational environmental procedures, such as dust control, waste dump construction, water management, emergency response.

6.2.35. Many of these procedures can follow generic procedures and guidelines for the mining sector, though the specific procedures must be adapted and expanded to suit the site and company, and the specific risks identified. Preparing such generic procedures and guidelines is a priority for the mining sector on Cyprus.

6.3. Abandoned Mines in Cyprus

Background

6.3.1. Mining is an important part of the country's heritage but has also given rise to unacceptable environmental impacts that blight areas of the Cyprus countryside. The copper/pyrite mines constitute the major impact and are medium to large open pits often with extensive waste dumps and occasional associated underground operations. There are few tailings dams as the ore was usually trucked to centralised concentrators and process facilities.

6.3.2. The open pits are benched but instability of the pit walls is a common occurrence. In many cases the bottoms of the pits are flooded and it might be expected that there is significant natural background groundwater contamination associated with former mine sites. Due to the instability and the hostile soil conditions, natural recolonisation of the orebody area and waste tips tends to be limited. The tips contain significant pyrite giving rise to very low pH in the soils and, having been formed by end-tipping, are characterised by long, high slopes at c. 35-40 degrees giving rise to surface scouring. However the tip material appears well graded and relatively free draining and, as a result, large-scale instability does not appear to be a problem.

6.3.3. Surface gullying is a common occurrence and the most significant environmental hazards associated with the mines are rainfall run-off and the erosion of the waste into surrounding watercourses. This, and the production of contaminated water due to rainfall leaching through the tips, is likely to result in the pollution of surface watercourses with metals and other contaminants. The high permeability of the tips and low pH may also exacerbate the levels of natural pollution in shallow wells in adjacent land.

6.3.4. The scale of the pits and the tips also gives rise to considerable visual impact which can be seen as both a negative impact (despoliation of a predominantly rural landscape) or as a benefit (interesting features forming part of the island's mining heritage). The balance between positive and negative can only be looked at on a mine by mine basis. However, it could be said that the waste tips are of less interest than the open pits.

Reclamation Strategy for the Abandoned Pyrite Mines

6.3.5. A reclamation strategy for an abandoned mine should have the objectives of ensuring the long term physical and chemical stability of the site and, wherever possible, of

enabling the land to be returned to a beneficial after-use. The reclamation scheme should mitigate any actual or potential hazards but do so, where possible, without detracting from any assets of the site. These assets could include unusual ecological habitats, geological features or items of historical or archaeological interest.

6.3.6. The practical and financial constraints of any restoration scheme to a beneficial hard after-use are substantial and any proposals should be examined closely prior to approval. The use of the open pits for water storage could be considered on a site-by-site basis to ensure that the stored water will be of suitable quality and that the stability of the pits is not compromised. Similarly the use of the voids for the disposal of wastes was also briefly considered but the costs of engineering the sites to EC standards would be unjustifiable. Also the re-use of the sites to agricultural land of any reasonable quality is likely to be limited. Restoration options are therefore like to be mainly to forest, amenity or rough grazing.

6.3.7. The amenity use of the sites was considered in more detail in association with the reinstatement of preserved mining artefacts to serve as a record of the mining heritage of Cyprus and to provide some tourism potential. Relatively few mines however have retained any of their infrastructure and any remaining ancient underground workings appear to have been largely absorbed into later workings. Some sites may have intrinsic geological interest but archaeological value on many sites appears to have been lost.

6.3.8. The exception to this is the underground mine at Kokkinoyia near Mitsero. This has a good selection of buildings complete with headgear, winding engine, and compressors. Although this is a relatively modern mine the intact nature of the site makes it of value. If restoration as a tourist attraction is feasible the presence of an adit and a shaft may enable an 'underground experience' to be included on the site. This would provide much greater interest than a museum limited to the surface, although the practicalities and costs of such a venture would have to be examined in detail. The proximity of the Kokkinopezoula open pit, which is one of the more visually striking and accessible pits, also adds to the potential interest of the area.

6.3.9. The problems associated with mine site reclamation were considered in detail in the Phase 2 Interim Report and various reclamation options were discussed. A detailed proposal for the investigation of restoration procedures, based on a trial sites associated with the Mitsero mines was provided in the Stage 3 Interim Report to which reference should be made.

Small and medium sized abandoned quarries

6.3.10. A number of small abandoned sites were visited. At only one was there any evidence of systematic attempts at restoration but at many others regeneration was returning the sites to a natural condition. Some sites were being used for more formal commercial or industrial waste disposal but most sites had become a focus for illegal refuse tipping (fly-tipping). At many sites buildings, plant and equipment, that presumably were of no value, had been abandoned.

6.3.11. At most of the small abandoned quarries the impact of the former operations was small and naturally diminishing as natural regeneration was overtaking working areas, industrial relicts were decaying and former building were collapsing or occasionally being re-used.

6.3.12. It would be desirable to require that operators tidy up sites that have been abandoned but it is anticipated that it would be difficult to implement this successfully or fairly across the country.

6.3.13. The issue of fly-tipping is clearly not restricted to abandoned mineral workings but is a widespread problem in Cyprus. Many of the abandoned quarries visited were easy to access and were not fenced off; for safety reasons increased security at old sites would be desirable which would in turn reduce or discourage fly-tipping. However while targeting to fly-tipping at abandoned quarries may be practical it is unlikely to have a major impact on what is a more widespread problem.

6.3.14. The importance of planned closure of operational sites such that they do no place a burden on future occupancy or have wider adverse environmental impacts is in previous chapters. It is clearly desirable to avoid increasing the legacy of abandoned and derelict mineral working that may eventually have to be restored from public funds.

6.4. Current and New Technology in the Extractive Industry

Introduction

6.4.1. Drills and explosives, used to break the rock, and shovels and trucks to move the mineral, are the main methods of extraction. In underground mines drill-and-blast continues to be the main method of rock breakage and mine exploration continues to rely largely on core drilling. These techniques have not fundamentally changed for almost a century.

6.4.2. Mining operations today are highly mechanised, but they are almost completely un-automated. However the rate of change in mining technology may well be increasing and whereas in the next 25 years the essential mining operations of rock breakage, rock transport, and ore processing will still exist, the use of drills, shovels, load-haul-and-dump vehicles (LHDs) and trucks might well be replaced by continuous, intelligent, automated mining systems.

6.4.3. A range of technologies is now coming together which might well introduce new systems for example:

- Mechanised equipment will be available that is capable of selectively mining ore bodies
- Geophysical techniques implemented as part of drilling and rock-cutting operations will continuously update computer models showing ore boundaries and ore grades.
- Most of the mining equipment will be made more productive and more reliable through automation.

Future Developments - Drilling and blasting

6.4.4. Drilling and blasting is, and is expected to continue to be, the principal method for breaking strong rock. However blasting is imprecise; it is difficult to control the sizes of rock fragments; it produces collateral damage to the walls of the excavation; it causes difficulties in mining accurately to a given boundary; it imposes several

environmental concerns (fumes, dust, noise, and vibration), and it is hazardous. Many of these problems would be alleviated if models were developed that enabled each blast to be simulated on a computer before it was performed in the mine. However, despite their importance blasting models find limited use in current mining operations for two reasons

- They need to be calibrated for specific sites and at best they provide only a rough guide to blast design and to the blasting outcomes.
- Such models need accurate information on the behaviour of the explosive charges, the sequential timing of these charges, and the properties of the rock mass. Detailed information is available on the first two of these parameters but the information on the rock properties is generally poor.

6.4.5. At many mines the rock mass properties change significantly not just between adjacent benches (or adjacent stopes) but also between adjacent holes. This requires the measurement of rock properties in each blasthole. Already today manufacturers are marketing drills that monitor data such as drilling rate, torque, and thrust and software is being developed to interpret rock property information from these data. This is a significant step forward from the common position today where almost no information is gathered from blastholes (other than assaying drill cuttings). For a relatively small increase in cost the data gathered during the drilling operation could be used to:

- Modify the drilling pattern (i.e. hole spacing and hole burden).
- Modify the hole depth/length (for the purpose of keeping the blastholes in the orebody).
- Design the explosive charge for each hole (not just the quantity of explosive to be emplaced in each hole but decking charges around shear zones, etc).

6.4.6. It is anticipated that future blasthole drills will be fitted with a range of mechanical and geophysical sensors which will provide real-time information on the rock mass. They will also monitor the position of any ore-body boundaries and, for some ore types they will allow assessment of the ore grade along the hole. In some deposits they will be capable of monitoring impurities found within the ore body.

6.4.7. This information will be used as immediate input to a numerical blasting model. This model will enable the mining engineer to change the design of the blasting round during the drilling operation. It will allow the engineer to design the explosive loading of each hole individually and to design the sequence and the timing of the round to optimise the breakage process.

Rock cutting and continuous mining

6.4.8. Although drilling and blasting is likely to continue to be the main means of breaking hard rock current advances in rock cutting as an alternative are being developed. This might also have a major impact on improving handling efficiencies through continuous mining rather than current batch processing. Mining or working a quarry face today is a batch process because the initial rock-breaking step (drill-and-blast) is, almost by definition, a discontinuous operation. The ore/rock loading and transport operations, often LHD (underground) and shovel and dump truck (surface mines), are in turn batch processes.

6.4.9. Non-explosive breakage could transform the mining operation into a continuous process. Continuous excavation machines will require continuous transport systems which may well employ conveyors or ore pumping equipment to transport the broken rock from the mining machine to the processing plant. This continuous, factory approach to mine production exists today in longwall coal mines. In these underground mines the excavation machine (shearer) cuts the coal from the face and deposits it directly onto a steel face conveyor. This conveyor transports the broken coal onto a series of belt conveyors out of the mine.

6.4.10. The main difficulty arises from the premature failure of existing cutting tools when used to machine strong rock. New approaches to rock cutting and rock cutting equipment are being developed and a range of new mining systems may be developed that may well find application in both underground and surface mining operations.

Automation

6.4.11. During the last half of the 20th century manufacturing industries have improved productivity by embracing automation technologies; this has not yet found much application in the mining industry. This is expected to change as technology improves but significant problems need to be overcome. A mine, in contrast to a factory, is a constantly changing and a hostile environment. Fast sensing systems that constantly update the position of a mine robot in relation to its task are necessary.

6.4.12. Mining automation requires the development and deployment of robust sensors and the development of software, to operate the machine that combines the data from many sensors to generate a coherent model of the local environment and the position of the machine in that environment. It is only in recent years that the technologies of sensors, data fusion, and computing power have been developed to the point where mining automation can now be performed reliably and economically.

6.4.13. It is already common practice in underground mines to operate load-haul-dump machines (LHDs) by line-of-sight remote control into unsupported areas (e.g. stopes). The next step is for LHDs and trucks to drive themselves. Operators would still be required to monitor and intervene but would be able to "operate" several vehicles simultaneously. Several research groups around the world are working to achieve this goal.

6.4.14. Many mining operations are inherently hazardous and the automation of many such operations would result in the exposure of fewer workers to this environment. This is one important potential means for improving the rather dismal safety record of the mining industry. Automation could have two other important consequences. One is improved productivity. The other is improved equipment reliability because automation systems would prevent overloading of machine components.

Disposal of mine tailings

6.4.15. Safe disposal of mine waste, including tailings, is generally recognised as the single largest environmental challenge facing the mining industry worldwide.

6.4.16. Mine tailings commonly contain heavy metals that give can rise to toxic pollution but also contain sulphides that, when exposed to air, oxidize and give rise to acid mine drainage or AMD. This in turn accelerates metal leaching in tailings. In Cyprus AMD

is mainly a legacy of the past that still requires attention but continues to have a toxic impact on ground and surface water around abandoned mines.

6.4.17. Modern open-pit mining has a very high waste-to-product ratio and the storage of the waste arisings poses significant engineering challenges. Tailings dams are giving rise to concern worldwide and recent serious accidents in Romania, Guyana, Spain, and the Philippines caused by tailings-dams failures and other major mine waste management problems such as those faced in Papua New Guinea have focussed public attention on this problem.

6.4.18. As a result there has been substantial research and documentation into the management of mine tailings facilities. Because mine operators and agencies now have a better understanding of the physical function of tailings and have improved techniques to reclaim them, tailings have become less problematic. However, tailings impoundments will require long-term monitoring to verify that they are not a source of contaminants. Among recent trends in dealing with tailings are:

- Regulatory controls are becoming more stringent, and mine operators are expected to rigidly adhere to them.
- Dry tailings deposition systems, such as dewatered paste, or air-dried tailings, are reducing management problems.
- There is much wider recognition that intense geochemical testing early in mine planning is necessary to characterise tailings chemistry and to plan environmentally sound deposition.
- To achieve long-term physical stability of the impoundment, proper designs for closure more commonly considers long-term storm-water retention and seismic stability.
- An increased use of non-acid-generating waste materials for construction of mine facilities is reducing both disturbed areas and costs.
- Mine companies attempt to reduce cyanide levels to the lowest concentration consistent with technical feasibility and reliability to protect human health and wildlife.
- Contaminant monitoring programs and response plans are more widely required.
- Geosynthetic and clay liners have become widely accepted and are commonly used.
- Topsoil salvage and revegetation of tailings has become the norm.

Material processing

6.4.19. Ore crushers are considered as a significant weak link in operations; crusher reliability is especially critical because an interruption in downstream operations can be very costly.

6.4.20. Many aggregates producers are deploying mobile crushers and screeners to increase production to meet steadily growing demand in the construction industry. Mobile plant also provides increased flexibly although this is offset by relatively short working lives and more regular maintenance overhauls. Vertical impactors are

gradually replacing cone crushers in the aggregates industry to boost throughput and to allow operators to meet increasingly tight buyer specifications that call for aggregates of a consistent "clean" grade and more precise shape. However, vertical impactors also tend to have shorter wear lives (five to 10 years) and require more-frequent overhauls.

Hydraulic fragmentation and drilling of rocks

6.4.21. A considerable amount of research was conducted during the '70s and '80s into hydraulic fragmentation and mining and practical applications began to emerge including abrasive jet drills, cavitating jet drills, high-pressure jet drills (continuous) high-pressure jet drills (pulsed), high-pressure jet assisted mechanical drills, and high-pressure jet borehole mining.

6.4.22. The application of water jet assisted pick-cutters on coal measure rocks realised a reduction of mechanical cutting forces. Various nozzle designs were developed and tested for specific applications and the application of additive chemicals in the jetting water were shown to enhance cutting efficiency. However there are no indications that hydraulic fragmentation will provide benefits in hard rock excavation.

6.5. Mining Waste

The Mining Waste Directive

6.5.1. In June of 2003 the European Commission presented a proposal for a Directive to regulate the management of waste from the extractive industries (mining and quarrying). The main reason for introducing this new legislation was because this waste can constitute a serious threat to the environment and human health if not properly managed. The proposal seeks to introduce EU-wide rules designed to prevent water and soil pollution from long-term storage of waste in tailings ponds, waste heaps, etc. The stability of these waste-storage facilities must also be guaranteed to minimise possible consequences from accidents.

6.5.2. The proposed Directive seeks to improve the ways in which waste from the extractive industries is managed by setting minimum requirements and specifically addressing the environmental and human health risks that may arise from the treatment and disposal of such waste. It covers waste from all sectors of the extractive industry and specifically focuses on operational issues connected with waste management, prevention of soil and water pollution, and the stability of waste management facilities (in particular tailings ponds).

6.5.3. The proposal lists conditions to be attached to operating permits in order to ensure that sufficient environmental and safety measures are in place. Waste has to be classified before disposal and the method of management tailored to its particular characteristics. Another key provision is that operators of waste management facilities should draw up closure plans, to form an integral part of the overall operating plan. Proper monitoring is also an essential feature of the proposal, during both the operational and the after-care phases.

6.5.4. In addition, the proposal contains an obligation to provide for an appropriate level of financial security to reinforce the "polluter-pays" principle. This entails ensuring that sufficient funds are available to leave waste sites in a satisfactory state after closure if,

for example, if a company goes into administration, becomes insolvent or even engages in asset-stripping (the so-called "walk away" practices).

6.5.5. Extractive operations often generate large volumes of waste. These wastes, which may be major sources of pollution, include topsoil, overburden, waste rock and tailings.

6.5.6. Waste from the extractive industries represents a large waste stream in the EU. It is estimated that such waste amounts to about 29% of total waste generated in the EU each year, with an annual volume in excess of 400 million tonnes.

6.5.7. Waste from extractive industries is subject to the general provisions of the Waste Framework Directive (75/442/EEC). More importantly, facilities for the disposal of waste from the extractive industries are also covered by the Landfill Directive (1999/31/EC). However, the latter contains provisions that are not always adapted to mining waste. It is therefore necessary to create an appropriate legal framework that would exempt waste from the extractive industries from the provisions of the Landfill Directive and establish tailor-made rules.

6.5.8. The requirements of the Directive will place significant additional responsibilities on both the mineral operators and the government regulators. These will include amongst others:

- Careful planning of waste and waste management through the lifetime of the mineral operations
- The preparation of closure plans
- Monitoring and enforcement of the regulations by the appropriate authorities.

Mine and Quarry Waste in Cyprus

6.5.9. One of the most important environmental issues in relation to the mining industry in Cyprus is the poor record of mine-waste management. The unregulated historic dumping of waste associated with past sulphide mining is a problem already discussed at length. However the disposal of mineral waste continues to be relatively poorly controlled.

6.5.10. There were numerous examples noted during the Phase 1 field survey where operators had dumped quarry waste outside their licence limits or on riverbanks and in most cases there appeared to be no particular plan for mine-waste management. Disposal was generally haphazard and double handling of wastes was commonplace. Spoil is usually disposed of in large end-tipped mounds; at elevated locations, spoil was often tipped down the valley side. These practices have significant impacts on the landscape, alterations of water courses and on ecology.

6.5.11. It is also evident that some mineral operations are producing and discarding waste that could otherwise be used for construction purposes. This was particularly evident at those quarries producing dimension stone or stone for marine armour works where wastage is comparatively high. At many of these sites however poor access would limit the extent to which large quantities of stone for bulk fill could be recovered without causing unacceptable environmental problems.

6.5.12. To ensure adequate control of wastes arising from mine and quarry sites all operations, including the waste disposal, should be within the licensed areas.

Appropriate land-take allowances should be made for mine waste management within the licence application and operators must consider spoil management within the framework of the overall mine or quarry operations. The disposal of mineral waste should conform to the framework laws for the integrated protection of soil, water and air.

6.6. Construction Waste Recycling

6.6.1. Most construction and demolition waste is inert and suitable for a variety of secondary uses. Some materials, such as reclaimed bricks can be reused directly. Soil, removed during site excavation can be used for landscaping. Demolition waste can be reprocessed for use as aggregate in new construction or road-building projects. Some secondary materials left over from other industrial processes can also be used as primary construction materials.

6.6.2. A good example of re-use involves road planings and other bituminous based materials removed from roads, car park surfaces, footpaths and other hard standings. It is becoming highly cost effective and common practice to re-use or recover the aggregate and binder from asphaltic wastes.

6.6.3. Landfilling waste from construction and demolition sites is the least efficient and least sustainable waste management practice. A high proportion of potentially recyclable inert waste is often mixed with other wastes, highlighting the common practice of disposing mixed building wastes and soil from the construction industry. While they could still be used as cheap fill this denies the opportunity of reusing or recycling these materials to produced higher value products.

6.6.4. The high levels of mixed material that goes to landfill sites (in the UK and elsewhere) would suggest that opportunities exist for increased segregation and more beneficial use of construction and demolition wastes.

6.6.5. Quality constraints have to be considered. An absence of adequate technical specifications has inhibited wider use of recycled materials to date. Also recycling isn't always cheaper and transport costs, for example, can make recycled aggregates uncompetitive with primary aggregates. Permanent recycling facilities usually need to be close to source to minimise transportation costs. The use of mobile plant for crushing and screening on-site is becoming increasingly common where the aggregate is re-used as soon as it is processed. Substantial savings can be made on raw materials, transportation costs, energy use, and wear and tear on roads and equipment.

Economics of Recycling

6.6.6. The bulk of recycled aggregates are used as road base and other low-value products with a relatively smaller proportion used for new concrete and asphalt hot mixes. The low usage in high-value products is mainly related to quality issues, both real and perceived.

6.6.7. Concrete recycling has proven to be profitable. However transportation costs need to be kept low, which forces the market to be urban-oriented, and user specifications and prejudices can also restrict the market. The availability of feedstock into recycling plants is fixed by the amount of demolition taking place, which generally places the activity within older, larger towns.

6.6.8. The energy used in producing a recycled aggregate has been estimated as 75% of that used to manufacture primary aggregates.

6.6.9. The future for recycled aggregates will be driven by reduced landfill availability, greater product acceptance, continuing government recycling mandates, and the continuing decay of infrastructure, as well as by the demands of a healthy economy.

6.6.10. A sustainable recycling industry however requires sufficient construction and demolition feedstock together with a demand for new infrastructure, favourable transportation distances, product acceptance and limited landfill space

6.6.11. In the UK the introduction of a Landfill Tax, an Aggregates Tax and other changes in the waste management licensing regulations had a significant impact on construction and demolition waste management practices. Following the introduction of these new regulations the quantities of construction and demolition waste sent to landfill was halved.

6.6.12. Research is also continuing in the use of recycled aggregates in building and road construction and bulk fill as alternative materials to primary aggregates. Predictions of the *in-situ* performance of alternative and conventional aggregate materials are being investigated as regards both mechanical and environmental loading. Performance based mechanical specifications are also being developed and guidance is being prepared on the importance of good design and construction techniques for recycled aggregates which focuses on minimising the required quantity of natural aggregate material.

6.6.13. There are proposals to upgrade the solid waste management system on Cyprus that will include the installation of inert waste recycling plants. However Cyprus is currently going through a phase of new-build and the availability of demolition materials for recycling or re-use may be limited.

6.7. Environmental Levy

6.7.1. In Cyprus operational quarries are required to pay an "Environment Levy" which provides significant funds for use in environmental protection and restoration activities. The levy is set at 15 cents (CYP) for every tonne of material quarried. Of the total money raised 75% is allocated to the local communities affected by the quarrying or mining activity, which must be uses for development projects in the area. The remaining 25% of the funds are allocated to the government, for environmental projects, and are managed by an Interdepartmental Committee.

6.7.2. Communities undoubtedly benefit from the environment levy but there is the suggestion that the levy is being used to some degree by the mining industry as an inducement to reduce complaint from local communities rather than improving environmental conditions associated with quarrying.

6.8. Financial incentives for environmental protection

6.8.1. In an effort to boost technological advancement and the use of environmental technologies in quarries, the government, through the Industrial Policy of the Ministry of Commerce Industry and Tourism, has been offering financial incentives for the purchase of equipment for environmental protection.

6.8.2. The program has been facing some criticism due to the small ceiling on funding (£CY 30,000) and delays in the procedures and the submission of the funds. However the principal of providing additional funding for improved environmental practices may appear to be contrary to the "Polluter Should Pay" principal. Also such funds should not be used to pay for measures that might be considered as good practices which would normally be implemented and enforced through the quarry planning or licensing conditions.

7. Conclusions

7.1. Objectives of the Study

7.1.1. The key study-objectives as defined by the Terms of Reference were:

- To formulate a Strategic Plan for the sustainable and rational development of the mineral wealth and the quarrying industry of Cyprus.
- To conserve minerals as far as possible, whilst ensuring an adequate supply to meet needs;
- To ensure that the environmental impacts caused by mineral operations and the transport of minerals are kept, as far as possible, to an acceptable minimum;
- To encourage sensitive working, restoration and aftercare practices so as to preserve or enhance the overall quality of the environment;
- To protect areas of designated landscape or nature conservation value from development, other than in exceptional circumstances and where it has been demonstrated that development is in the public interest;
- To prevent the unnecessary sterilisation of mineral resources.

7.1.2. These objectives have been achieved. A framework for institutional and legislative changes has been recommended alongside proposals for raising awareness and standards of planning and environmental management. A strategy for the evaluation and designation of new quarry zones has been proposed which, together with a systematic review of each of the major quarry units, will ensure a sustainable provision of raw materials for future development without compromising the social or environmental fabric of the Island.

7.2. Findings

Reserves, Resources and Quality

7.2.1. There are substantial resources of essential minerals that can meet the development requirements of Cyprus for the foreseeable future. However in terms of permitted (licensed) reserves in the short to medium term there will be a shortfall of clay for brick manufacture and, in Paphos area, a shortfall of rock suitable for construction aggregate production.

7.2.2. In the medium term, apart from the circumstance above, there are adequate reserves of all essential minerals although additional reserves will need to be identified and released (i.e. granted permits) within the time-frame of the project, that is prior to 2025.

7.2.3. In the case of aggregates the quality control mechanisms in place ensure that products meet Cyprus standards. Both limestone and diabase are suitable for producing high quality concreting aggregates but where higher strength products are required diabase has significant advantages.

Environmental issues

7.2.4. There is an evident need to improve the conditions and controls relating to environmental effects of mineral operations. Discussions and field observations drew attention to the poor record of environmental management and control of the industry. In particular there is generally little attempt to minimise visual impact of the operations or take account of the sometimes-sensitive environmental or ecological location of operational sites. Although operations at the majority of sites do not pose a threat to the water environment there was a noticeable lack of measures in place to provide protection from potential pollution accidents. The movement of heavy traffic is a perennial problem at many sites but plant noise and vibration from blasting is now generally well controlled although these have been issues in the past.

Legislative Framework

7.2.5. The current legislation sets out an elaborate system for the control of mineral operations but it is becoming excessively bureaucratic and the lack of resources and expertise within the regulatory bodies is a significant weakness in the monitoring and enforcement of regulations.

7.2.6. There is evident duplication between the Mining Laws and other legislation and current procedures for issuing prospecting permits and mining licenses could be usefully reviewed. There is however a continuing role for the mining legislation to control issues that are specific to the industry and in particular regulate mining processes, product quality and collection of levies.

7.2.7. The planning system determines whether development is appropriate, how much is desirable, where it should best be located and what are its impacts on the environment. All the fundamental requirements for addressing these issues are already in place within the existing planning laws.

7.2.8. However the issuing of temporary permissions for minerals operations is inhibiting many aspects of the control of the industry and does not explicitly recognise the continuous and long-term nature of minerals development. Whereas the threat of closure may provide a powerful control mechanism over the industry there are fundamental flaws to this approach; if the operator is in serious breach of conditions substantial damage to the environment may have already occurred and if removed from the site any essential remediation will be both difficult and costly.

Mine Closure Planning

7.2.9. At some point a mine or quarry will close due to exhausted reserves or uneconomic operations. The legacy of mine dereliction on Cyprus, both historically and arising from more recent mine closures, indicates that a more rigorous mine closure regime is desirable. Early planning for closure can reduce overall closure costs and ensure that adequate financial provision is made for the closure programme and without risking financial liabilities to the public purse

7.2.10. The implementation of the proposed EU Directive on the Management of Waste from the Extractive Industries will require that closure planning becomes an essential element of the mine planning process.

Forward Planning

7.2.11. It is the role of the planning system to make adequate provision for future development and at the same time take account of the need to protect the natural and built environment.

7.2.12. Minerals are an important national resource but can only be worked where they occur. However they are a finite resource and in this context the principle of sustainability is becoming an increasingly important planning consideration. Although they have a finite life their exploitation can have a greater impact on the environment than almost any other form of development and mineral operations can cause lasting harm to the environment.

7.2.13. Cyprus generally adopts a plan-led approach to development and the Development Plan provide a means of reconciling conflicts between the need for development and the requirement to protect the built and natural environment. An essential element of a sustainable planning framework is the maintenance of a long-term supply of strategic minerals and to identify land:

- where essential mineral resources are likely to occur,
- that meets meet with identified policies and
- which can be protected so as to ensure the long-term and sustained provision of essential raw materials.

7.2.14. The current system of quarry zones and policies is primarily intended to control the industry rather than encourage and sustain mineral production and ensure the provision of raw materials. This needs to be reviewed

Environmental Management

7.2.15. No mining companies in Cyprus have implemented a comprehensive or properly documented Environmental Management System and only a few have implemented operational procedures on environmental issues. There are no specific International or European environmental management systems for the quarrying and mining industry but ISO14001 sets out the basis of an Environmental Management System (EMS) and provides a good framework that is applicable to the mining sector. An essential part of any EMS is establishing procedures for:

- organisation and responsibilities for environmental functions,
- monitoring and reporting of environmental performance and compliance with action plans, standards and norms,
- operational environmental procedures, such as dust control, waste dump construction, water management, emergency response.

7.2.16. Preparing such generic procedures and guidelines is considered an important consideration for the mining sector on Cyprus.

Abandoned Mines in Cyprus

7.2.17. Mining is an important part of the country's heritage but has also given rise to unacceptable environmental impacts that blight areas of the Cyprus countryside. The

open-pits mines are often benched but instability of the pit side-walls is common. The associated spoil tips suffer from significant erosion and natural recolonisation is limited due to the instability and aggressive soils. Pollution from the old mines sites occurs where surface run-off carries sediment and contaminated water into adjoining land and watercourses. Groundwater pollution is also associated with the mine sites but this might be naturally occurring rather than a consequence of mining activities.

7.3. Recommendations

Institutional changes and organisation

The Minerals Commission

7.3.1. To implement many of the proposals put forward in this report it is recommended that a Minerals Commission be established by a Council of Ministers decision. It would be an interdepartmental body comprising representatives from the Department of Town Planning and Housing, Environmental Services, Mines & Quarries Service, Geological Survey Department and the Department of Labour Inspection. It would set-up and manage the minerals planning team, maintain a policy and co-ordinating role between the various Ministries and Departments involved in managing the mining and quarrying sector and would be the lead agency for dealing with the legacy dereliction and pollution from past mining and quarrying.

The Minerals Planning Team

7.3.2. Increased resources are necessary to adequately implement an improved regime for the control and planning of the minerals industry. The Department of Town Planning is the competent authority for exercising control over the minerals industry but at present does not employ appropriate specialist staff and is not resourced to provide a routine inspection of mines and quarries. An enhancement of government services is essential and it is proposed that a minerals planning team be established that would have amongst others the following tasks and responsibilities:

- Development control: including authorisation, day-to-day control and community liaison.
- Forward planning: including data collection, plan and policy preparation
- Advice: the provision of guidance, codes of practice and revisions to legislation.

7.3.3. The staff engaged in mineral planning would have a wide range of professional and technical skills, exercise continuous supervision over mineral workings and be wholly employed on minerals work over long periods. The minerals planning team would work alongside other departments/agencies responsible for licensing and inspection of mines and quarries, pollution control and waste management.

Changes in Legislation and Review of Mineral Operations

7.3.4. The use of temporary planning permits for quarries should be phased out and the mining industry subject to new permits that reflect the long-term nature of mineral operations.

7.3.5. Prior to this all quarries should be subject to an individual review. New planning applications should be submitted for each operation that include detailed working plans, environmental management schemes and closure plans. Details of reserves, markets and anticipated outputs should also be provided. Appropriate conditions should be imposed to ensure that working methods and reclamation avoid short and long term environmental liabilities.

7.3.6. The day-to-day control of mineral working, both from land use planning and environmental viewpoints should be strengthened. This would be an important function of the minerals planning unit

7.3.7. The way in which forthcoming EU legislation, in particular the IPPC Directive and the Mine Waste Directive, will be transposed into Cyprus law will have a wide effect on mineral working. The latter, in particular, will necessitate the adoption of a longer term licensing regime for mines and quarries.

7.3.8. The current Mining Laws should be reviewed to see if they unnecessarily duplicate other legislation.

Forward planning

7.3.9. The ability to predict and plan ahead is dependant on the quality of data available. The review of mineral operations, as above, will provide more accurate data than is currently available on the markets concerning minerals and available reserves.

7.3.10. The maintenance of a sustainable reserve of essential minerals is an important aspect of minerals planning. New sites will need to be identified and commissioned such that as reserves are worked they are replenished within a rolling programme of new permits. For aggregates and raw material for the cement or brick industries the size of the 'minerals bank' of reserves would be linked to the scale of capital investment at the mine, quarry and associated plant so that security of supply can support high costs of investments and the long amortisation period; at least 7 years reserves might be considered appropriate.

7.3.11. A methodology for the assigning new quarry zones should be adopted with the objective of providing a strategic reserves of minerals based on regional demand and supply within, say, a 50km radius of production. A meaningful strategic plan can only be achieved if there is a move away from the use of temporary 2-year planning permits for mines and quarries.

Abandoned mines and quarries

7.3.12. The proposed introduction of closure planning into the current control regime for operating quarries should help to prevent future despoliation of the land by mining activities. However there remains a legacy of polluted and derelict land where reclamation may have ultimately to be funded by the Government. Means of raising additional revenues to fund a programme of reclamation need to be explored, and could include an additional levy on mine and quarry production.

7.3.13. A framework for reclamation to beneficial use of abandoned mines and quarries is given in is given in the Phase 2 and 3 Interim Reports and the potential opportunities to reinstate old mine sites as examples of the mining history of Cyprus is also discussed.

Training and consistency of approach

7.3.14. An essential requirement for both regulators and operators is the need to raise awareness and standards of mineral planning and environmental management. The importance of employing skilled personnel who understand both the industry's needs and the regulatory requirements cannot be overemphasised. The essence of many of the recommendation in this report is the improvement of knowledge and cooperation within the government agencies and between those agencies and the industry.