DRAFT TANZANIA STANDARD

TBS/MMDC1 (5035) P3 Classification of terminologies for exploration of mineral deposits

TANZANIA BUREAU OF STANDARD

1st edition

Foreword

This draft Tanzania Standard is being prepared by the Mineral Exploration Technical Committee (MMDC 1), under the supervision of the Mining and Minerals Standards Divisional Committee (MMDC).

In preparation of this draft Tanzania standard the main assistance was drawn from Bureau of Indian Standards (BIS) specifically from IS 12595:1989, Classification of terminology for exploration of mineral deposits.

Classification of terminologies for exploration of mineral deposits

1 Scope

Section 1: Reserves and resources; this section specifies the definitives for a classification of terminology pertaining to reserves and resources of economic mineral deposits subjected to appraisal through mineral exploration.

Section 2: Exploration in general; This section provides classification of activities in each step of mineral exploration program, depending upon the basis of works, and the objective at each step of the program as well as the resultant status of resource evaluation. The various phases of the activities are as under:

i. Reconnaissance for broad inventory of the resources,

ii. Preliminary exploration for establishment of developmental potentiality,

iii. Detailed exploration for formulation of actual mine plans and designs, and

iv. Guidelines for environmental studies

Section 1: Reserves and resources

2 General.

2.1 Ore

A solid and natural aggregate of one or more minerals, from which one or more metals or economic minerals can be extracted profitably and may encompass industrial minerals and rocks, for example, clays, abrasives and salt.

2.2 Deposit

A portion of earth's crust, where the natural incidence of minerals or metals is abnormally high over the normal crustal abundance.

2.3 Resources

A concentration of solid, liquid or gaseous materials on earth or any other celestial body in such form, that commercial extraction of the commodity is either possible at present or feasible within the foreseeable future, through a technology which has either existed on the drawing board or has found application on laboratory scale.

2.4 Reserve

A calculable tonnage of ore or metal including those that are believed, though not conclusively established, to exist within given mineralized boundaries and divisible into the categories of 'Developed', 'Proved', 'Probable and Possible', depending upon their degree of assurance on existence.

3 Terms relating to mineral resources

3.1 Inferred mineral resource

The part of mineral resource for which quantity and grade (or quality) are estimated on limited geological evidence and sampling. Geological evidence is sufficient to imply but not verify geological and grade (or quality) continuity. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, pits, trenches, workings and drill holes.

An inferred mineral resource has lower level of confidence than that applying to an indicated mineral resource and must not be converted to an ore reserve. It is reasonably expected that the majority of inferred mineral resource should be upgraded to indicated mineral resources through continued exploration.

3.2 Indicated mineral resource

The part of mineral resource for which quantity, grade (or quality), densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of modifying factors in detail to support mine planning and evaluation of economic viability of the deposit.

Geological evidence is derived from adequately and detailed reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, pits, trenches, workings and drill holes and is sufficient to assume geological and grade (quality) continuity between points of observations where data and samples are gathered.

An indicated mineral resource has lower level of confidence that that applying to, measured mineral resource and may only be converted to probable mineral reserve.

3.3 Measured mineral resources

The part of mineral resource for which quantity, grade (or quality), densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of modifying factors in detail to support mine planning and final evaluation of economic viability of the deposit.

A measured mineral resource has higher level of confidence than that applying to either an indicated mineral resource or inferred mineral resource. It may be converted to prove mineral reserves or under certain circumstances to probable mineral reserve.

3.4 Modifying factors

Considerations used to convert mineral resources to mineral reserves. These include but not restricted to mining, processing, metallurgical, infrastructure, economic, marketing, legal, environmental, social and governmental factors.

4 Terms relating to reserve

4.1 Developed reserve

This category includes the very best of the economically exploitable sections or parts of the deposit wherein, the degree of geological assurance on tonnage, grade and other physico-chemicalcum- metallurgical parameters are decidedly the highest. These reserves should be blocked out and be kept ready for immediate exploitation with quality and quantity estimated on mine development preparatory to industrial production. Ore blocking out is to be in suitable dimension, guided by the nature of physico-chemical characters of the deposit including beneficiability, if needed, as well as the method of working to be adopted in actual mining; with developmental mining carried out preferably on four sides of the block thus designated. Open-cuts, and/or cross-cuts for a systematic sampling must be provided at suitable and regular intervals. The error or estimation of tonnage should not exceed 10 percent.

Samples collected from open-cuts and crosscuts should be subjected to laboratory scale and
pilot plant tests for determination of process parameters, namely handling, comminution, beneficiation, agglomeration, for the ore. The reserve estimate has to be based upon cut-off grade which could sustain the current industrial requirements. Ore below the cut-off as well as the waste rock within the ore body, have to be sized up with commensurate degree of assurance in reference to mode of distribution and the

relation with mineable ore. It is desirable that reserves, grade and waste quantity are indicated benchwise or levelwise for facilitating production planning and quality control system during the mining period to follow.

If the best known part of a deposit is not to be taken up for immediate mining for any geological, techno-economic or marketing reasons, or alternatively if some part of the deposit was partially mined in past and with further exploration acquired higher degree of assurance though not being set for immediate mining; even then the term 'Developed Reserve' should be applied for the reserves thus estimated and may include recoverable reserves as in vogue for the tonnage being ushered in for concurrent exploitation.

4.2 Proved reserve

This category will have to encompass conclusions on all main geological aspects of the deposit or part thereof, in matters such as tonnage, grade, physico-chemical and metallurgical parameters. Though strictly a geological ore reserve, the reserve included herein, must have total evaluation of the type of occurrence, shape and structure of the deposit including attitude and tenor, etc., in different segments of the blocks under the purview of 'Proved Reserve'. The configuration of the mineral body should be defined by adequately spaced boreholes and/or exploratory openings. The information collected should be sufficient to facilitate preinvestment decisions on production planning, mine development, capacity projections and preparation of feasibility records with techno-economic options, alternatively delineated after studies on anticipated recoverable mine produce. The error of estimation in tonnage should be in the range of 10 to 20 percent.

4.3 Probable Reserve

This category implies a clearly lower status to the ore reserves in terms of degree of assurance, in spite of being still within the direction of economic considerations. Here the tonnage and grade are computed, based partly on the data retrieved from 'Developed' or 'Proved' blocks on extensions and partly from geological knowledge of analogous ore or mineral bodies within the metallogenetic province or epoch. This category thus must include the currently non-produceable parts of the deposits being exploited, developed or under feasibility study, besides the deposit which too may become producible with marginal improvements in economic and/or technological fronts. The error of estimate of tonnage should be in the range of 20 to 30 percent.

4.4 Possible reserve

This category includes reserves estimated after exploration which may suffice for a rapid evaluation of tonnage, grade and physico-chemical characters of a deposit; based on assumed continuity of ore from geological evidences and/or widely spaced exploration openings, corroborating geophysical/geochemical survey data, large-scale geological maps and/or rather disconnected surface information from pits, cliff sections, mine faces and similar suggestive interpretations; if available. The 'Possible Reserves' may have an error level of 30 to 50 percent.

Section 2: Exploration in general

5. Norms of exploration

5.1 Reconnaissance

The basis of this initial level of work is often the disjointed and piece-meal information received on mineral incidence and/or interpretations from available literature. The objective of reconnoitory phase is to search for mineral districts, narrow belts or prospects

The activities of reconnaissance may include:
a) Geological mapping on 1: 200 000 to 1: 50 000 scale;
b) Satellite imagery/airborne geophysical survey/regional geochemical survey, etc.;
c) Synthesis of existing available geological, structural, tectonic date with regional correlation and analogy;
d) Petrographic analyses to ascertain the rock types and mineral assemblages;
e) Identification of mineral/zone of interest; and

The resultant status of the reconnaissance phase may register spatial definitions of commerciable mineralized zones, which may contribute to produce one or many blocks/prospects warranting further studies. If no zone qualifies into these considerations all subsequent interests may have to be called off.

5.2 Preliminary exploration

The basis of this step in an exploration system is often the encouraging results of reconnaissance. In cases of more discrete information from literature, personal knowledge or informal reports, the preliminary exploration phase is limited without going in through a reconnoitory phase.

The objective of preliminary exploration is to assess broad potential over a wide field area and selection of blocks/prospects for eventual detailed exploration, if necessary.

In order to narrow down the space and time of exploration by eliminating unproductive ranges, preliminary exploration is divisible into two stages namely, stage I and stage II.

The activities of the stage I of preliminary exploration program should include:
a) Geological Mapping on I: 50 000 to 1: 25 000 scale.
b) Analysis of the mining history of the region;
c) Petrographic study of all the lithological units;
d) Determination of the geological type for the deposit/occurrence and its analogy with known deposits;
e) Soil sampling, stream sediment study and detailed geochemical prospecting;
f) Detailed group-geophysical prospecting;
g) Pitting and trenching/drilling wherever necessary; and
h) Assessment of geological data base including tectonic, stratigraphic, hydrological and geotechnic studies.
The activities of stage II of preliminary exploration program should include:

a) Surface survey including triangulation and bench height, with transference of national grids and bench marks and/or triangulation points on to the base map;
b) Limited surface geological mapping in scale I: 10000 to 1: 2000;
c) Analyses of geology, structure, tectonics, history of investigation and mining and geological documentation of all exploratory works including pitting and trenching, core drilling and chemical analysis of samples thereof;

Drilling aspects comprise planning of the hole locations, execution and management of drilling, logging of holes in suitable format, and interpretation;

Chemical analysis aspect comprises the analysis of primary samples for grade, assay, composite samples for gauge composition, trace elements for deleterious constituents and check sampling for reliability tests;

d) Petrographic study of rocks associated with the mineral deposit and study of rocks suitable to host the mineral;
e) Mineralogical study of host and ore, grain size distribution, structures and textures and liberation characteristics wherever necessary;
f) Systematic geochemical sampling and interpretation;
g) Application of borehole geophysics;
h) Technological analyses of samples so as to indicate the ore characters and possible beneficiation techniques under bench scale testing conditions;
j) Preparation of geological cross-sections, longitudinal sections, slice plans and drawings correlating different litho units and structures, isometric panel projections and block diagrams, etc., indicating (i) structural disposition, (ii) ore area, (iii) lithostratigraphic succession, (iv) grade maps as well as, (v) broad-based grade-tonnage curves indicating trend features; and
k) Geomathematical evaluation of exploration data for facilitating the next phase.

Preliminary exploration enables an organization to derive the resultant status as follows:

a) Reserves of mineral deposit estimated in the 'Probable' and 'Possible' categories that is remain as identified resources;
b) Avoid inadequate, incomplete or superfluous studies accounting for infructuous expenditure;
c) Avoid subsequent unnecessary work if nonprofitability is established at this phase;
d) Establish the initial evaluation of the economic soundness or otherwise of the project;
e) Determine the approximate cost estimate for the next phase of work;
f) Identify the gaps in the data base and technological know-how; and
g) Increase in confidence on the relative economic value of. the deposit through reliable sample location, collection analysis interpretation and control during the execution of this phase.

5.3 Detailed exploration

The basis of detailed exploration phase of the program stems from the choice of mine-compatible blocks derived as conclusions from preliminary exploration program.

The objective of detailed exploration is to provide stable data base for possible mine feasibility studies to be carried on the in-shelf projects. The aims of the detailed exploration are as follows:

a) To firm up results obtained during preliminary exploration;
b) To collect more data on the mineral deposit with regard to ore geometry, reserves and grade distribution within the body, mineability, process-technological know-how and marketability, etc.;
c) To establish higher degree of accuracy and dependability by projecting the geometrical pattern of the deposit and blocking out reserves on a predetermined norm which would help in drawing up the mine plans;
d) To obtain mining - geological, details including waste dump yards and plant structural sites, etc.; and
e) To help in the preparation of detailed project report for opening up the mine and exploitation of the mineral commodity.

The activities in the case of detailed exploration must include:

a) Preparation of a base map with total complement of surface. survey details and geology as in the preliminary exploration stage II but with details commensurate with the scale of I: 1 000 to 1: 250, as and when necessary;
b) Physical execution of exploration inputs such as:
Surface drilling or underground drilling at a closer interval with borehole surveys,

1. Aditing and trenching,
2. Collection of data on all the rock formations including host rock, hanging and footwall rocks,
3. Collection of geohydrological and environmental data,
4. Collection of borehole samples, composite samples and their laboratory testing,
5. Conducting beneficiation test on. pilot plant scale,
6. Preparation of detailed geological plant, X-sections and L-sections,
7. Ore reserve estimation
8. Estimation of confidence to assure quantitative reliability index for the conclusions, and
9. Broad outlines of grade and reserve distributions and waste inclusions within ore to facilitate mine planning.

c) Detailed documentation of exploratory words and geological information as appropriate to the scale of present operations;
d) Detailed geochemical sampling to make use of all trace elements;
e) Geophysical survey in drillholes and underground exploratory workings, wherever necessary;
f) Technological investigation of bulk samples;
g) Choosing the most suitable processing/ treatment plant after pilot-plant scale and industrial scale testing of the produce;
h) Detailed study of physical properties of rocks and raw materials which control the development of the deposit and the choice of extraction procedure with drainage-ventilation- haulage methodology;
j) Geomathematical studies on the ore deposit and predictive forecasts; and
k) Environment database compilation comprising ground water, petromineral, rock mechanics and geotechnical studies.

The resultant status after the Detailed exploration will end up in estimates of reserves of the categories such as developed, proved, probable and possible; which shall be adequate for the purposes of the feasibility report on the mining of the mineral deposits explored so far.

6. Quantum of exploration input

Quantification of exploration requirements corresponding to various categories of reserves at different stages of exploration, shall depend upon:
a) Aim of the work;
b) Prediction accuracy desirable;
c) Shape, size and complexity of the mineral deposit;
d) Type of the mineral commodity; and
e) Geological homogeneity/heterogeneity.
In the absence of comprehensive feed-back data on exploited deposits and correlation with exploration program of past, broad groupings of the geological archetypes have been standardized on the basis of semblance in the attributes, which are:
a) Stratiform, stratabound, tabular bodies with predictable regular habit;
b) Lenticular bodies and massive bodies of irregular shape and grade, silicified linear zones;
c) Lenses, veins, and replacement bodies,
d) Gemstone and rare metal pegmatite reefs and veins; and
e) Placers and residual refractory mineral deposits.

Spacing in terms of exploration openings may be designed, based on experiences in India and abroad and average characters of deposit archetypes. Judicious considerations of all aspects may include necessary changes in exploration intervals, as per individual needs,

Exploration practice in different types of deposits is given in Annex A, for guidance.

7. Environmental studies

Environmental studies at different stages of exploratory work have been given in Annexes Band C

ANNEX A
(normative)

Example of exploration practice in different types of deposits

Types of Deposit	Characteristics of Deposit	Principal Kinds of Mineral	Exploration Practice
Stratiform, stratabound and tabular deposits.	Regular habit with predictable change in trend with sharp to moderate physical contrast with bounding surfaces; low dipping to moderately steep, simply folded and faulted. Also as blanket cappings and surficial tabular bodies.	Coal seams, lignite beds, iron-ore formations and cappings, manganese horizons in sedimentary and metasedimentary sequences, thick bauxite cappings, regional chromite lodes in large ultramafic; limestone, dolomite barytes, gypsum, potash. and salt beds; chalk and fireclay; fuller's earth.	Wide-spaced drilling generally good enough up to probable reserve category with attendant alternate exploratory pit/trench openings for bulk sampling, as necessary. Spacing; Coal, gypsum, potash and Salt beds 1000 m Iron and manganese ore 400-200 m Limestone and dolomite 500-300 m Bauxite of thick capping 400-200 m Chromite as regional load lodes 300-100 m Barytes formations 400-300m Progressive grid reduction for higher category. Adit in suitable topography. Dry drilling in bauxite and in formations vulnerable to wash.
Stratiform, stratabound and tabular deposits.	Irregular habit and/or with faults of large measure folds' solution cavities, irregular erosion and weathering (oxidation) feature, partings and bifurcations, igneous intrusives, facies changes, etc.	Coal seams, lignite beds, iron-ore formations and cappings, manganese horizons in sedimentary and meta-sedimentary sequences, thick bauxite cappings,	Close-spaced, probing, choice of location and number of sites dependent on variability. Borehole geophysics in complicated fault or folded structures; regular grid pattern may be replaced by selection of sites best suited to unravel the structural complexity.

		regional chromite lodes in large ultramafic, limestone, dolomite barytes, gypsum, potash and salt beds, chalk and fireclay; fuller's earth.	Example may be cited of a faulted coal basin where the area may be subdivided into polygonal homogeneous blocks bounded by structural planes (here faults). Assessibility in complicated folded body is poor.
Lenticular bodies of all dimensions including bodies occurring in echelon; silicified linear zones of composite veins.	Gradual and abrupt charge in thickness and grade along strike and dip direction; bounding surfaces of mineralized bodies often sharp, but in sulphides mostly defined by assay contacts; (a) massive bodies with irregular shape and grade-homogeneous distribution of metal values as in replacement and disseminated type bodies -shapes interpretative; (b) steeply dipping narrow bodies with or without pitch; pinch and swell type, with or without bifurcations, partings etc.	Base metal sulphides, supergene iron and manganese bodies in lateritoed country pockety bauxite and nickel-cobalt laterites, auriferous quartz reefs, graphite lenses; porphyry deposits of copper, molybdenum and tin; pyrites and pyrrhotite bodies.	Moderate to close-spaced drilling and pitting up to probable reserves; adits/ shafts and two level development and underground boreholes for steeply dipping bodies with deviation check; sampling interval commensurate with complexity (0.5 m to 1.0 m) check sampling. Spacing of probe points along strike generally not to exceed 200 m to be decided on the length of individual lenses in series drilling in dipping mineralized zones. fewer probe points in deeper intersections. Drilling preferably with application of borehole geophysics. Exploration planning to be guided by the results of ground geochemical and geophysical surveys.
Lenses, veins and pockets; stockworks, irregular shaped, modest to small size bodies.	Bodies distributed in space lacking estimable regular patterns; structural control less than lithologic, if any; small cluster of multi-shaped bodies, of volcanic origin pipes and chimneys, of magmatic origin plugs and pods, clots and segregations of hydrothermal origin vein and replacement. Bodies in stock-work. Metamorphic and metasomatic in skarn and	Small multimetal complex sulphide bodies of Cu. Pb-Zn-Sb-Hg, podiform chromite; Sn-Ag chimneys and pipes; tectite mineral bodies; skarn deposits of scheelite, powellite, wollastronite, fluorite, etc., and semigem minerals, network of apatite, barytes, asbestos veins, vermiculite bodies, magnesite lenses and mica in pegmatite, pyrophyllite lens and veins, opal, insitu-sillimanite, kyanite lenses, high grade bauxite in clay pockets, clay, ochre and bentonite lenses, diamond pipes.	Irregularity in shape and' distribution of grade demand larger input of exploratory mining, deep pitting, trenching/benching, level development in underground mines with supporting underground boreholes. Close drilling (50m-25m) to assess grade wise estimates of reserves. Well documented surveys-surface and sub-surface. Proved category difficult to achieve.

	tectites, in griesens and in thermal aureole around intrusives		Exploration planning to be guided by the results of careful ground geochemical and geophysical surveys. Exploration preferably with attendant exploitation scheme
Gemstone and rare metal pegrnatites, reefs and veins.	Highly erratic distribution of minerals and metals. No trend in grade and thickness; no assured continuity; cluster of high values haloed by barren zones; structural and litholigic controls indeterminate	Tin-tungsten-tantalum-niobium – molybdenum veins and pegrnatites; beryl, topaz, emerald deposits, mineralization associated with alkaline rock complexes and veins in carbonatites.	High input of exploratory mine openings-open pit or underground with bulk determination of grade. Role of drilling secondary to delineate likely outline of host rock. Category of reserve unattainable beyond possible reserves. Exploration of regional and preliminary resource evaluation scale followed by direct exploitation.
Placers and residual refractory mineral deposits of hill and valley wash.	Eluvial, colluvial and alluvial placer concentration of heavy metals and minerals; pebble and cobble, boulder beds, gravel beds in alluvium and colluvium; conglomerates, foothills fan deposits, grain-size from extremely fine striated material to rough to polished boulders	Placer tin and gold deposits, monazite, garnet, limenite, rutile; diamoniferous conglomerate; floats and grave] beds of corundum, kyanite, sillimanite, floats and talus deposits of magnetite	Pitting in grids; trenching hydraulicking, sluicing and pannings for bulk sample, concentration and concentrate analysis, large diameter drilling; boulder exposure tracing in alluvial and colluvial terrains; geomorphic analyses of terrain and slope formation.

ANNEX B
(normative)
Guidelines for environmental studies for exploration/mining

The environmental base line data is to be acquired during mineral exploration comprising the following:
a) Geoscientific data base
b) General demographic data

B-1 Geoscientific data base

B-1.1 Geological documentation

i. Geological map of the area (Quarternary and recent formations to be mapped if needed).

ii. General geological data;

- Lithology and its distribution pattern
- Rock texture and its variability
- Mineralogical data for significant lithologies
- Chemical composition of rocks and soils
- Type of deposits
- Thickness of soil cover and other overburden/ interburden
- Thickness of ore body with its morphological feature
- Ore to overburden data

iii. Structural Geological Data:

- Lineament
- Folds
- Faults
- Foliation
- Joints
- Dip and strike
- Igneous intrusions (dykes, sills, etc.)

iv. Rock Texture, (crystallinity, grain size, shape, etc.).

B-1.2 Geomorphological map and terrain analysis

i. Geomorphological Mop, on a scale of not less than 1: 50 000.

ii. Land forms-hills, plateaux spurs, valleys, low-lying plated, scarps, peneplained areas, height from local erosional surface. Surface water regime-flow dimensions of rivers, streams and nallas, ponds, lakes and reservoir-bodies, etc.
Water-falls with water flow measurement during the different local seasons. General stream system with its relation to minor/major river basins (for regional-scale documentation and landsat imageries if available, may be used).

iii. Terrain analysis

- Break of slope analysis

- Vulnerability of soil/surface deposits, etc., to erosion, sate of erosion due to surface drainage, etc.

B-1.3 Geotechnical documentation

i. Slope stability study, of hill and natural slopes.

ii. Geological Discontinuities, (Nature of their occurrence, orientation and position in space, continuity, intensity, surface properties, etc.).

iii. Geological Hazards Studies, (Subsidence, landslides, mud-flow, seismicity, etc. Past record, frequency, intensity, areal extent of areas prone to these hazards).

iv. Geotechnical Properties, of rocks to be subjected to mining operations.

- Joint survey, (Type of structure, position in space, orientation, intensity, joint wall rock hardness, continuity, gauge strength).

- Physico-mechanical properties, of the rocks, soils, etc., and their distribution. Hardness, density, adsorption, soluble component, organic material, strength, elasticity, permeability, swelling index, etc.

- Solid bed and soil quality analysis, (Grain size, plastic limit, water content, specific gravity, bulk density, organic material content, soluble material content, coefficient of permeability, cohesion and coefficient of internal friction).

B-1.4 Geohydrological documentation

i. Geohydrological Map of the Area (showing groundwater table, aquifier, wells, spring, drainage channels reservoirs, etc.).

ii. Ground Water Inventory, (flow pattern with seasonal fluctuations to be specified).

iii. Geophysical Data Acquisition, (available log of bore holes, data on temperature gradient and radio activity, etc.).

iv. Geochemical Investigations, of soil, orebody, over-burden rocks, underlying rocks, etc., with particular reference to toxic elements.

v. Physical and Chemical Qualities, of surface and ground water:

- Physical (taste, turbidity, color, odor, etc.)
- Chemical

- Total solids (amount, nature and composition)
- Water analysis (Important chemical constituents and deleterious substances (harmful elements, total hardness, Eh, pH, COD or chemical oxygen demand, etc.)

- Bacterial analysis (coliform test)

B-1.5 Other potential hazards

i. Air

- Background qualitative appraisal, of ambient air quality. Mass concentration of the particulate matter (mg/m3), sulphur oxides. (mg/m3), nitrogen oxides, carbon dioxide, carbon monoxide hazardous toxicates, etc.

- Atmospheric heat
- Radioactivity (particulate) in air
- Thermal discharge, due to spontaneous combustions, mine fires, etc.

ii. Noise and vibration

- Existing level
- Possible causes/sources
- Effects/observation, if any

B-2 General demographic data

B-2.1 Location

B-2.2 Aerial extent

B-2.3 Altitude

B-2.4 General topography

Topographic map of the area marked or referred to with' at least a triangulation station or other established altitude points (bench mark), on a scale or 1: 50 000 with a contour interval of not more than 20 m to be submitted with a brief description of topography.

B-2.5 Features existing within 10 km of the site

i. Human Settlements, number of villages and their population (including tribal), with particulars regarding their means of livelihood and habits. Fishing habits if any; prevailing earning structure of the common people. Festivals and fairs (Places of religious importance and their ages). Incidence of gypsy camps/settlements in the area.

ii. Lands, distribution of government and private land, showing land-use pattern on map, specifying the forest land, revenue land, cultivable land, grazing land, etc. Type of cultivation, irrigational infrastructure. Cropping pattern, Income pattern from land, public attitude for mineral exploration from present land-use.

iii. Weekly shandy markets, shopping and recreational facilities, schools and hostels, etc.

iv. National parks, sanctuaries, places of archaeological interest, caves, other tourist spots, beach resorts, etc.

v. Railways, tramlines, aerial ropeways electrical transmission lines/substations, telephone lines, national/state highways, roads, tracks, waterways, pipelines, etc.

B-2.6 Meteorological Data, (with average annual and seasonal fluctuation pattern based on at least 5 years' data).

ANNEX C
(normative)

Environmental program for exploration projects

C-1 Preliminary exploration-stage I

C-1.1 Reconnaissance

Flora, fauna ecological archaeological, historical and heritage surveys.

C-1.2 Establish air, water and noise, ambient quality monitoring program. Assist in the location of access roads, drilling and camp sites and sight lines to reduce site impacts; supervise repair work.

C-2 Preliminary exploration stage II

C-2.1 Extend and upgrade the reconnaissance surveys. undertake preliminary surveys of terrain, soils and erosion, hydrological and meteorological studies and surveys of existing land use, residents and rural properties, local communities and townships
to cover area affected by possible mining project options.

C-2.2 Expand monitoring program into additional areas of potential disturbance. Work out cost-conceptual environmental engineering safeguards to minimize potential impacts associated with the components of the various project options.

C-2.3 Prepare CAC report, that is, Constraints, Alternatives and Safeguards report.

C-3 Detailed exploration/prefeasibility

C-3.1 Undertake investigations of natural and physical environment, land use, cultural, sociological and economic aspects of people and communities to ensure all potential constraints on the project are identified and defined.

C-3.2 Analyse the results of ecological, air, noise and water quality monitoring to establish ambient conditions before mining.

C-3.3 Examine each component of the project, the construction and the operational stages in order to identify and minimize direct and/or indirect impacts due to pollution and conflicts at the local, state and national levels, by change in the design and/or addition of safeguards and controls.

C-3.4 Prepare the environmental impact statement, detailing the likely and unavoidable effects of the projects.

C-4 Project planning

C-4.1 Undertake any additional work required by authorities' plan and commence all long-term and detailed environmental studies and research; to establish base-line conditions accurately.
C-4.2 Upgrade air, water and noise monitoring.
C-4.3 Commence rehabilitation trials.
C-4.4 Finalize design details for safeguards to satisfy pollution control requirements.