

FEDERAL REPUBLIC OF NIGERIA
MINISTRY OF MINES AND STEEL DEVELOPMENT (MMSD)

MINERAL SECTOR SUPPORT FOR ECONOMIC DIVERSIFICATION
PROJECT (MinDiver)

TERMS OF REFERENCE
FOR THE ENGAGEMENT OF CONSULTANCY SERVICES FOR QUALITY
ASSURANCE & QUALITY CONTROL OF TOPOGRAPHIC MAPPING
PRODUCTS USING THE MGCP DIGITAL MAPPING STANDARD

1.0 INTRODUCTION

The Federal Government of Nigeria has obtained a credit/loan from the International Development Association (IDA) to fund the Mineral Sector Support for Economic Diversification (MinDiver) Project. The project has the following development objectives:

- To improve the attractiveness of the Nigerian Mining sector, as a driver for economic diversification, for long-term private sector investment in the exploration and production of minerals.
- To create a globally competitive sector capable of contributing to wealth creation, providing jobs and advancing our social and human security.

2.0 CONTEXT

The Federal Government of Nigeria has embarked on an economic diversification campaign with the aim of leveraging on the Nation's vast natural resources to diversify the economy from the oil and gas sector to achieve economic emancipation.

The sector's growth and contributions to GDP have remained less than ideal, accounting for only about 0.33% in 2015. To address this, the Ministry of Mines and Steel Development (MMSD) recently developed a roadmap for mining growth and development with objectives to deepen sector reforms, attract new investors and collaborate with a wide network of partners and stakeholders to rejuvenate the sector and build a prosperous economy propelled by inflows from the solid minerals sector.

The overall objective of the MinDiver Project is to link with the Roadmap and enhance the mining sector's contribution to the economy by strengthening key government institutions, improving information infrastructure and knowledge, and fostering domestic investment in the sector. The Project consists of the following parts:

Part A. Establishing a Strong Foundation for Mining Sector Development

- Carrying out of a program of activities designed to strengthen the MMSD's capacity for governance and administration of the mining sector;
- Carrying out of a program of activities designed to strengthen the Nigerian Geological Survey Agency as well as geological knowledge and information infrastructure for the mining sector,
- Implementing a program of activities designed to strengthen the Recipient's capacity for management of environmental, health and social impacts in the sector

Part B. Facilitating Downstream Sector Development and Enhancing Competitiveness

- Strengthening administration of the artisanal and small-scale mining sub-sector,
- Implementing a program of activities designed to leverage the mineral sector for regional development
- Implementing a program of activities designed to enhance value addition to mineral products (including upstream development of industrial minerals and dimension stones domain) in the mining sector,
- Implementing a program of activities designed to advance proof-of-concept investments and to attract private sector investments

Part C. Project Management and Coordination

- Strengthening the capacity of the MMSD for implementation, supervision and management of the Project through the provision of goods, consulting services, non-consulting services, operating costs and training for the purpose.
- Supporting quality control of Project activities and outputs as well as monitoring and evaluation of Project outputs and results.

The key results of the project will include:

- Increased availability of precompetitive geo-science data enhancing mineral transactions;
- Institutional information systems integrated with multi-sector planning tools;
- Incentives created for Artisanal and Small-Scale Mining (ASM) formalization;
- Improved environmental and social compliance by mining industry operators

It is important to highlight that the focus of the advisory expert services is aligned with Subcomponent A2 of “MinDiver” Basic mapping with international standards using common satellite imagery and geophysical methods.

This Terms of Reference for Quality Assurance & Quality Control (QA/QC) will review the quality of the products to be produced under the TERMS OF REFERENCE published earlier regarding the following work description:

- **“.....Production of topographic mapping (Geo-database), using international standards (MGCP or Vmap2) to be used as "foundation/basic data" for the further development of geo-scientific products involving PRIORITY AREAS”**

The basic mapping unit area for this work is defined as a “Cell” which is a square area (1° Latitude X 1° Longitude). This unit normally comprises 16 maps at a 1: 50,000 scale. Any basic mapping requires the generation of topographic mapping products (Geo-database), using international standards such as Multinational Geospatial Co-production Program (MGCP) or VectorMAP Level 2 (Vmap2) so that the product can be used as "*foundation* or basic topo-data" for the further development of geo-scientific products (geology, geophysics, prospectivity analysis and interpretation). Consequently, the primary objective of the work is to **produce updated topographic maps (using international standards) to be used for other stages of the “MinDiver” project.**

In this regard and for operational purposes the Component A2-1 from the Project Appraisal Document (PAD) has been used to develop the IMPLEMENTATION work mapping **totalling 15.5 Cells (1 degree by 1 degree) of MGCP CARTOGRAPHIC PRODUCTION, which is approximately 248 topographic map sheets.**

3.0 PERSPECTIVE & OVERALL OBJECTIVES

Once the topographic mapping work has been contracted and the **first deliverable imagery and/or digital geospatial mapping products** have been produced, an independent quality assessment will take place on those submitted products. This activity called **Quality Assurance and Quality Control (QA/QC)** is the purpose of current Terms of Reference.

The purpose of this contract is focussed on the **preparation of QA/QC Reports and datasets resulting from the production of digital Topographic Line maps** that is considered as the first component of “Basic Mapping”. This mapping is required to complete map coverage in **areas of specific geological interest** as defined and demarcated by “MinDiver” Project within the “Proof-of-Concept” sites.

Topographic maps will identify numerous ground features, which can be grouped into the following categories: **Relief:** mountains, valleys, slopes, depressions as defined by contours; **Hydrography:** lakes, rivers, streams, swamps, rapids, falls etc, **Vegetation (Land Use):** wooded areas, farmland etc, **Transportation:** roads (paved and unpaved), tracks, trails, railways, bridges, airports/airfield; **Structures and Utilities:** buildings, urban development, power transmission line, pipelines, dams, towers etc; **Boundaries:** international, provincial/territorial, administrative, recreational, geographical etc; **Toponymy:** place names, water feature names, landform names, boundary names etc.

The mapping **products (MGCP standard) will be generated by an IMPLEMENTATION contractor based on the interpretation of the terrain and cartographic elements** using high-resolution (optical) satellite images (between 0.5 m and 2-5 m of spatial resolution). The 2-5m ground resolution imagery will be used to cover 100% of the Area of Interest (AOI), whereas the 0.5 m geometric resolution may be used for specific “target areas” specified by the client.

The satellite images will be used by the **MGCP IMPLEMENTATION contractor** to capture the terrain features and elements. These images will be ortho-rectified using a digital terrain model (DTM) with a grid, of at least 30 m to achieve a precision comparable to a DTED level 2-compliant product or similar. Normally, the consultant or

MGCP IMPLEMENTATION contractor, will be able to generate other “derived imaging products” during the work process such as anaglyphs for 3D viewing, image mosaics and terrain interpretation.

Once cartographic and typically topographic elements are extracted (*through imagery interpretation and feature extraction processes*) from satellite imagery -interpreted and vectorized, they will be stored in a standard *geo-database* that is already defined (Note: this geo-database is available in ESRI ArcGIS format). **The quality of the data entry work should be in accordance with the *Multinational Geospatial Co-production Program (MGCP)* standards to obtain a graphical representation scale of 1: 50,000 Topographic Line Map (TLM50).**

To ensure consistency among all satellite imagery interpreters, standard, common procedures and a Feature Extraction Manual, will be required, to be used by the MGCP IMPLEMENTATION contractor. The objective of this manual will be to have common definition of interpretative features leading to harmonization. This is important in order to obtain a quality product that is truly interoperable which can be used in several thematic areas outside of geological mapping and is a true multi-sectoral geographic data infrastructure.

NOTE-1: The “MinDiver” project will facilitate the **MGCP IMPLEMENTATION contractor** with all the **provision of existing topographic maps (from the Nigerian Ordnance Survey) of the areas, which require mapping, so that such dataset will be used as “reference or collateral information”.**

These existing topo-maps (in raster or vector format) will be useful to increase the quality of the features identified with the satellite imagery and to add the necessary *gazetteer* (place names) to the final MGCP or Vmap2 compliant product to be used in subsequent project stages. **Thus, the topo-mapping process (using MGCP or Vmap2 format) will serve as a real cartographic update for other government offices besides the use related to the geo-science products of “MinDiver”.**

NOTE-2: A Method will be designed –in a separate contract- by a mapping expert to extract ALL place names from existing topographic maps in a semi-automatic way and cross checking with other national sources in

order to have an adequate *toponimia* (placenames-gazetteer) to be used consistently in all products.

3.1 SCOPE of SERVICE (SPECIFIC OBJECTIVES)

1. **Quality control for 15.5 Cells** (1 degree x 1 degree) geodatabase according to MGCP 1:50,000 specifications.
2. **The cartographic works will be reviewed and validated, through QA/QC GAIT method.** The mapping IMPLEMENTATION activity briefly described will be supported by External QC/QC Consultants – the purpose of these TERMS of REFERENCE involves checking of all data generated and **providing final QC reporting of the work of the contractor firm undertaking the mapping work.** The Implementation Contractor/Consulting Firm shall work closely together with the External QA/QC consultants and correct all highlighted errors identified.
3. This QA/QC consultancy shall encompass the following operations:
 - **Develop the quality control methodology according to the existing MGCP 1:50,000 specifications and ISO 19157 “Geographic information - Data quality”.**
 - **Check the extraction quality of 15.5 Cells (1 degree x 1 degree) geodatabases results of the cartographic production project (Mapping IMPLEMENTATION Contractor).** The errors should be recorded in different cartographical error categories. The following list contains some examples of cartographic error categories:
 - i. **Format consistency errors:** Degree of adherence to the MGCP database conceptual schema.
 - ii. **Logical consistency errors:** Correctness of the features topological relationships and adherence of values to the established domains in MGCP TRD semantic model.

- iii. **Positional accuracy:** Quantitative error measures considering the MGCP maximum allowable errors for the cartographic scale 1:50,000
 - iv. **Thematic accuracy:** Incorrect identification, feature extraction or misclassification of the cartographic elements according to the MGCP TRD extraction guide.
 - v. **Usability:** Degree of adherence of the datasets to the final user requirements.
4. **Report the errors found to the cartographic supplier or Mapping IMPLEMENTATION Contractor.** These reports should include written documents with the description of the main problems together with the proposed solution and digital geographic files with the invalid features and shapes.
5. **Provide support to the cartographic supplier or Mapping IMPLEMENTATION Contractor to correct all errors reported.**

It is important to note that during the execution of the cartographic work by **MGCP IMPLEMENTATION Contractor** and along all stages of its development until final delivery, the **selected firm or independent QA/QC consultant will be following up the production work and will prepare quality control systems for cartographic production.** Consequently, **the pace of the QA/QC work will need to be adapted to the progress achieved by the mapping contractor and a strong coordination and information sharing (based on a predefined time frame) will be followed.**

In addition, the independent QA/QC consultant firm will check the topological and interpretative quality of the Geo-database being produced to ensure coherence and continuity of interpretations features (vector layers) in the assigned Cells. Special attention will be paid to coherence & continuity in adjacent edges with other Cells (border zones of two or more cells).

3.2 **PRIORITY AREAS**

The Nigerian area **covered by the Proof of Concept concession and other target areas** that require topo-mapping is subdivided according to the following priorities. These priorities are subjected to area grouping (during the mapping implementation work) that will be concatenated in time as follows:

- 1- TopoMap (MGCP Std.) Planning Areas A-1 & A-2
Totalling **71 topo sheets** 1:50k (TLM50)
- 2- TopoMap (MGCP Std.) Planning Areas B-1, B-2 & B-3
Totalling **47 topo sheets** 1:50k (TLM50)
- 3- TopoMap (MGCP Std.) Planning Area C1
Totalling **29 topo sheets** (TLM50)
- 4- TopoMap (MGCP Std.) Planning Areas D1, D-2, D-3 & D4
Totalling **85 topo sheets** (TLM50)
- 5- TopoMap (MGCP Std.) Planning Areas S2
Totalling **16 topo sheets** (TLM50)

Area Groupings

Areas A-1 & A-2 + Areas C1 -> 100 sheets (TLM50)

Areas B-1, B-2 & B-3 + Areas S2-> 63 sheets (TLM50)

Areas D1, D-2, D-3 & D4 -> 85 sheets (TLM50)

Therefore, strong coordination and information sharing (based on a predefined time frame & planning) will be followed and agreed by the teams carrying out the mapping and those undertaking the quality control and verification work.

4.0 REQUIRED QUALIFICATIONS AND EXPERIENCE

The Contractor firm's team shall include all the necessary expertise required to complete the work as specified within the terms of reference for the assignment. The experience required of the experts will include thorough knowledge of similar institutions of international standard as detailed below:

The consultant will be an engineering firm specializing in the analysis of the territory with proven experience in carrying out work in the field of cartography/mapping, remote sensing and geographic information systems, particularly in the generation of topographic mapping. Satellite images and especially in the use of MGCP formats.

The most important requirement is to have a staffing resource with direct and **demonstrable experience** at the firm or individual level of more than 3 years in the context of **production of vector data type MGCP**. The company must be able to demonstrate its technical capacity to complete the work in the time stipulated (**14 months**) by mobilizing QA/QC assessors and GIS specialists with demonstrable experience in MGCP format and related processes.

The firm should also demonstrate its abilities to organize a work team including specialists who have already worked in an MGCP project, with the United Nations or with other organizations using the same formats, **with special emphasis in the QA/QC process (GAIT)**. The consultants will be very familiar with the Feature Extraction Manual (FEM) and the structure of the MGCP-type of geodatabase.

It is recommended that the company/firm/consultant also has expertise in satellite image analysis to produce image by-products of more than 5 years, or in-remote sensing and GIS.

The Contractor’s Team should have the following Key Staff as tabulated below;

Position	No.	Qualification	Experience
<i>Team Leader QA/QC</i>	1	MSc in Mapping, Cartography, Gis or related discipline	At least ten (10) years in field of cartography/mapping, particularly in the generation of topographic mapping as well as remote sensing and geographic information systems. Demonstrated (proven) experience of at least (5) years working with MGCP data formats and strong background in QA/QC tools (GAIT for MGCP standard)
<i>GIS/QA QC Expert support person- MGCP topographic</i>	2	Master's degree in Earth Sciences or mapping/GIS	At least eight (8) years in field of geosciences, cartography/mapping, particularly in the generation of topographic mapping as well as remote sensing and geographic information

mapping			systems. Demonstrated (proven) experience of at least (3) years working with MGCP data. A strong background in QA/QC tools (GAIT for MGCP standard) is key for this position.
GIS and mapping assistant for QA/QC support	1	Master degree in GIS and good knowledge of topographic mapping standards (ESRI) geodatabases for MGCP topo mapping	At least five (5) years of professional experience in the preparation of mapping products derived from different data sources. Good understanding and hands on experience in GIS databases and geodata processing, especially the QA/QC GAIT procedure.

Key Selection criteria

The consultants shall be independent experts within their team having the following competences and qualifications:

- **Strong familiarity with MGCP quality control methodologies and tools: GAIT (Key requirement), ESRI data reviewer, topology.**
- **The consulting firm should have done, at least 4 Cells, in the last 2/3 years using the GAIT tool (latest versions) for MGCP quality assurance. This requirement will be critical for the selection process.**
- Good knowledge of GIS Suites compatible with MGCP schema: ESRI defense mapping, Geomedia, Digi3D.
- **Familiarity with MGCP / VMAP2 cartographic schema and ISO 19157 cartographic quality control specifications.**
- **More than 5 years of experience in image interpretation, feature extraction and cartographic production, including 20+ years of proven working experience using MGCP/VMAP2 standard.**
- Practical experience in topography or cartography quality control of and/or management of cartographic production teams.
- Systematic, rational and conscientiously working methodology.

- High degree of commitment, responsibility and flexibility. Service oriented attitude.
- High level of capability to organize and manage work, including the ability to cope with demanding tasks.
- **Degrees in agronomy, cartography, ecology, forestry, geodesy, geography, geology, topography or cartographic related areas. Recommended a master degree in GIS or remote sensing.**

5.0 REMUNERATION AND PAYMENT TERMS

The duration of the Topographic mapping QA/QC assignment will coincide with the time allocated to the Mapping Implementation contractor that will be in-charge of developing the set of products that will require QA/QC, and it could be extended thereafter based on satisfactory performance and needs of work extensions. The successful QA/QC consultant/ firm would be paid a lump sum amount, on a monthly basis as a function of the payment schedule agreed which will be based on the percentages of work to be completed in each of the milestones.

The assignment will be **done remotely and only four mission travels will be required**

1. To the offices of the Mapping implementation contractor (3 times)
2. To the “MinDiver” project office in Abuja (1 time).

The consultant will be reimbursed for operational expenses such as travel, accommodation incurred while carrying out this assignment and in line with World Bank guidelines and procedures. Before reimbursement can be made the consultant will need to submit a statement of expenses supported by valid documentation.

NOTE:

It should be noted that the Contractor firm in charge of the MGCP mapping production of the 15.6 cells will first have to carry out an **"internal quality control during the implementation of the mapping works"**. The editing of the Geo-database should be done with a minimum of 10% (sample) of the vector objects extracted as features.

Consultants/firms will use the quality control procedures normally used in the MGCP context (such as the GAIT test).

The QA/QC consultant/firm will eventually verify all the information in order to validate the map data in an objective manner. In addition, the QA/QC consultants will verify that the mapping contractor is implementing the changes into the final MGCP geodatabase as the mapping contractor has the responsibility to generate an "error free" geodatabase.

The result of this validation will be taken into consideration for the successive payments (at the completion of each 5 cells) related to the progress of the work. In addition, the consultant must provide the products free of topological errors (full topology checks & error free).

Once this QA/QC work will be assigned, the winner of the bidding process will submit a schedule for MGCP quality control of the Topographic Production which will be detailed within the contract signed between the "MinDiver" project and the QA/QC consulting firm(to be coordinated and agreed with the mapping production firm).

6.0 OUTPUTS, REPORTING and DELIVERABLES.

The Consultant will **report to the PIU's Project Coordinator for this project as well as the Geoscience Advisor.** The consultant is also expected to coordinate and communicate with the MMSD and work directly **under the technical supervision of the Geoscience Advisor and Technical Advisor** as well as other key consultants recruited.

The work-plan of the consultant will be directly dependent on the timeframe and schedule of geoscience-related activities as described above

Expected results of the mission

Check the quality of the extraction of 15.5 geo database cells of 1 degree x 1 degree concerning the cartographic production project of “MinDiver”. **The errors should be classified in different categories of map errors.** The following list shows some examples of map error categories:

- a. Format Uniformity Errors:** Degree of Conformity to the Conceptual Schema of the "MGCP" Database.
- b. Logical consistency errors:** Accuracy of the topological relationships of characteristics and respect of values of domains established in the MGCP TRD semantic model.
- c. Location precision:** Quantitative error measures considering the maximum allowed errors of the "MGCP" for the cartographic scale at 1: 50,000.
- d. "Thematic" accuracy:** Non-correct identification, feature extraction or misclassification of map elements according to the "MGCP TRD" extraction guide
- e. User-friendliness:** The degree of compliance of data sets with end-user requirements.

The **Consultant will produce the following reports:**

Expected deliverables

- a. **An Inception Report** outlining the work plan, defining its tasks and the planned implementation periods and schedules, identifying target submission dates of reports, based on a first assessment of the pipeline of the MGCP mapping deliverables. This schedule will be coordinated between the MGCP mapping contractor and the QA/QC firm. The report will be submitted within 4 weeks of the commencement of the assignment and once approved and issued in its final form, will serve as the consultant’s baseline for the management and monitoring of the tasks;
- b. **Monthly Progress Report;** The Consultant shall prepare Monthly Progress Reports covering progress towards achieving the objectives in this ToR in line with the main Topo Mapping contractor’s milestones and deliverables as well as

identified areas of weaknesses and strategies for improvement. The reports shall provide a brief but comprehensive end-of-month progress assessment and details of impediment to the works and proposals for overcoming them.

- c. **A Final Report** bound in three (3) copies and an electronic copy, within the last month of the assignment, taking into account the comments of **Geoscience Advisor** as well as other key stakeholders in MMSD.

All reports Shall Be in English and Presented to the Project Coordinator MinDiver and the final report will contain the following documents:

- Report highlighting the errors found on the part of the Mapping Implementation Supplier (cartographic products). These reports should include written documents with a description of the main issues found, proposal of solutions, as well as files (geospatial data) with the wrong features.
- Provide support to the mapping provider to correct any reported errors.
- Produce a **Report for each assigned MGCP Cell** with the computer files of the corrections made.

These corrections should be coordinated with the mapping contractor (implementation) in order to incorporate those corrections into the final mapping and satellite imagery product.

The Reports for each MGCP Cell will include, at least, the following information (as an indication only).

1. Introduction

2. Scope

3. Quality specifications summary

3.1. Image quality control (IMG_QC)

3.2. Preliminary quality control of the cartographic data (PRE_QC)

3.3. Topological and automatic quality checks of the cartographic data (AUTO_QC)

3.4 Visual quality control of the cartographic data

4. Report of the quality control results of the cell oXXEoXS

4.1. Results of image quality control (IMG QC)

4.2. Results of preliminary quality control of the cartographic data (PRE QC)

4.3 Results of topological and automatic Quality Checks of the cartographic data (AUTO QC)

4.4 Results of visual quality control of the cartographic data (MAN QC)

4.5 Summary of the quality control

Appendix A: Acronym list

Appendix B: Glossary of terms

Appendix C: Bibliography

Appendix D: GAIT checks results

Appendix E: Minutes of the teleconferences between the data providers and the quality control consultants

7.0 DURATION

The duration of the work is as follows, bearing in mind that the MGCP mapping **implementation period that is set at 14 months**. Therefore, and given the fact that QA/QC will need to continue after the submission of the last Cell, the **completion time for the QA/QC will be 16 months finishing two month after the MGCP mapping implementation work**.

Obviously, the time starts counting two months after the MGCP mapping implementation kick off. **Thus, it is advisable that signing the contract for QA/QC will take place immediately after the signing of the contract for the MGCP mapping**. However, the consultant / firm for the QA/QC is free to **organize its work according to the criteria of availability of geospatial datasets (deliverables)** and in line with the schedule of the MGCP mapping work or any other operational and organizational criteria.

8.0 CONFIDENTIALITY AND INTELLECTUAL PROPERTY

Confidentiality of “produced Deliverables and intermediate results used to undertake the QA/QC work”-

The deliverables of this Topographic Mapping contract as well as all the information on the QA/QC consulting work are products that contain information of a technical nature and confidential nature and is of the exclusive property of the client, the Nigerian Ministry of Mines (MinDiver project). The list of these *contract deliverables* will be subjected to confidentiality measures.

It is, therefore, necessary to establish **protection conditions** of this confidential information and to lay down the rules concerning their use and their protection, to avoid any dissemination, disclosure, use by the consultant (s), his staff or by some third parties.

The **Bidder-consulting** for the QA/QC Topo-Mapping firm will sign a “**Confidentiality agreement**” (relating to the mineral sector Support for economic diversification (MinDiver) project **between** the firm and the **MindDiver** project). The Agreement will be signed at the same time as the contract for QA/QC Service Provision.

This “Confidentiality agreement” is to ensure commercial information (geoscience) related to the results and deliverables of the Topo-Mapping is NOT leaked or disseminated, in an unwanted way, by both staff of the consulting firm for QA/QC or staff of the Nigerian Ministry of Mines without the necessary dissemination consent. It is important to note that a parallel, Data Disclosure Agreement will be part of the Confidentiality Agreement. Note that severe penalties are foreseen in the event of violation of the agreement.

9.0 SELECTION METHOD

The consultant will be selected through QCBS selection method.