TERMS OF REFERENCE (ToR):

Development of Methodology and Model for data collection, processing and quality control

Project name: Geospatial Infrastructure and Valuation Enhancement (GIVE)

Activity: B.1.1.1

Contract no.: *(to be assigned)*

Task Duration: 12 months
Client: Federal Administration for Geodetic and Real Property Affairs (FGA), GIVE Project Implementation Unit

Document version: v1.0 – August 2025

CONTENTS

COMMON ABBREVIATIONS, ACRONYMS AND DEFINED TERMS

Abbreviation/Acronym/Term	Full terminology/Definition
ToR	This Terms of Reference
GIVE Project	Geospatial Infrastructure and Valuation Enhancement Project
FGA	Federal Administration for Geodetic and Real Property Affairs
Client	Federal Administration for Geodetic and Real Property Affairs
Consultant	The legal entity (firm or organization) contracted to deliver the services described in this Terms of Reference
FBiH	Federation of Bosnia and Herzegovina
Real Estate Register/RER	Legal term defined by FBiH regulation for the official database of real estate, including buildings, parts of buildings, and parcels. In official language of FBiH is the term "Registar nekretnina" (REN) used
Building Register/BR	Operational term used in the GIVE project. Synonymous with the Real Estate Register (RER) in legal terminology. In official language of FBiH is the term "Registar zgrada" (RZ) used
LSGU (Local Self-Government Unit)	Municipal or city-level administrative authority responsible for spatial planning, address management and local data maintenance
TopoDB/Topographic Database	Intermediate spatial database of features derived from DOP/LiDAR, used before integration into the Building Register
DOP/Digital OrthoPhoto	Geometrically corrected aerial imagery used for mapping buildings and land features
LiDAR/Light Detection and Ranging	Remote sensing method that produces 3D point clouds of the terrain and objects by measuring reflected laser pulses
CILAP	Capacity Building for Improvement of Land Administration and Procedures in BiH
SPR	Sales Price Register

DSM (Digital Surface Model)	Elevation model that includes buildings, trees, and all surface features
DEM (Digital Elevation Model)	Elevation model showing only the bare ground, excluding buildings and vegetation
LoD (Level of Detail)	Standardised scale of 3D building model complexity, ranging from basic footprints (LoD0) to detailed structures (LoD3+)
CityGML	Standard data model for 3D city objects and urban elements, supporting multiple LoD levels
LADM (Land Administration Domain Model)	International standard (ISO 19152) that defines a conceptual reference model for describing land administration systems
INSPIRE	EU directive requiring harmonised spatial data infrastructure and data exchange formats among member states
GIS (Geographic Information System)	Technology for capturing, storing, analysing and visualising geospatial data
SDI (Spatial Data Infrastructure)	Integrated framework of data, standards and technologies for sharing and using geospatial information
Metadata	Structured information that describes datasets, including content, origin, quality and usage conditions
QA (Quality Assurance)	Procedures to ensure the accuracy, consistency and reliability of collected or processed data

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION AND CONTEXT

As part of the implementation of the **Geospatial Infrastructure and Valuation Enhancement (GIVE)** project, the Federal Administration for Geodetic and Real Property Affairs (FGA) plans to establish the **Building Register (BR)** - which is legally referred to as the **Real Estate Register (RER)** under Federation of Bosnia and Herzegovina (FBiH) law. This register will represent a unified, spatially accurate, and attribute-rich database of buildings and other real estate across the territory of the Federation of BiH.

It will serve multiple strategic and operational purposes, including:

- Supporting the property mass valuation system;
- Facilitating spatial planning and development for local self-government units (LSGUs);
- Monitoring construction trends and dynamics;
- Ensuring interoperability with cadastral system, land register, address register, utility cadaster and other official datasets;
- Supporting sustainable development and climate-and risk-adaptive policies.

The GIVE project is financed through a World Bank loan, and the FGA serves as the implementing agency in the Federation of BiH. The Project Implementation Unit (PIU) established within the FGA serves as the operational and executive body responsible for the day-to-day implementation of project activities. The project aims to modernize land administration through the digitalization and standardization of spatial data, with a strong focus on the development of the **RER as a key infrastructural component.**

The RER must be developed in accordance with modern geoinformatics principles and aligned with the following:

- **High-accuracy spatial data collected through aerial surveys (DOP and LiDAR)**;
- **Integration of data from existing official registers** (cadaster, land register, address register, spatial plans, sales price register, utility cadaster, etc.);
- **Field collection of additional attribute data on buildings**;
- **Mechanisms for cyclic data updates** based on change detection.

Previous projects, such as **CILAP** (Capacity Building for Improvement of Land Administration and Procedures in BiH), laid important foundations — including pilot activities for building data collection in selected municipalities and the development of methodologies. These now serve as the basis for a scalable and institutionally sustainable implementation within the GIVE project, particularly under Component B.1.1.1.

2. GENERAL OBJECTIVE OF THE ASSIGNMENT

The objective of the consultant team is to develop a **technically precise, standardized, and scalable methodology** for the collection, establishment, and maintenance of the **Real Estate Register (RER)** in the Federation of Bosnia and Herzegovina.

The methodology shall include:

- All phases of collection, integration, validation, and updating of spatial and attribute data;
- Integration with official registers (cadastral system, land register, address register, spatial plans, sales price register, utility cadaster and other);
- Cyclical maintenance and monitoring of spatial changes;
- Institutional protocols for data processing, validation, and management.

The RER, which serves as a terminological equivalent of the Building Register (BR) acts as a **de facto repository of real estate data**. Its purpose extends beyond traditional land and building registers by focusing on **actual, up-to-date characteristics of properties** — including both formal and informal structures.

Through the GIVE project, the development of the RER is a **necessary precondition for the introduction of a property mass valuation system**, as it enables:

- Consolidated and standardized data for all properties;
- Algorithm-based approaches to estimate market value;
- A transparent and equitable real estate market.

In addition, the RER provides essential input for:

- Comprehensive and objective records of the existing built environment;
- Use of methodologically uniform valuation models;
- A foundation for social, urban, and climate-related policies.

To ensure the RER is functional, reliable, and interoperable within national and international spatial data infrastructures, the methodology must be based on established and recognized technical and geoinformation standards.

As a minimum requirement, the methodology must comply with the **INSPIRE Data Specification – Buildings v3.0 (2013),** which defines the structure and semantics of building data at the European Union (EU) level. This ensures alignment with European Commission directives and enables cross-border data exchange. It also ensures that the geometry, attributes, and relationships between entities are consistent and interpretable within a broader spatial data infrastructure.

In addition to INSPIRE, the methodology shall be technically structured based on the **CityGML 2.0 specification (OGC 12-019)**, which enables three-dimensional modelling of structures (e.g., LoD2/2.5 buildings) in accordance with international practices for representing urban and built environments. This is particularly important

in view of the planned acquisition of DOP and LiDAR data and the generation of highly detailed spatial building models.

Furthermore, the application of standards from the **ISO 191xx series** is mandatory, with a particular focus on:

- **ISO 19115** – for metadata definition and management, enabling all spatial layers to be properly documented and understood by users,
- **ISO 19157** – for spatial data quality assurance through clearly defined indicators of accuracy, completeness, consistency, and credibility,
- **ISO 19152 (Land Administration Domain Model – LADM)** – for modelling legal, administrative, and spatial aspects of property, essential for linking data from land registers, cadaster and address registers.

In addition to the above reference frameworks, the consultant team will be responsible throughout all phases of methodological development to:

- Identify additional relevant standards and technical guidelines applicable to specific tasks related to the development of the RER;
- Consult with the FGA project supervisory team to confirm the applicability of such standards within the institutional and technical context of the Federation of BiH;
- Include appropriate references to all standards and protocols within each deliverable.

Finally, all products and recommendations developed under this engagement must be technically compatible with the digital spatial infrastructure of the Federation of BiH, including interoperability requirements of public registers as defined in the relevant legal and technical framework.

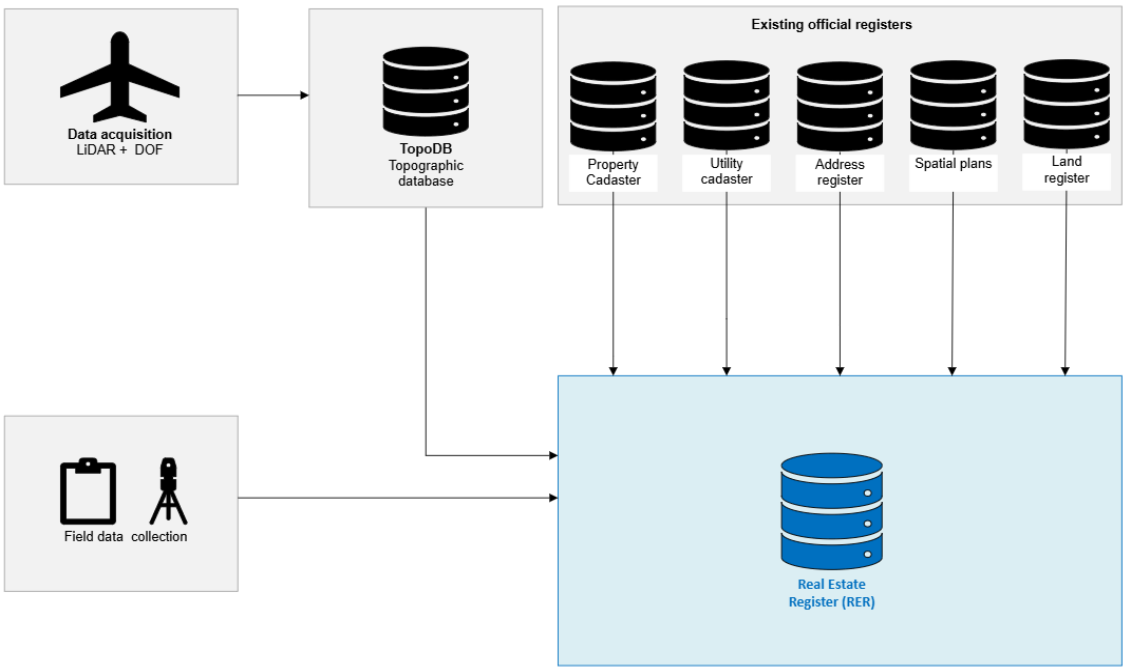

Figure 3.1.: Conceptual Scheme for Establishing and Maintaining the Real Estate Register

The conceptual diagram above presents a preliminary overview of the envisioned structure and data flow supporting the development of the RER. It is designed to assist the Consultant in gaining a clearer understanding of the interdependencies between data acquisition processes, existing registers, and the integration logic that underpins the future system.

The Building Register is conceptualized as a central database that consolidates spatial, legal, and functional data on buildings. It relies on three key input streams: **topographic data**, **existing registers** and **field data collection**. Each of these sources feeds into the RER by contributing specific attributes.

This schema is a conceptual design and does not imply finalized architecture or system design. It is intended to guide the Consultant in understanding the complexity of data integration and to support the development of a robust, standards-compliant methodology and technical framework for further phases of the assignment.

2.1. Collaboration with FGA, Validation, Timeline and Phase Coordination

The methodology for establishing the Real Estate Register (RER) will be developed in close and ongoing collaboration with the Federal Administration for Geodetic and Real Property Affairs (FGA), the leading institution for the GIVE project in the Federation of BiH.

The Consultant is required to:

- Maintain continuous communication and cooperation with the FGA supervision team throughout all phases of the assignment, through working meetings, technical sessions, and exchange of draft documents;
- Present each key deliverable to the FGA team for review and comment, including but not limited to the functional model of the RER, specifications for DOP/LiDAR acquisition, TopoDB design, and other technical components;
- Facilitate formal validation of each key deliverable prior to advancing to the next phase, including securing a signed record of acceptance or formal confirmation from FGA;
- **Provide a minimum of ten (10) working days** for FGA to review each major deliverable.

The total task duration is limited to a maximum of twelve (12) months, encompassing all phases of work, including validation, presentations, and incorporation of feedback.

Where appropriate, the Consultant and FGA may jointly identify specific activities that can be executed in parallel, provided that such parallelization does not compromise the integrity of the methodology or the final outcomes. Decisions regarding parallel execution shall be made by the designated project leads from both sides, considering phase interdependencies, data and resource availability, and overall implementation efficiency.

This approach ensures that the methodology development process remains efficient, high-quality, and aligned with institutional standards and expectations.

3. PHASE 1: INITIAL ANALYSIS AND CONCEPTUALIZATION OF THE RER

3.1. Objective of This Phase:

The objective of this phase is to lay a solid foundation for the full development of the RER methodology as one of the key outcomes of the GIVE project. To ensure efficient, sustainable, and institutionally acceptable methodological solutions, all subsequent phases must be built upon a comprehensive understanding of the legal, institutional, and technical context in which the RER will be developed and used.

This phase requires a detailed review of all strategic, legal, and operational documents relevant to spatial registers and a mapping of institutional mandates and capacities to provide a clear picture of the strengths and limitations of the existing system. The analysis must enable understanding of the regulatory framework for integrating the RER with other registers (cadaster, land registry, SDI, address registry, sales price register, utility cadaster, etc.) and identify any need for amendments or adaptations of existing laws and procedures.

Furthermore, this phase must conceptually define the vision and core functionalities of the RER-what is the RER, which data types it must include (geometric, functional, attribute), how it connects to other sources, and which standards it must follow (e.g. INSPIRE, CityGML, ISO 191xx, LADM). This creates a shared conceptual framework ensuring all later development phases are consistent, interconnected, and technically feasible.

Equally important, this phase serves as a diagnostic and planning basis—identifying necessary resources, competencies, technical solutions, and institutional support for full methodology implementation. By assessing existing capacities within FGA and local self-government units (LGUs), an initial strategic baseline will be defined, serving as the reference framework that FGA validates and uses to monitor progress and evaluate quality in subsequent phases.

In doing so, this phase not only provides analytical insight into the context but also establishes a common operational language among all stakeholders, including FGA, the consultant team, and other relevant institutions. Clearly defined expectations, institutional boundaries, and methodological assumptions reduce the risk of misalignment, duplication of effort, or inadequate implementation in later phases.

3.2. Tasks and Description:

The tasks outlined below represent the core analytical activities of Phase 1. This phase consists of four tasks:

1. **Analysis of the legal and strategic framework**

The consulting team will perform a comprehensive review of:

- Legal acts relevant to the RER (e.g. the regulation on the Real Estate Registry database, the Law on Surveying and Cadaster, the Spatial Planning Law, etc.);
- Strategic and project documents (e.g. the GIVE Project Appraisal Document, contractual frameworks, strategic objectives of Component B);
- International standards and guidelines (at minimum):
    - **INSPIRE Data Specification – Buildings v3.0 (2013);**
    - **CityGML 2.0 (OGC 12-019)**;
    - **ISO 191xx series**, specifically:
        - ISO 19115 (metadata),
        - ISO 19157 (data quality),
        - ISO 19152 (LADM – legal aspects of land administration).

The purpose is to guide the methodology development within a valid legal and technical framework and ensure future compliance with national and international legislation and interoperability requirements.

2. **Analysis of institutional structure and authorities**

The consulting team will map the roles of all relevant institutions, including but not limited to:

- **FGA** as the implementing body of the RER;
- **Local self-government units (LSGUs)** as potential field-level operational actors;
- **Land registry offices**;
- **Ministries and agencies** responsible for planning and infrastructure;
- Relevant reference projects and initiatives such as **CILAP** and previous pilot initiatives.

The purpose is to individually define the tasks, authorities, and relationships among institutions that have an operational or strategic role in establishing and maintaining the RER. This analysis lays the foundation for an appropriate governance and management model for the register.

3. **Defining core functionalities and database contents of the RER**

Based on the analysis above, the consulting team will conceptually propose the minimal mandatory set of features and attributes that the RER must contain. This includes but not limited to:

- Geometric data: **building footprints, heights, number of floors, and 3D models at LoD2/2.5**;
- Attribute data: **building classification, purpose/use, quality, construction status, areas (gross and net), number of units, year of construction**;
- Administrative data: **links to parcel IDs, addresses, cadaster and land registry identifiers.**

The purpose is to create an initial reference model to serve as the basis for designing the TopoDB database, conducting field data collection, and integrating with existing registers.

4. **Identification of needs and strategic preconditions**

The consulting team must prepare an initial analysis of the resources and assumptions required for successful implementation of the methodology. This includes but not limited to:

- Technical equipment available at FGA and partner institutions;
- Human resources and training needs;
- Institutional capacity for managing and maintaining the register;
- Potential challenges (e.g. data access issues, legal gaps, budget constraints);
- Recommendations for possible legal or organizational adjustments.

The purpose is to document a framework upon which FGA will confirm the continuation of work and steer subsequent activities according to priorities and realistic possibilities.

5. Assessment of LiDAR Data for Potential Use in RER

The consulting team shall conduct a detailed review of the ongoing LiDAR project in Bosnia and Herzegovina, which is currently in its final stage, in order to evaluate the potential use of its outputs for the development of the Real Estate Register (RER). The consultant will:

- Analyze the Terms of Reference, technical specifications, and deliverables of the LiDAR project contract;
- Assess the suitability of the LiDAR-derived products (point clouds, Digital Terrain Model, Digital Surface Model, and classified outputs) for integration into the RER methodology, particularly for building footprint delineation, height extraction, and 3D modelling at LoD2/2.5;
- Identify possible limitations, data quality issues, or gaps in relation to RER requirements (e.g., resolution, coverage, classification accuracy);
- Discuss the findings and preliminary recommendations with the Client to validate feasibility and identify potential adjustments;
- Incorporate the final recommendations into subsequent phases of this ToR, ensuring that the use of LiDAR data is considered as a strategic resource for cost-effective and accurate establishment of the RER.

3.3. Deliverables of Phase 1:

Table 4.1.: Deliverables of Phase 1

Deliverable	Description	Applicable Standards	Implementation Deadline

1. Context Analysis Document	Analysis of the legal, strategic and institutional framework for RER development	ISO 19115, INSPIRE	Month 1
2. Functional Model Document	Proposed scope, attributes, structure and functions of the RER database	INSPIRE v3.0, LADM, CityGML	Month 2
3. Conceptual Schema and Diagram	Visual representations of entity relationships, processes and data flows (using UML, BPMN)	ISO 19103, OGC	Month 2
4. Existing LiDAR Data Assessment Report	Comprehensive analysis of the LiDAR project deliverables, including recommendations for their potential use in the RER establishment.	*ISO 19157, ASPRS LiDAR guidelines*.	Month 2
5. Initial Assumptions Report	Assessment of resources, needs, risks, and recommendations for institutional arrangements	ISO 19157, internal QA	Month 2

3.4. Tasks Included in this Phase:

This phase includes a set of horizontal tasks that ensure a standardized, transparent and technically consistent approach to developing the RER methodology. All obligations must be carried out in parallel with the main tasks of the phase.

Compliance with international and domestic standards

- **INSPIRE Data Specification – Buildings v3.0 (2013)**: ensures interoperability and structural compliance with EU requirements;
- **CityGML 2.0 (OGC 12-019)**: for modelling of building geometry at LoD2/2.5;
- **ISO 19115 (Metadata)** and **ISO 19157 (Quality Control)**: for establishing consistent documentation and mechanisms for assessing data reliability;
- **ISO 19152 (LADM)**: for future integration of legal and institutional aspects of the property registry.

The consulting team is required to identify any other relevant standards during this phase and propose them to FGA for formal review and validation.

4. PHASE 2: DEVELOPMENT OF TOR FOR AERIAL DATA ACQUISITION AND TOPOGRAPHIC DATABASE (TOPODB) DESIGN

4.1. Objective of This Phase:

This phase is crucial for creating the technical foundation for producing the spatial data that will underlie the establishment of the Real Estate Register (RER). It involves preparing a consolidated technical document (ToR) for acquiring spatial data via Digital Orthophoto (DOP) and LiDAR surveys, and developing a structured, interoperable, and functional Topographic Database (TopoDB).

The TopoDB will serve as the core spatial database in which the datasets generated by analyzing aerial data (DOP and LiDAR) are stored and managed. The database will be designed to allow multi-layered and semantically rich representations of the environment, with data organized according to international standards such as INSPIRE Buildings v3.0, CityGML 2.0, ISO 19152 (LADM), and others.

At a minimum, the TopoDB will contain the following core data**:**

- **Objects:**
    - preliminary classification of objects (e.g., house, buildings and other structures),
    - object height,
    - number of floors,
    - roof outline,
    - roof type,
    - object footprint area,
    - object volume,
    - 2D/2.5D LoD2 geometry models.
- **Land Cover:**
    - forests,
    - agricultural land,
    - water bodies (rivers, lakes),
    - barren/rocky terrain,
    - other categories defined by INSPIRE coding**.**
- **Infrastructure:**
    - road and railway networks,
    - power lines and installations,
    - other public objects or linear structures.
- **Terrain:**
    - Digital Surface Model (DSM),

- Digital Terrain Model (DTM),
- generated layers for slope and aspect, used as inputs for spatial planning and risk analyses.

This Topographic Database will serve as the main source of spatial data for building and updating the RER. In particular, it will rely on automated analysis of DOP and LiDAR data using advanced algorithms for:

- object segmentation,
- recognition of building geometric properties,
- land cover classification,
- integration with cadaster and address register identifiers.

The TopoDB must be designed as a **PostgreSQL/PostGIS database (recommendation),** with a defined schema, referenced code lists, and connections to external systems via object identifiers and standardized APIs. The database design must ensure linkage with:

- cadastral parcels (cadaster IDs),
- addresses (address register),
- land use (urban plans),
- legal records (land register and property ownership).

The structure of TopoDB will be developed in parallel with the preparation of the ToR for DOP/LiDAR data acquisition. It will be used to define:

- the expected data layers and contents in the collected data,
- the data formats and attributes to be delivered,
- quality control procedures and validation methodology.

And together they will form an integrated technical framework for public procurement and spatial data processing.

Given the technical nature of the task, the FGA anticipates that this phase may be carried out partly **in parallel with Phase 1**, with the condition that coordination is maintained through project leaders on both sides. This flexibility should ensure efficient use of time and resources without compromising the quality of the final results.

4.2. Detailed description of tasks:

The consulting team will prepare a consolidated ToR document that encompasses and combines both geospatial data acquisition methods. This document must include all technical requirements, quality assurance procedures, and specifications of the output products to be delivered.

In order to achieve a reliable and semantically rich TopoDB, the consulting team must design the data model and processing workflow in a way that integrates both automated and manual classification steps. Automated classification, based on advanced algorithms (machine learning, deep learning, and rule-based feature

extraction), shall be applied to Digital Orthophoto and LiDAR datasets to generate preliminary object classes such as buildings, vegetation, infrastructure, and terrain features.

These automated results must then undergo a structured process of manual review and refinement to ensure compliance with quality requirements, remove misclassifications, and capture complex or ambiguous features that automated methods may not resolve. The combination of automation and expert-driven manual validation will ensure that the final TopoDB achieves the necessary accuracy, semantic detail, and interoperability with cadastral, legal, and planning registers.

The consultant shall clearly plan the documentation of the workflows of classification, including algorithms applied, decision rules, validation metrics, and the procedures for manual refinement. This documentation must form part of the technical annex to the TopoDB design, ensuring transparency and reproducibility of the process.

The tasks outlined below represent core activities of Phase 2. This phase consists of four tasks:

1. **Preparation of the ToR for DOP and LiDAR surveys**

The document must cover the technical, QA, and delivery requirements for both types of data acquisition.

It must specify all inputs, standards, and technical parameters, such as:

General requirements for the DOP (Digital Orthophoto):

- **Data type**: true orthophoto (with object tilt correction) to ensure planimetric accuracy of objects.
- **Resolution**: as proposed by the consulting team (FGA suggests 10 cm).
- **Format type and metadata**: GeoTIFF (uncompressed) and ECW (compressed) format with accompanying ISO 19115 and ISO 19139 XML metadata.
- **Coordinate systems**: ETRS89 and the national reference system (EPSG codes to be defined).
- **Purpose**: visual identification of buildings, roof contours, and their planimetric positioning.
- Data preparation for sharing using network services, optimization to be specified by the consulting team, including but not limited to:
    - Orthophoto tiles organized in a consistent naming convention,
    - Image pyramids creation,
    - Optimized cache packages (such as for WMTS/XYZ services).

General requirements for LiDAR survey:

- **Point density**: as proposed by the consulting team (FGA suggests 20–30 points/m²).
- **Mandatory classification**: Minimum classes proposed by the consulting team according to ASPRS.

- **Data formats and products**: classified .las/.laz files plus derived DSM and DTM layers.
- **Quality and validation**:
    - The RMS vertical accuracy (Z) must be specified, documented, and tested.
    - Classification accuracy must be assessed using control areas and ground truth validation.
- Coverage and homogeneity of data must be ensured. **Purpose**: To create building height attributes, volumes, terrain layers, and to automatically generate LoD2/LoD2.5 building geometry.
- Data preparation for sharing using network services, optimization to be specified by the consulting team (DTM/DSM and Classified Point Clouds).

The ToR document must clearly define the **quality control procedures and acceptance criteria**, expected deliverables, delivery formats, monitoring plan, expected inputs, survey control points, and the contractor's responsibilities.

2. **Development of TopoDB structure**

The TopoDB is a spatial database model that serves as the **operational basis for creating the RER**. It represents a repository of all output data from DOP/LiDAR surveys, including their derived attributes.

The recommended database structure is as follows:

- **Database and System**: PostgreSQL + PostGIS (mandatory open-source solution supporting spatial queries and versioning).
- **Spatial classes (Entities):**
    - **Buildings**: roof outline, height, area, volume, LoD2 (2.5D) geometry,
    - **Land cover**: forests, agricultural land, water bodies and other according to this ToR requirements,
    - **Infrastructure**: roads, railways, power lines, and other elements,
    - **Terrain**: digital terrain model (DTM), digital surface model (DSM), slopes, aspects.
- **Attributes**:
    - Spatial identifiers,
    - Unique object IDs,
    - Area, volume, building height,
    - Links to parcels, addresses, cadaster, and land register.

Alignment with Standards (recommended):

- INSPIRE Data Spec. Buildings v3.0 (2013),
- CityGML 2.0 (OGC 12-019),
- ISO 19152 (LADM),
- ISO 19115 (metadata),
- ISO 19157 (quality control).

3. **Integration of TopoDB design into the ToR for DOP/LiDAR survey**

The database structure must be **developed in parallel with the ToR** preparation to ensure full technical alignment between the expected data products and their placement in TopoDB.

Specifications for DOP/LiDAR acquisition must reflect the need to support automated and manual classification workflows, ensuring that the delivered datasets (e.g., point density, classification codes, orthophoto resolution) are fit for both machine-driven segmentation and expert validation.

The database design role is to:

- Define the layers and entities that the contractor must deliver (e.g., “building_geometry”, “vegetation_class”, “lidar_surface”);
- Specify the attributes and their data types;
- Determine data formats: raster (GeoTIFF), vector, database;
- Specify QA methodologies, including the use of validation points and control zones;
- Enable direct linkage between the source data and subsequent RER layers.

4. **QA plan for spatial data**

A quality control plan must be developed in accordance with ISO 19157 and should include:

- RMS errors for DOP (planimetric – XY) and LiDAR (vertical – Z);
- Point cloud classification validation;
- Comparative checks (visual and statistical);
- Definition of test zones and sampling;
- Documentation of quality control methods and ground control points.

4.3. Deliverables of Phase 2:

Table 5.1.: Deliverables of Phase 2

Deliverable	Description	Applicable Standards	Implementation Deadline
1. Draft Combined ToR (DOP + LiDAR)	Technical specifications for DOP and LiDAR survey, including QA methodology, data formats, CRS, expected products, and required layers/topologies	INSPIRE DS Buildings v3.0, ISO 19115, ISO 19157, ASPRS LAS 1.4, OGC	Month 2
2. Draft TopoDB Design	Database model with object classes, relationships, attribute schema, and links to other registers.	CityGML 2.0, ISO 19152 (LADM),	Month 2

	Implementation in PostgreSQL/PostGIS is recommended	INSPIRE, UML/BPMN	
3. QA Plan for DOP and LiDAR	Detailed plan for checking spatial accuracy, point cloud classification, coverage, and metadata. Includes RMS calculations, validation points, samples, and control zones	ISO 19157, ASPRS Accuracy Standards, internal FGA QA models	Month 3
4. Final ToR and TopoDB Model	Revised documents updated with FGA comments, including a validation log, versioned database schema, and final QA plan	Internal FGA protocols, document versioning	Month 3

4.4. Tasks Included in this Phase:

This phase entails a number of horizontal tasks that ensure the technical completeness, interoperability, and institutional compliance of spatial data acquisition and database design. All tasks must be conducted in parallel with the main tasks of the phase, with continuous collaboration with the FGA.

Compliance with international and domestic standards

- **INSPIRE Data Specification – Buildings v3.0 (2013)**: ensures the structural alignment of DOP/LiDAR data and their applicability in the EU context;
- **CityGML 2.0 (OGC 12-019)**: defines the semantic and geometric model of LoD2/2.5 buildings to be included in the projected layers;
- **ISO 19115**: Metadata standard – each generated dataset (DOP, LiDAR, TopoDB) must have complete documentation of source, validity, and specifications;
- **ISO 19139**: XML implementation of the ISO 19115 standard according to Implementing Rules for Metadata in the Federation of BiH;
- **ISO 19157**: Spatial data quality standard – includes RMS errors, classification accuracy, and coverage;
- **ISO 19152 (LADM)**: Relevant for long-term integration of TopoDB with legal records (cadaster, land register).

The consulting team must continuously identify any additional technical standards relevant to this phase and propose them to the FGA for consideration and formal approval through the supervisory mechanism.

Given the highly technical nature of this phase, some activities may proceed **in parallel with Phase 1 analyses**, especially those related to database structure modelling and technical parameters for DOP/LiDAR surveys. Decisions on this will be

made by project managers from FGA and the consulting team in coordination meetings.

5. PHASE 3: DEVELOPMENT OF THE RER DATABASE MODEL

5.1. Objective of This Phase:

Build a structured, interoperable, and multi-layered database model for the Real Estate Register (RER) that enables the integration of spatial and attribute data on buildings, their units, and legal statuses. This model must facilitate the integration of object geometries (LoD2/2.5) with registry sources and ensure future compatibility with mass property valuation system.

This phase also aims to operationalize the core concepts defined in previous phases by creating a concrete database in a PostGIS environment (recommended), along with all relevant technical specifications and documentation.

5.2. Detailed description of tasks:

The tasks outlined below represent the core activities of Phase 3. This phase consists of seven tasks:

1. Building classification and definitions

In this activity, the Consultant's team must systematically harmonize and finalize the building classification. Although the basic classification categories have already been developed in previous projects (e.g., CILAP, SPR, etc.), targeted research and adaptation for the needs of the RER are necessary. The SPR classification that exists is a classification according to the real estate market and does not necessarily correspond to real estate in the field. This step is crucial because the classification structure directly determines the entities, attributes, and business rules in the database.

The Consultant shall carry out the following activities:

- Collect and review existing classifications and relevant sources (CILAP, SPR/FGA reports, legal framework) and analyze the existing classes, code lists, and definitions already used in similar projects;
- Consolidate and compare the collected classifications and prepare a unified proposal adapted to RER requirements;
- Clearly define each class (a concise and unambiguous definition that precisely determines the inclusion criteria for that class);
- Preliminary determine the minimum (mandatory) and supplementary (optional) set of attributes to be collected for each class (e.g., for a building: footprint, height, number of floors, LoD; for a unit: area, floor, function);

- Identify and describe all cases of inconsistencies or gaps from previous data (where data or legal basis are missing) and propose practical solutions (additional field survey, legal verification, modification of code lists).

The recommended basic classes include (but are not limited to):

- Residential buildings (house, row house, duplex),
- Apartments (apartment, apartment in a house),
- Commercial buildings and parts of buildings (retail units, tourism/hospitality facilities, sports and recreation facilities, offices),
- Mixed-use (residential-commercial) buildings,
- Garages (detached, row, parking space in building, open parking space),
- Industrial buildings (light and heavy industry),
- Agricultural buildings,
- Parts of buildings (apartments, , commercial premises, garages and similar),
- Other buildings and structures (e.g., covered structures, canopies).

The Consultant is required to deliver a document containing the building classification with detail definitions (terminology) and codes. This step must be completed before the development of the ER model to ensure the model complies with legal, technical, and operational requirements.

2. Creation of the Entity-Relationship (ER) database model

The consulting team will develop a **structural database model** serving as the backbone of the future information system for the RER. The ER model must provide a **logical representation of all entities and their relationships**, ensuring proper integration of all relevant data – spatial, attribute, and legal.

The model will include at least the following **core entities and their characteristics (examples)**:

- **Building** (as the central entity of the RER),
- **Parts of buildings** (e.g., apartments, commercial premises),
- **Parcel** (cadastral unit on which the building is located),
- **Ownership** (links with land register and LADM structures),
- **Use,**
- **Object status,**
- **Number of Floors and Morphological Characteristics**,
- **Floor Level of Unit** (micro-location)
- **Data Sources and Revisions** (to track the origin of the data).

The model must include **one-to-many (1:N) relationships** (e.g., one building has many units) and **many-to-many (M:N) relationships** (e.g., multiple owners for multiple units). These relationships must be explicitly represented, with identifying links and clearly indicated **primary and foreign keys**.

The ER model must be drawn using **UML notation**, including class diagrams, data flow diagrams, and other visualizations needed to understand dependencies. All entities and relationships must have unique ID labels to enable future versioning,

synchronization with other databases, and maintenance of data integrity over the system's lifecycle.

3. **Definition and classification of attributes**

For each entity in the ER model, the team will develop a **detailed description of attributes** with a clear classification by origin, type, and purpose.

Attributes will be categorized by their sources:

- **From DOP/LiDAR**: spatial data generated by aerial image analysis, including:
  - object footprint contours,
  - object height,
  - area,
  - volume,
  - geometric center,
  - roof type and slope.
- **From official registers** (cadaster, land register, address register):
  - parcel ID,
  - ownership information,
  - address,
  - legal status,
  - planned and registered land use.
- **From field data collection**:
  - construction material,
  - number of functional units,
  - building condition (e.g., well-preserved, devasted),
  - energy efficiency class,
  - year of construction or renovation (if not known from other sources).

For each attribute, the following must be specified:

- **Name and description,**
- **Data type** (text, number, date, geometry),
- **Unit of measure** (m², m³, classification code, etc.),
- **Validation rules** (e.g., value range between 0 and 100),
- **Obligation and tolerances** (e.g., "required if use = residential"),
- **Defined source and date of last update.**

The goal is for the database to support **consistent data entry, validation, and reporting**, and to enable straightforward interoperability with other registers through clearly defined semantics.

4. **Standards alignment**

To ensure long-term sustainability and possibility of integration with national and international systems, all parts of the database model must comply with the following standards (at minimum):

- **INSPIRE Data Specification – Buildings v3.0 (2013):** used as a framework for semantic and structural attribute mapping;
- **CityGML 2.0 (OGC 12-019):** applied for the geometric representation of objects at LoD2/2.5;
- **ISO 19152 – Land Administration Domain Model (LADM):** used to structure relationships, ownership links, status, and land use of properties;
- **ISO 19115:** the primary standard for documenting metadata (sources, versions, contact points, validation elements) for all tables and attributes;
- **ISO 19107**: specifies conceptual schemas for describing the spatial characteristics of geographic entities, and a set of spatial operations consistent with these schemas;
- **ISO 19103**: specifies provisions for the use of a conceptual schema language within the context of modelling geographic information. The chosen conceptual schema language is a subset of the Unified Modeling Language (UML).

If the consulting team identifies additional standards that could enhance the model's functionality or interoperability, they must propose them to the FGA for consideration and formal approval.

5. Database schema and administrative documentation

Based on the ER model, a technical **database schema** will be created, implemented preferably in PostgreSQL/PostGIS.

The schema must include (at minimum):

- The structure of all tables and entities;
- Precise definitions of attributes and their data types;
- Constraints and relationships (e.g., foreign keys, not null, unique);
- Validation rules;
- Sample queries and rules for generating reports.

In addition to the database, the consultant must prepare an **administrative manual** for database management, which includes

- Versioning policy,
- Access rights,
- Change log,
- Proposed procedures for incremental updates.

6. QA measures and metadata

Every table and attribute must be documented according to **ISO 19115**, including:

- Description of content and purpose,
- Defined data source (e.g., cadaster, DOP, field),
- Date of last update and entry,
- Responsible person or institution (contact point),

- Entry version and revision history.

This documentation will allow **full data traceability and high-quality validation throughout the database's lifecycle**, especially in cases of legal or technical audits.

7. **Versioning and validation of the model**

The database model must be tested in a **demo environment** using a simulated dataset (dummy dataset) for all key entities. The aim is to verify that the model allows:

- logical and technically correct entry of all necessary data,
- consistent validation of attributes and relationships,
- clear report generation and the ability to synchronize with other systems.

All changes and revisions during testing must be documented in a **Change log**, including:

- date of change,
- reason for change,
- version identifier,
- comments from the responsible person.

Final validation and approval to use the model as version "1.0" will be given by the FGA after the model meets all requirements and passes verification through trial data entry and simulation.

5.3. Deliverables of Phase 3:

Table 6.1: Deliverables of Phase 3

Deliverable	Description	Applicable Standards	Implementation Deadline
1. Document with building classification and definitions	Consolidated building classification from CILAP/SPR/FGA/legal sources: codes + concise definitions, preliminary mandatory/optional attribute lists, identification of gaps and proposed remedies	INSPIRE, LADM, CityGML, national legal framework, internal FGA validation	Month 5
2. ER model for the RER database	Contains entities, relationships, and linkages	LADM, INSPIRE	Month 5

3. Attribute list and descriptions	Purpose, source, type, and control for each attribute	ISO 19115	Month 5
4. Database schema and flow diagrams	Visual representation and structure	CityGML, UML	Month 6
5. QA protocol and metadata	ISO QA checklist and XML metadata	ISO 19157, ISO 19115	Month 6

5.4. Tasks Included in this Phase:

This phase involves a set of horizontal tasks and control mechanisms to ensure that the RER database is standardized, transparent, and ready for subsequent implementation.

Compliance with international and domestic standards (at minimum)

- **INSPIRE DS – Buildings v3.0 (2013);**
- **CityGML 2.0 (OGC 12-019);**
- **ISO 19115, ISO 19157, ISO 19152 (LADM), ISO 19103, ISO 19107.**

The consulting team must continuously identify any additional technical standards relevant to this phase and propose them to the FGA for consideration and formal approval through the supervisory mechanism.

Collaboration and validation:

- **All models, schemas, and QA protocols must be validated through workshops with the FGA team.**

Duration and schedule:

- This phase is planned for a **minimum of 90 days**, including FGA review periods;
- Each key deliverable must allow **at least 10 working days for comments and validation**;
- FGA and the consultant team may agree on parallel processing of parts of the database as long as it does not compromise the consistency of the final deliverables under this ToR.

6. PHASE 4: DATA INTEGRATION AND FIELD DATA COLLECTION METHODOLOGY

6.1. Objective of This Phase:

Develop a unified, technically grounded methodology that defines how the Real Estate Register (RER) is **populated and updated** by combining:

1. data from official registers (cadaster, land register, address register, spatial planning documents, sales price register, utility cadaster etc.),
2. results from aerial surveys (DOP/LiDAR and TopoDB), and
3. data collected through structured field data collection.

This phase plays a key role in **integrating and harmonizing multiple sources** into a single, standardized and operational RER database. Its implementation provides a technical framework for linking spatial, attribute and legal information through precisely mapped processes and QA protocols.

Given that most of the activities are of a technical and integration nature, the FGA foresees that the phase can be **realized to a large extent in parallel with phase 3**, with the agreement of the project teams of both parties.

6.2. Detailed description of tasks:

The tasks outlined below represent the core activities of Phase 4. This phase consists of six tasks:

1. Integration of official registry data into the RER

This activity involves a **detailed analysis of the available official registers** in the Federation of BiH that contain data relevant to real estate, aiming to determine **their potential for integration into the future RER structure**. The focus areas include:

- The **cadastral database**, including infrastructure, technical attributes, parcel records, land use data, and registered buildings;
- The **Land Register (LR)**, as the source of legal status and ownership relations over parcels and buildings;
- The **address register**, which enables an unambiguous link of buildings to their location and postal codes;
- **Spatial planning databases**, which may contain additional information on land use, building status, and current or planned use depending on object classification.

The consultant team should:

- Document the technical characteristics of each source (format, structure, key attributes);

- Identify how entities from the registers (e.g. parcel, building, user) can be **mapped and linked** to the corresponding entities in the RER (building, unit, owner);
- Develop technical documentation for **harmonizing code lists, classification schemes, and ID systems** so that data from different sources can be unified without loss of semantic meaning;
- Connect the integration model to the **ISO 19152 (LADM)** standard, ensuring consistent modelling of legal relationships in space;
- This activity is crucial to ensuring the **legal relevance and interoperability** of the RER database with other official records

2. **Mapping attributes from DOP/LiDAR and TopoDB**

In this task, the focus is on **automatically extracting spatial characteristics of buildings** from aerial survey data – i.e. the DOP and LiDAR layers already prepared and structured in the TopoDB.

The consultant's tasks include:

- Defining **algorithmic rules and technical procedures** to derive attributes such as:
  - Preliminary classification of objects (e.g. house, building),
  - Preliminary land cover/land use,
  - Object height,
  - Preliminary number of floors,
  - Roof type,
  - Building footprint outlines,
  - Surface area (footprint area),
  - Volume,
  - Spatial position relative to surroundings.
- Identifying which of these attributes can be **reliably generated automatically** and for which **manual verification** is necessary (e.g. in cases of unclear imagery, overlapping objects, or vegetation cover)
- Documenting the software tools, input/output formats, and the methodology for accuracy evaluation.

The goal is to maximize the **automation of attribute generation**, while establishing defined accuracy thresholds and a clear QA mechanism.

3. **Field data collection methodology**

Since many attributes are **not available through existing registers or from DOP/LiDAR data**, it is necessary to develop a **specialized methodology for field data collection.**

The consultant team should:

- Define the structure of standardized procedures and data exchange forms that will be used in fieldwork;

- Select and propose technology for data entry (preferably **through defined and structured files that can be verified and imported into the system**);
- Precisely describe which attributes must be collected in the field, for example.:
    - **construction material,**
    - **year of construction,**
    - **energy efficiency class,**
    - **current use** (e.g. residential, commercial),
    - **number of apartments or usable floors** not clearly visible from aerial images.
    - **other attribute data in accordance with the FGA.**
- Ensure that the methodology is compatible with the results of previous pilot projects (e.g. CILAP), learning lessons from them and adapting to a broader scope.

4. **Organization and training of field teams**

Considering that the fieldwork will be extensive and of long duration, the consultant must:

- Prepare operational protocols and QA checklists.
- Develop a **handbook for field data collectors** that includes:
    - Definitions of each object type identified in the previous phase,
    - Instructions on how to complete the data collection forms,
    - Guidelines for using any tools or devices (if used),
    - Basic principles of data control and validation,
    - Measures for safety and communication in the field.
- Prepare guidelines for supervisory teams who will oversee the work of the field teams and conduct on-site quality control.

6.2.1. Data integration process diagram (Data Flow Diagram)

For successful integration of all data sources into the RER, it is necessary to graphically display the data flows, validation steps, and interrelationships between system modules.

The consultant’s tasks are:

- Create a data flow diagram using **BPMN, UML, or similar standards**;
- Create a graphical representation of **incoming data from registers, aerial surveys, and field data collection**;
- Identify all points of **QA control, validation, harmonization, and verification**;
- Show the final path of data from source to integration in the RER database;

The diagram must be clear, applicable, and ready to be used as a reference during implementation.

6.2.2. Quality criteria and completeness threshold

Finally, it is necessary to define:

- **Which attributes are considered mandatory** for each entity (building, parts of buildings, parcel);
- **The minimum requirements** for an entry to be considered “complete” (e.g. it must include basic geometric and functional attributes);
- Rules for **rejecting entries that are incomplete** or contain conflicts;
- Mechanisms for sampling and consistency checks of entries, including:
    - **cross-checking between sources** (e.g. DOP vs. field),
    - **sampling methodology**,
    - technical validations within the database (e.g. topological error checks).

These rules will be integrated into the QA plan and serve as the basis for data verification.

6.3. Deliverables of Phase 4:

Table 7.1.: Deliverables of Phase 4

Deliverable	Description	Applicable Standards	Implementation Deadline
1. Source map + attribute schema	Detailed specification of data sources and available attributes	ISO 19115	Month 7
2. Handbook for mapping DOP/LiDAR data	Algorithmic model and procedures for deriving attributes	CityGML, INSPIRE	Month 7
3. Field data collection methodology	Structure of forms, QA protocols, and operational manuals	LADM, QA procedure	Month 7
4. Data integration flow diagram	Visual representation of data flows through the system	BPMN, ISO 19157	Month 8
5. QA criteria and completeness thresholds	Minimal set of attributes and validation thresholds per entity	Internal FGA validation	Month 8

6.4. Tasks Included in this Phase:

This phase encompasses horizontal technical, organizational, and QA activities that ensure the validity and sustainability of the integrated data.

Compliance with international and domestic standards (at minimum)

- **INSPIRE DS – Buildings v3.0 (2013)**
- **CityGML 2.0 (OGC 12-019)**
- **ISO 19115, ISO 19157, ISO 19152 (LADM)**

The consulting team must continuously identify any additional technical standards relevant to this phase and propose them to the FGA for consideration and formal approval through the supervisory mechanism.

Collaboration and validation:

- Maintain joint workshops with the FGA and other stakeholders
- Validation of the methodology on sample territories
- All documents must include:
  - version control,
  - a change log table,
  - confirmation of acceptance of the version.

7. PHASE 5: TESTING THE METHODOLOGY AND PILOT IMPLEMENTATION

7.1. Objective of This Phase:

The objective of this phase is to **empirically test the developed methodology** by applying it to a **selected pilot area** – specifically, in the territory of two cadastral municipalities (“KO”) that are representative in terms of building types and diversity. This phase serves to **verify feasibility, identify technical and organizational challenges**, and provide concrete inputs for the final adjustment of the methodological approach before its broader implementation in the Federation of BiH.

The pilot implementation enables:

- **field verification of defined forms, applications and procedures**
- **testing of the data integration workflows from DOP, LiDAR, registers, and field data;**
- **evaluation of the quality of the output data and functionality of the database;**
- **identification of institutional and technical bottlenecks.**

The pilot areas are to be proposed by the FGA in cooperation with selected Local Self-Government Units (LSGUs), preferring diversity in building types, urbanization levels, data availability, and administrative readiness.

7.2. Detailed description of tasks:

The tasks outlined below represent the core activities of Phase 5. This phase consists of six tasks:

1. **Preparation and technical framework for the pilot**

Before starting field work, the consultant team – in collaboration with the FGA – will prepare an operational plan that includes:

- Selection of pilot cadastral municipalities,
- Analysis of the availability of spatial data (DOP, LiDAR),
- Identification of institutional partners at the local level,
- Logistical and technical preparations (database, tools, team training),
- Development of a timeline and QA checklists for the test period.

2. **Collection of DOP and LiDAR data**

This includes:

- Generating **TopoDB layers for the pilot area**;
- Extracting basic geometric and semantic attributes of buildings (height, footprint contour, volume, etc.);
- Providing visual inspection tools and support for the field team.

3. **Field data collection implementation**

Based on the methodology defined earlier, a field data collection is conducted in the pilot area. Activities include:

- Engagement of the field team (the service provider's responsibility);
- Collection of attributes not available by other means (such as construction material, number of apartments, energy efficiency class, building condition, and other attributes agreed with the FGA);
- On-site checking and validation of spatial data.

Linking the collected data with the existing DOP, LiDAR, and registry layers for full entry into the test RER database.

4. **Data integration into the test RER database instance**

Based on the developed database model and infrastructure specifications, a test RER database instance is implemented for the pilot area. The integration covers:

- Geometry from **TopoDB (DOP/LiDAR),**
- Legal and administrative data from the cadaster, Land register (LR), and the address register,
- Supplementary attributes from the field data collection.

This test database is used to verify the correctness of entity integration, attribute consistency, and data completeness.

5. **Analysis of results and evaluation**

After entering all relevant data, the consultant team and the FGA conduct an evaluation of the success of the test implementation. The analysis includes:

- Comparing data completeness against the defined **QA criteria**,
- Identifying errors, inconsistencies, and incomplete attributes,
- Evaluating the performance of tools, procedures, database, and field forms,
- Collecting feedback from local users and the field teams.

6. **Preparation of report and recommendations for scaling**

Based on the pilot conducted, the consultant prepares a **consolidated report** that documents:

- All lessons learned and technical challenges,
- Specific proposals for changes or optimizations to the methodology,
- Recommendations for phased or parallel scaling to the rest of the Federation of BiH,
- Identification of potential resource requirements and institutional capacities needed for wider implementation.

7.3. Deliverables of Phase 5:

Table 8.1.: Deliverables of Phase 5

Deliverable	Description	Applicable Standards	Implementation Deadline
1. Pilot preparation and launch	Selection of CMs, operational plan, logistics	Internal document + FGA approval	Month 9
2. Completed RER test database	Integrated data from three sources (DOP/LiDAR, registers, field data collection)	QA check + FGA verification	Month 10
3. Pilot phase report	Evaluation of results, recommendations for changes and scaling	ISO 19157, FGA review	Month 10

7.4. Tasks Included in this Phase:

This phase encompasses horizontal technical, organizational, and QA activities that ensure the validity and sustainability of the integrated data.

- Field supervision and geodetic validation in at least one CM;
- Verification of geometric accuracy and semantic consistency of attributes;
- Conducting workshops with the FGA team after pilot completion;
- Documenting all revisions and versions of the database and forms.

Note: This phase allows final adjustment of the methodology — based on empirical insights — before the start of wider implementation. The FGA will use the results for **formal approval of the final methodology and validation of the approach for the remainder of the Federation of BiH**.

8. PHASE 6: MAINTENANCE AND UPDATING OF THE RER

8.1. Objective of This Phase:

The objective of this phase is to establish a sustainable, systematic model for the **regular updating and technical maintenance of the RER database**, so that real estate data remains accurate, up-to-date, and usable for mass property valuation system, urban planning, fiscal policy, and other sectors. Maintenance includes **automatic change detection mechanisms** as well as **targeted field verifications** when the algorithms identify changes that cannot be reliably classified from aerial data.

This phase represents a **bridge between the one-time implementation and the ongoing management of the RER** as an official record.

8.2. Detailed description of tasks

The tasks outlined below represent the core activities of Phase 6. This phase consists of five tasks:

1. Development of a cyclical model for spatial data acquisition

Based on best practices in land administration and spatial planning, the consultant team will propose a model for cyclical acquisition of DOP and LiDAR data that allows:

- Periodic updating of geometric and visual data (orthophoto + point cloud),
- Coverage of the territory in rotational intervals (e.g. every 3–4 years),
- Prioritized acquisition of **urban and fast-growing zones** in shorter cycles.

The model should include a **timeframe**, prioritization criteria, and an indicative budget framework for implementation through public procurement.

2. Change detection using algorithms

Advanced algorithms are expected to be applied for **change detection** between two temporal surveys (for example, LiDAR DSM from 2025 and 2029) to highlight locations where building changes are likely to have occurred.

- Techniques may include analysis of height differences, NDVI changes, roof shape, and volume.
- The result is a **list of suspect objects** that are subject to further verification.

The consultant team will develop technical documentation and propose methods and software tools (open-source or commercial) for this purpose.

3. **Targeted field verification**

Instead of conducting a full comprehensive survey again, **a targeted field inspection** approach is proposed that focuses only on locations where:

- An increase in building volume exceeds a defined threshold (e.g. 30 m³);
- A demolition or an extension of a building has been detected;
- An overlap with other sources is detected (e.g. from LSGU databases).

The consultant team will propose **procedures and protocols for this type of inspection**, including activation thresholds, logging forms, and the logic for involving Local Self-Government Units (LSGUs) as partners.

4. **Data interoperability and exchange model**

For maintenance to be scalable and decentralized, it is envisaged to:

- Use **web services (WFS, WMS, REST API)** for data exchange between the RER database, cadastral databases, SPR, Utility cadaster, LSGUs, and other relevant authorities;
- Include metadata about changes (timestamp, user, reason for change);
- Provide technical specifications for data exchange formats, authentication, and security.

Ensure this model complies with **INSPIRE, OGC, and other identified protocols and standards**.

5. **Institutional management and maintenance plan**

For the long-term operation of the RER database, a clear division of roles and responsibilities is necessary. It is envisaged to develop an institutional model that includes:

- The **FGA** as the responsible body for maintaining the **spatial and technical components of the database**,
- An **outsourcing mechanism** for **updating attributes** obtained from fieldwork,
- A centralized mechanism for managing versions and revisions,
- Rules for **backup, archiving, restoration, and auditing of the database.**

8.3. Deliverables of Phase 6:

Table 9.1.: Deliverables of Phase 6

Deliverable	Description	Applicable Standards	Implementation Deadline

1. Cyclical acquisition model	Proposed intervals, data types, and priority zones	INSPIRE, ISO 19157	Month 11
2. Algorithmic change detection approach	Technical documentation of methods and software	Internal QA document	Month 11
3. Protocol for targeted verification	Decision logic and validation methodology	QA + local validation	Month 11
4. Interoperability and exchange plan	Technical specifications for services and APIs	INSPIRE Network Services	Month 11
5. Institutional maintenance plan	Distribution of roles, system documentation, and version control	ISO 19152 (LADM), internal model	Month 11

8.4. Tasks Included in this Phase:

- Propose standards that enable the **automatic integration** of changes into the RER;
- **Ensure alignment with previously defined technical and organizational structures**;
- Collaborate with the FGA and other relevant institutions to **validate and adopt the proposed maintenance system**.

9. PHASE 7: FINALIZATION OF THE METHODOLOGY AND GUIDELINES FOR BROAD APPLICATION

9.1. Objective of This Phase:

The objective of this phase is to consolidate all elements of the developed methodology for the Real Estate Register (RER), and to harmonize and validate them so as to establish an official, versioned document ready for wide institutional application. This phase plays a key role in transforming the experimental methodology into an operational framework that can be systematically implemented across the Federation of BiH.

9.2. Detailed description of tasks:

The tasks outlined below represent the core activities of Phase 7. This phase consists of five tasks:

1. **Finalization and technical editing of all documents**

The consultant team is required to consolidate all components of the methodology developed through the previous phases - including ToR documents, technical specifications, data models, algorithmic procedures, and QA plans - **into a single, consistent document**.

The editing must ensure:

- consistency of terminology (especially for terms such as “building”, “special part of the building”, “volume”, “LoD2/2.5”, etc.),
- elimination of contradictions and redundancies,
- inclusion of clear references to standards and sources (e.g. INSPIRE, ISO, LADM, CityGML).

2. **Versioning of all methodology components**

Each key element of the methodology (e.g. the data model of the RER database, ToR for DOP/LiDAR, field data collection methodology, QA protocols) must have:

- A version number (e.g. v1.0),
- A log of changes and comments from the validation process with the FGA,
- Linked documents (e.g. data flow diagrams, UML models),
- A validation status (approved, in preparation, or for review).

The versioned documents are to be delivered in Word and PDF formats and stored in the centralized FGA documentation archive.

3. **Preparation of an implementation guide for LSGUs**

To enable broad application of the RER, the consultant team will prepare a **detailed implementation guide** for Local Self-Government Units (LSGUs), which includes:

- Technical and legal steps for accessing the RER database,
- Obligations for updating and verifying local attributes (e.g. from field data collection),
- The role of key partners in exchanging data with the FGA,
- Recommendations for interoperability with other information systems.

4. **Recommendations for legal and institutional changes**

If, during the development of the methodology, any aspects were identified that are not adequately supported by current legal or regulatory acts (e.g. the legal obligation to conduct field data collection, data exchange between registers), the consultant team will develop **precise legal-technical recommendations** for amendments or additions to the relevant regulations.

These recommendations should be presented as:

- An analytical review of the existing legal framework,

- Specific proposed changes to law/regulation articles,
- Comparative examples (e.g. from EU countries).

5. **Final presentation and workshop with the FGA and partners**

A final **interactive workshop** will be organized, during which the consultant team will:

- Present the main components of the methodology,
- Demonstrate the data flows and database structure,
- Define a framework for future revision and evolution of the methodology through versioning and feedback from practice.

9.3. Deliverables of Phase 7:

Table 10.1.: Deliverables of Phase 7

Deliverable	Description	Applicable Standards	Implementation Deadline
1. Final methodology	A consolidated document (Word + PDF) with all annexes	(QA team + FGA)	Month 12
2. Implementation guide for LSGUs	Step-by-step instructions for operational application	Legal + technical sections	Month 12
3. Recommendations for legislative changes	Legal analysis and proposed amendments in text form	Internal approval	Month 12
4. Final workshop	Presentation, QA session and minutes of conclusions	Public report + validation	Month 12

9.4. Tasks Included in this Phase:

- Formal acceptance of the methodology by the FGA is considered the end of this phase;
- All documents should be published in digital form on the official web platform (portal/repository);
- It is recommended to assign a dedicated **organizational unit within the FGA** to manage iterations of the methodology and validation of new versions;

- Planned updates must be based on the experience from the pilot and maintenance phases.

10. SUMMARY TABLE: PHASES, KEY DELIVERABLES AND DEADLINES (FINAL VERSION)

Table 11.1.: Summary table: phases, key deliverables and deadlines

Phase	Key deliverables	Deadline (months from contract)
Phase 1: Initial analysis and conceptualization of the RER	Analysis of the strategic, legal and institutional framework; defined concept of the RER and initial baseline; approved findings and baseline assumptions	**Month 2**
Phase 2: ToR development for DOP/LiDAR and TopoDB design	Unified ToR for aerial acquisition; draft and final TopoDB design; QA plan for spatial data	**Month 3**
Phase 3: Development of the RER database model	Building classification and definitions; ER model of the database; list and classification of attributes; technical database schema; QA specifications and metadata	**Month 6**
Phase 4: Data integration and field data collection methodology	Technical manuals for integration of register and acquired data; field data collection methodology and training; data flow diagram	**Month 8**
Phase 5: Pilot implementation of the methodology (2 cadastral municipalities)	Populated test instance of the RER; pilot implementation report; identified recommendations for scaling	**Month 10**
Phase 6: Model for maintenance and updating of the RER	Proposed cyclical acquisition plan; change-detection algorithms; targeted verification protocols; interoperability model; institutional responsibilities	**Month 11**
Phase 7: Finalization of the methodology and guidelines for application	Final methodology (version 1.0); implementation guide for LSGUs; legal/institutional recommendations; final stakeholder workshop	**Month 12**

Payments under the consultant contract will be made in a total of **four tranches**, each linked to key phases and groups of deliverables. Each payment is subject to formal approval of respective deliverables by the **FGA supervision team**, with confirmation of fulfilment by the **FGA Project Manager**.

10.1. Overview of the payment tranches

Table 11.2.: Overview of the payment tranches

Payment	Covered phases / deliverables	Percentage
1. Payment – Initial methodological basis	Phase 1 and Phase 2: Initial analysis, functional description and RER concept, and the unified ToR for DOP/LiDAR and TopoDB design	25%
2. Payment – Database structure and source integration	Phase 3 and part of Phase 4: ER model of the RER database, attribute schema, standards alignment, methodology for integrating registers and spatial data	25%
3. Payment – Maintenance and finalization	Completion of Phase 4 and full Phase 5: Field survey methodology, test data integration, pilot report and database validation	25%
4. Payment – Maintenance and Finalization	Phase 6 and Phase 7: Model for updating and maintaining the RER, interoperability guidelines, final methodology, LSGU guide and recommendations.	25%

10.2. Conditions for approval of payments

Each payment shall be executed on the basis of:

- Submission of the **complete documentation** for the relevant phases;
- Technical and formal review by the **FGA supervision team**;
- **A certificate of acceptance** signed by the FGA Project Manager.

After validation of the deliverables, the consultant may submit an invoice for the corresponding tranche.

11. REQUIRED TEAM OF EXPERTS AND THEIR COMPETENCIES

Qualification Requirements of the Consulting Firm

The evaluation of Expressions of Interest will be based solely on the qualifications and experience of the Consulting Firm (individual firm or joint venture). The maximum score that can be awarded to the firm is 100 points, based on the cumulative evaluation of all criteria.

The following shortlisting criteria will be applied to all consulting firms (individual company or joint venture overall) that have submitted EoI:

General Experience (maximum 10 points):

The Consultant shall be awarded up to 10 points based on the quality and relevance of their references. Relevant areas include:

- Minimum of 3 years in business providing consulting services in geodesy, geoinformatics, land administration, or related fields (up to 5 points).
- Core business relevance: Demonstrated track record of assignments in geospatial data, cadastral, land administration or public registry-related services (up to 5 points).

Specific Experience (maximum 65 points):

The Consultant shall be awarded up to 65 points based on the quality and relevance of their project references. Relevant project areas include:

- Geospatial data expertise: Acquisition, processing, and delivery of DOP/LiDAR/other remotely sensed data (up to 30 points).
- Database expertise: Development and management of spatial databases according to international standards (INSPIRE, CityGML, LADM, ISO 191xx, or equivalent) (up to 15 points).
- Registers and valuation systems: Development of methodologies for cadastre, land register, address register, or mass property valuation (up to 10 points).
- Institutional and project experience: Implementation of international projects in the fields of land administration, SDI, or cadastral modernization, including coordination with public institutions (up to 10 points).

Additional Preferential Criteria (maximum 25 points)

- Regional/BiH experience: Proven professional experience in projects implemented in Bosnia and Herzegovina or comparable countries with similar legal/institutional frameworks (up to 10 points).
- Certification and licenses: Possession of a valid certificate issued by the Federal Geodetic Authority (FGA) for cadastral database creation (up to 10 points).

- Local capacity: Ability to operate in official languages of the Federation of Bosnia and Herzegovina (Bosnian, Croatian, or Serbian), and knowledge of the domestic institutional/legal context (up to 5 points).

FGA as Contracting Authority, intends to shortlist five to eight eligible firms to whom a subsequent Request for Proposals (RFP), both technical and financial, shall be sent.

For successful implementation of the assignment, a multidisciplinary team is required with proven expertise in developing geospatial databases, standardizing real-estate registers, spatial-legal regulation, and advanced techniques for acquisition and processing of spatial data. The consultant team must combine competencies in DOP/LiDAR acquisition and processing, spatial databases, harmonization of legal registers, and mass property valuation system. Experience in implementing international standards (INSPIRE, CityGML, ISO 191xx, LADM) and ability to operate in an institutional coordination environment are specifically required.

The firm (or consortium) submitting a proposal should demonstrate capability to carry out this assignment primarily through the quality and experience of the proposed expert team:

Table 12.1.: Required team of experts and their competencies

Profile	Description of the required expert / qualifications
Team leader / Project coordinator	University degree in geoinformatics, geodesy, urban planning, computer science or another relevant technical discipline. At least 5 years' experience in leading complex projects involving geospatial data, coordinating multidisciplinary teams, and communicating with institutional partners.
Key expert on property registers and mass property valuation	University degree in geodesy, law, economics, geoinformatics or a related field. At least 5 years of professional experience in the development and implementation of real estate and spatial data registers, including their integration with broader land administration and spatial information systems. Excellent knowledge of international standards such as INSPIRE, LADM, and CityGML, as well as proven skills in conceptual modelling, data harmonization, and interoperability of spatial datasets.
Geodetic expert for DOP and LiDAR	University degree in geodesy or a related field. At least 5 years' experience in planning, acquisition and processing of DOP and LiDAR data. Experience in point cloud classification, georeferencing, QA procedures and the creation of LoD2/2.5 building models. Experience in algorithmic processing of LiDAR and DOP data for change detection, reconstruction of LoD2/2.5 models, and the use of advanced software tools for 3D analysis and modelling.
GIS expert / database designer (DBA)	University degree in geoinformatics, computer science or technical science. Experience in designing and developing spatial databases in a PostgreSQL/PostGIS environment. Knowledge of schemas according to INSPIRE, CityGML and

	LADM standards. Experience in entity-relationship (ER) modelling, data versioning and interoperability.
Expert on registers (cadaster, land register, address register)	University degree in geodesy, law, computer science or other relevant fields. Experience working with cadaster, land registry and address databases. Knowledge of data structures, the legal framework, and application of the LADM model for linking with spatial layers.
Expert in field data collection	University degree in geography, geodesy, social sciences or other relevant disciplines. Experience in developing methodologies for field collection of attribute data, including QA mechanisms, validation and design of field survey instruments.

For each member of the team of experts, supplier must deliver the following documentation:

- University degree- diploma (certified copy),
- CV,
- Proof for technical skills including software (certification or/and confirmation from the employer).

Besides meeting the technical and professional criteria specified for each profile, candidates with the following attributes will be given preference:

- **Proven knowledge of the local institutional, legal and technical context of land administration in the Federation of Bosnia and Herzegovina**, including practices of maintaining and ensuring interoperability of registers (cadaster, land register, address register, etc.).
- **Previous professional experience** in projects implemented in Bosnia and Herzegovina or related to the establishment of registers, mass property valuation, spatial databases or land administration reforms in a similar context; Particular value will be placed on proven engagements that were implemented in accordance with the applicable legal and sub-legal acts currently in force in the Federation of Bosnia and Herzegovina.
- **Ability to communicate in one of the official languages of the Federation of Bosnia and Herzegovina** (Bosnian, Croatian or Serbian), to ensure effective cooperation with the FGA, LSGUs and other domestic institutions, and to facilitate communication during field activities and validations.

These preferences are not formal elimination criteria, but will be **positively evaluated** in the overall assessment of proposals for key expert positions.

The list of expert profiles presented in this document represents the **minimum set of key experts** whose competencies are necessary for successful completion of the assignment.

The service provider is **obliged to**:

- Ensure the engagement of **additional technical, administrative and support staff** as needed for the project;
- Provide **appropriate computer and software equipment**, access to necessary tools and licenses, as well as other logistical conditions needed for the uninterrupted execution of the assignment;
- Organize the team and resources in a manner that enables **timely delivery of all tasks** within the prescribed deadlines and in accordance with the quality standards defined by this ToR.

It is the responsibility of the bidder to independently assess and provide all additional capacities needed for the effective and high-quality performance of the team, including coordination with the FGA and other relevant stakeholders.

12. LANGUAGE AND COMMUNICATION

The official language of communication during the implementation of this contract may be **English** or **any of the official languages of Bosnia and Herzegovina** (Bosnian, Croatian or Serbian), with a preference that operational and everyday communication, where possible, be conducted in one of the local languages of the Federation of BiH. This is particularly important in the context of field activities, consultations with domestic institutions, and technical workshops with stakeholders.

On behalf of the FGA, **an official team will be appointed for the oversight and coordination of contract implementation**, which will monitor progress, participate in validations, and give formal approvals for key deliverables. On the consultant's side, the **project manager** (named in the proposal) will be responsible for daily communication with the FGA, coordination of expert work, and timely progress reporting.

All **main deliverables** (documentation, reports, manuals, recommendations, etc.) must be submitted in **two versions**:

- In **English**, as the language of international technical communication; and
- In **one of the official languages of Bosnia and Herzegovina**, to ensure availability to all domestic institutions.

An exception to this rule applies exclusively to **strictly technical documents**, including but not limited to:

- Database schemas (ER models, SQL scripts);
- System diagrams (UML, BPMN, XML metadata);
- Configuration files and technical instructions in the context of GIS software and web services.

These technical documents may be prepared **only in English**, due to their universal use in IT/GIS tools and systems.

13. OWNERSHIP OF RESULTS AND LIMITATIONS ON USE

All documents, databases, schemas, methodological manuals, visual representations, program code, digital materials and other products developed during the implementation of this contract constitute the **intellectual property of the Federal Administration for Geodetic and Real Property Affairs (FGA)**.

The consultant (or consortium) **is not entitled, without prior written consent of the FGA, to**:

- reproduce, distribute, transfer, publish, or make available to third parties;
- use or process the materials for commercial or non-commercial purposes;
- share partial or complete results with other users, institutions, international organizations or projects.

The FGA retains the **exclusive right** to publish, modify, publicly use and further disseminate the developed materials.

The contracted consultant is obliged to deliver all draft versions, final documents, databases, schemas and accompanying materials to the FGA in properly versioned and electronic format, together with the corresponding metadata and documentation.

Failure to comply with this clause is considered a **serious breach of contractual obligations** and may be grounds for legal sanctions and termination of the contract.