Government of Montenegro

And the

United Nations Development Programme

IMPLEMENTATION OF AN ENVIRONMENTAL GIS FOR MONTENEGRO

Effective and appropriate decision making for the management of natural resources and monitoring the environmental effects of development, depend on an accurate and reliable source of information. GIS systems are now in worldwide use by governments as a means of gathering and integrating spatial information from a wide variety of sources and generating the information needed for critical decision making at both the national and local scale.

Montenegro is currently at the earliest stages in building a national spatial data infrastructure. A coordinated approach to the development of GIS is required to ensure that systems in government do not develop in a fragmented manner leading to a set of ambiguous data with a high level of redundancy. If partners in government fail to harmonize data and systems, the consequences can be serious. If they work together to deliver definitive data, the objectives of the sustainable development strategy will be much more achievable.

The project focuses on implementing consistent systems for creating and sharing basic data in the key areas of forestry, biodiversity and spatial planning. Information systems supporting these sectors that are developed in a progressive manner have a greater prospect of being successful.

Date: August 2004

1. Context

1.1 Situation Analysis

1.1.1 National Economic and Social Context

After more than a decade of wars in the Balkans, and facing high unemployment the major challenge for Montenegro is to generate economic growth, development. With the re-launch of the SESS[1], the Government of Montenegro (GoM) has chosen to pursue both economic and sustainable development. However, from commitment to actual implementation numerous challenges need to be met, not least that of developing an effective strategy in IT that ensures Government can fulfil its statutory responsibilities to managing and monitoring natural resources.

Three focus areas for "early Success Projects" within the SESS are forestry, energy and eco-tourism. Therefore, key institutions for the implementation of the Strategy are the Ministry for agriculture, forestry and water management (MAFWM) and the Ministry for environmental protection and spatial planning (MEPSP). Their weak institutional capacity in terms of available ICT infrastructure limits their access to reliable, up-to-date information impairing their ability to make informed policy decisions and manage resources entrusted to them.

The forest sector in particular has been seriously affected by the changing political and economic landscape, in which regional markets for timber products have disappeared, and timber prices have dropped sharply. Although illegal logging, cutting and damage from fire are widespread the ability to monitor these changes locally and at a national level are very limited.

Montenegro is categorized by Conservation International as a biodiversity hot spot in the Mediterranean basin, but uncontrolled clear cutting, extensive annual wildfires and environmental degeneration endangers the level of biodiversity. This is just one amongst many development threats which threaten the rich but poorly monitored bio-diversity. Often, information on land cover and local habitats has never been recorded; hence there is no reference point against which to measure the changes that are taking place.

Unrestricted illegal building construction is widespread, occurring inside both national Parks and protected areas endangering potential major eco tourism attractions –Skadar Lake (a Ramsar site), the Tara River and Kotor, two UNESCO protected sites.

2. The Strategy

2.1 National Strategy

The formulation of coherent national environmental policy, and its implementation, needs to be underpinned by reliable and accurate information if correct and timely decisions are to be made. The principal need is for a system that is efficient and able to take into account the rapid environmental changes taking place. Environmental changes, especially in forestry and the built environment are known to be accelerating and there is a need to put in place a consistent and transparent system for managing and maintaining different types of environmental information at a national level. This information needs to be accessible to various groups; internationally, within government, to individual citizens and at times to commercial organisations.

[1] SESS – Sustainable Ecological State Strategy

Geographic Information System (GIS) technology is now in worldwide use by governments to manage environmental data at the level of the state and to distribute this to a wide range of users. The technical infrastructure for such a distributed system in Montenegro, namely local computer networks, is rapidly being set up. However, caution and great coordination is required in building a centralized system that can be made effective in a short period of time. Starting from a base position of very poor facilities as is the current situation, there is a danger in prescribing an over technical solution, the implementation of which depends on a large variety of institutional arrangements being in place. Given that any one of the many factors that could affect a pan governmental system might prove a block to the system as a whole, it is wise to seek an approach that starts from a technically low level that is then built upon in stages.

The establishment of an integrated information system for the environmental sector as a whole will be a large and complex undertaking, requiring adoption of effective arrangements between departments that are generally not used to working together. This will involve technical integration and harmonization, harmonizing data policy, and establishment of collaborative agreements.

2.2 Needs to be addressed

Information and information management systems are highly inadequate in the GoM agencies responsible for forest management, environmental protection and urban planning. Current working practices in the sector are typically paper based and do not involve collaborative efforts between departments in the use or exchange of digital data. The absence of computer based procedures in the form of GIS systems for managing environmental data places a severe limitation on the ability of these departments to produce timely and accurate information in support of decision making.

Very few departments and agencies have IT facilities that are sufficient for their tasks, especially in the forest sector. The central governments' local network is still being developed and many departmental users are not physically connected to the Government Local Area Network (LAN) in Podgorica. Use of email as a basic method of inter departmental communication is not widespread. There is limited capacity in basic IT skills such as the use of commonly used desktop office programs.

The Real Estate Agency (REA) is the closest institution in GoM to a national mapping agency. However, although REA has a large amount of spatial data appropriate for many purposes, access to this digital information is highly restricted with very substantial fees being charged for data and services. Paper maps are generated with no restriction. There is strong centralisation of national cadastral data with very restricted access. Poor access to the digital data has undoubtedly limited more widespread use of GIS among potential users. The REA IT system itself has evolved from a mix of technologies and, while it is not currently well set up to serve data to external users, this ability could easily be added or improved with minor technical additions, given the political will to do so. As the manager of the national cadastral database REA is not a practitioner of GIS or a provider of such products and services to other departments.

The main need for most users is the ability to access the core GIS data sets, and computer resources with which to work. Faced with an urgent need for information, some departments are now developing standalone systems and this will inevitably produce redundancy in obtaining, maintaining, and sharing geographic data sets. There is a real danger as a result, that critical decisions on the environment will be made using fractured, inconsistent and inaccurate sets of data. This situation can only be expected to deteriorate unless there is a strategic decision made to set up a central GIS database that can serve the most accurate and consistent set of information.

GIS systems are already planned and under development in support of immediate MEPSP and urban planning objectives. To an extent the information requirements for these and for municipal level urban planning purposes are provided for by the current arrangement with the REA, albeit in an unsatisfactory manner.

2.3 Interventions

The requirement is to support a program of work that will eventually lead to an integrated way of managing environmental data at a national level. Given the technical challenges associated with implementing this, a successful outcome will most realistically result from a phased approach, (as requested by the Deputy Prime Minister, Mr Gvozdenovic) in which essential tasks are undertaken as separate components on the way to eventually completing an integrated system giving access to a full collection of environmental data. Each module will result in a fixed number of outputs, which can be fully tested and evaluated before proceeding to the next stage.

The implementation phases foreseen for the project as a whole are as follows:

Phase	Activity
1	Data gathering, land use mapping, spatial analysis and preparation of outputs at an effective geographic scale of 1:25-50,000.
2	Detailed land use mapping, integration of field data gathering, analysis and production of outputs at a geographic scale of between 1:10,000 and 1:25,000.
3	Implementation of an integrated system including web mapping components, linkage of all main users and producers of GI to the environmental database and the REA national land cadastre.

Table1. Implementation phases of a State GIS for the Forestry, Biodiversity / Conservation and Spatial Planning sectors in Montenegro.

Forestry	Conservation and Biodiversity	Spatial Planning	Scale	
Basic Forest Mapping	**Basic Habitat Mapping**	**National Structure Plan Tourism priority areas**	**National 1:25-50,000**	**PHASE I**
Detailed Forest mapping Management Units Integration of Field and Office systems	**Detailed Mapping**	**Detailed mapping Link to REA cadastre**	**'Local' 1:10,000-25,000**	**PHASE II**
SYSTEM INTEGRATION				**PHASE III**

Fig.1 Summary of implementation activities during Phases 1, 2 & 3

2.4 Programme Objectives

The program places a priority on providing the information requirements of the forestry sector. Completion of Phase 1 will satisfy the immediate and urgent information requirements of the forest sector and biodiversity/conservation groups, both of which have related needs in terms of GIS data, particularly land use. In the forest sector the main need is for basic national forest area and type information to support the long term planning process. Preparation of forest data from remote sensing would be just one component of a national land use map of Montenegro, that has never been prepared in the past.

A national land use map based on the analysis of current high resolution satellite data, supported by existing aerial photography and fieldwork is a fundamental requirement for those concerned with biodiversity and conservation.

Once completed, this and other data prepared as part of the work would immediately be made available to the MEPSP, IPN[2], NP[3] and other agencies.

2.5 Beneficiaries.

The Ministry of Agriculture, Forestry and Water Management, Ministry of Environment and Spatial Planning, Republic Secretariat for Development, Institute of Nature Protection, and National Parks would be the immediate beneficiaries.

There would be also be an important secondary group of beneficiaries consisting largely of organizations providing data to and working closely with MEPSP such as the Hydro-meteorological Institute, Institute of Seismology, Centre of Eco-toxicology (CETI) and Monstat. Other GoM departments with access to the information such as Ministry for Maritime Transport and Traffic would also be secondary users.

Assuming unrestricted access to the data, and the promotion of an open, knowledge sharing culture, benefits are expected to extend to many groups outside the main area of government, including scientific and academic institutions as well as

3. Results Framework

The Ministry of Agriculture, Forestry and Water Management, Ministry of Environment Protection and Spatial Planning, together with Forestry Institute and Forestry Directorate requested assistance from UNDP Podgorica to develop an ICT strategy mainstreaming ICT through a multi stakeholder fore on the integration and potential synergies for ICT in: Forestry management, Environment protection and planning, and Biodiversity. This initial approach by the ministry intended to bring greatest impact to forestry, recognizing the severe consequences of poor information availability on the state forest sector to operate efficiently. Given the need to set up an accurate system of forest management and monitoring in as short a period as possible, it is necessary to balance the benefits of capacity building at an early stage in project implementation with the risks to the forest estate in taking too long to establishing an effective and operational system.

It is recommended that efforts to support GIS capacity building in the initial stages of data gathering and processing phase are made secondary to the need for rapidly reaching the stage at which data becomes available to decision makers. This is particularly important in the preparation

[2] Institute for Protection of Nature
[3] National Parks

of land cover maps from satellite data and production of digital terrain models, which are typically very time consuming activities outside of a commercial production environment.

The benefits of accelerating the process by contracting out large parts of the preparatory work to consultants, in this case outweigh the costs in terms of lost opportunity for capacity building. By-passing a lengthy data gathering phase will make it possible to arrive quickly at the point where accurate GIS ready data is ready for immediate use in analysis and the preparation of outputs.

An important factor is the need to work synergistically with ongoing projects in the sector. GIS system development as envisaged in Phase I needs to be coordinated with the ongoing FODEMO project which started in March 2003. FODEMO seeks to assist GoM in restructuring and revitalization in the forest sector. Since FODEMO needs to implement its tasks and complete operations before March 2005 a key requirement would be to prepare this data and make it available for use in the project within a 1 year period before the project is due to terminate.

The need to work within these time constraints without any effective local capacity or experience in the data preparation process is a fundamental motive that this work is contracted out to an individual consultant or consultancy firm with the appropriate experience.

Capacity building and training in GIS applications would ideally start at the data analysis stage. This would be also undertaken by an international consultant in close collaboration with the Forest Directorate, Biodiversity, and Spatial Planning agencies. Local capacity would be strengthened by ensuring participation of staff from all three departments with an appropriate background. Local training in GIS in Serbian language would be provided by ESRI software distributor for Serbia and Montenegro, based in Belgrade.

3. Management Arrangements

3.1 Institutional arrangements

3.1.1 Government Inputs

In Part I of the Phase 1 two ministries of the GoM, MEPSP and MAFWM, will each contribute 5,000 Euros in cash and 5,000 Euros in kind, in the form of the time of the two experts that will be assigned to this project (as defined in the letters from MEPSP and MAFWM attached separately to this project document as pdf. files). GoM must ensure the coordination and cooperation between the national institutions according to the required tasks. All information, maps and digital data available to the Government and required for project implementation must be provided. During Phase II the team of four staff is expanded to include a staff member from the Real Estate Agency to coordinate installation of the data server and the Arc-SDE server side software. During project phase III a full time counterpart GIS manager is required, together with part time IT system and database administration support.

3.1.2 Project contributions

In Part I of the Phase 1 a full time consultant would be in country to install, coordinate establishment of the system and provide on the job training to GoM GIS staff members for 2.5 months. There will be a local project manager working with local staff (2+2) and international consultant. Satellite and local data, software and hardware will be purchased and relevant training organized (as specified in DETAILED PROCUREMENT LIST FOR Part I Phase 1).

At later stages of the project (Part II of the Phase I, Phase II and Phase III) provision would be made of three international consultants specialized in use of GIS for natural resource management, particularly forestry and land use planning during the fieldwork in preparation for interpretation as well as provision of in country GIS training related to data analysis and generation of outputs, plus provision of workshops related to project subjects.

3.1.3 Project Phase 1

Part I of the Phase 1

During the Part I of the Phase 1 data gathering, analysis and interpretation will occur. Set of national (digital) up to date land cover maps, forest maps and statistics would be produced that would be used by forestry people as well as national parks and people dealing with conservation, nature protection etc.

Output of the Part I of the Phase 1 would be an environmental database, an inventory baseline allowing better monitoring and more informed decision-making for MAFWM and MEPSP.

Part II of the Phase 1

Part II of Phase 1 will complete and add value to the main output generated during Part I of the Phase 1, i.e. the National Land Cover Map, (including forest map), and the high resolution elevation model. It will focus on items and activities that will support the important spatial analysis and information extraction tasks and the reporting of this (as maps, statistics, databases, and via internet) to both specialists and non-specialists in the most appropriate format for immediate action. Many items that will be procured during this Part II of Phase 1(see Annex 1 section B for more details) are those completing the proposed setup in the project document for 4 computer systems (biodiversity, environment and forestry), plus the pilot geodatabase, upon which the GIS database is developed.

The emphases during Part 2 of Phase I will be placed on activities and items that support the following tasks:
- Spatial analysis and modelling using the new land cover database and DEM,
- GPS/Mobile GIS supported fieldwork activities to check and verify mapping accuracy,
- Reporting and preparation of a series maps and statistics,
- Distribution of maps, statistics and databases in hard copy and electronic formats,
- Serving of selected data sets over the local Government Intranet and Internet.

Output of the Part II of Phase 1 is to put on Internet main outputs of the Part I of Phase 1. This is important bearing in mind the need to share data with others to accomplish tasks, deliver dynamic maps and data, and focusing on easy-to-use, task-focused applications. This should also be an important early success within this project in the use of ICT as a pilot national environmental mapping portal[4].

[4] In the Detailed procurement list for the Part II of Phase 1 (see Annex 1 section B for details) procurement of high-resolution satellite imagery for the national parks, which are of extreme national priority from the conservation and protection point of view, is included.

Complete Phase 1 encompasses land use mapping, spatial analysis and preparation of outputs would take place, producing a consistent GIS database at an effective geographic scale of between 1:25,000 and 1:50,000 scale. This is a short to medium term (estimated 15 month) task to provide the basic data required for strategic planning at a national scale for all three sectors. Four sets of computer facilities, hardware and software are installed at a one central location and at three further appropriate government locations. The central location would be developed as a pilot 'geo-database' to which the three 'departmental' systems would have shared access.

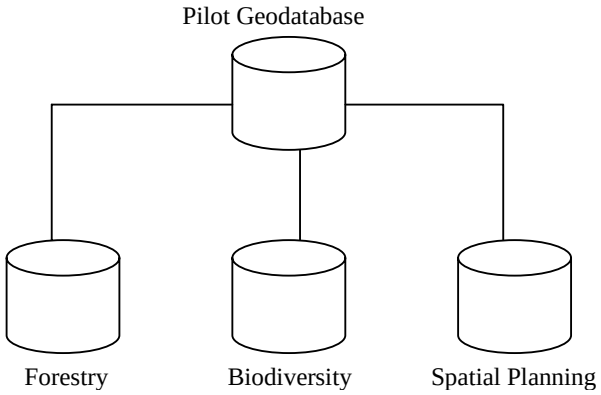


Fig. 2 Architecture of Phase 1 system.

A large fieldwork component will be necessary, undertaken by consultants and local GIS staff to develop an interpretation key for the satellite imagery. Data preparation, interpretation, and processing analysis tasks would be carried out by consultants at their own facilities. Local staff will receive basic training in GIS from the local GIS software distributor while data preparation and processing is in progress. Data analysis tasks which result in the main project outputs and deliverables will be carried out in Montenegro with local staff as part of on the job training.

Main Project Components and Functions	**Main Project Outputs**
Tendering and selection of consultants	1:50,000 scale Land Use Map
Procurement of software, hardware and data	National Forest Map
GIS database development	Digital Elevation Model, Land Cover Map
Data analysis and production of main outputs	
Basic Training in GIS	
On the job training in GIS analysis	Derived products.

Complete Phase 1. Main Outputs

Output	**Technical Specification**
National Land Cover Map of Montenegro	Land use mapping will be prepared using manual interpretation methods of high-resolution SPOT 2.5m satellite imagery. The classification will distinguish 5 Forest classes, urban areas, and a representative set of criteria that adequately describe natural vegetation types at the national level. Mapping will include the minimum spatial unit of .25 ha ($650m^2$)
Seamless Digital	A seamless 10 meter resolution DEM will be prepared using the

Elevation Model of Montenegro	digital 1:25,000 IGM maps as a base. Paper IGM maps are in widespread use in GoM as basemaps and it is important to be consistent with this. Both contour (hypsometry) and stream network should be used to ensure the resulting model is 'hydrologically accurate' and precise in the 'z' direction.
Derived Products	Land cover will be estimated within areas of thematic data derived from the DEM, including watersheds, elevation classes, aspect, slope, and land facets. Maps, statistics and digital products of these data will be prepared. Land suitability maps will be derived from further analysis of the data.

3.1.4 Project Phase 2.

During phase two, detailed land use mapping, establishment of techniques for managing and synchronizing field data from mobile systems, and advanced spatial analysis and production of outputs at a scale of between 1:10,000 and 1:25,000 will occur.

This phase includes a set of tasks to be implemented over the longer term, estimated at two or three years, designed to prepare a detailed spatial database for use in resource monitoring and management use at an operational level. The intention is to generate a more detailed database suitable for management and to provide a baseline against which future change in forest, habitat and the built environment can be measured and monitored.

In forestry, such a database would require close integration of spatial data with non spatial data for internal purposes as well as the need to provide a transparent process for monitoring and checking the activities of forest enterprises. Phase II would require international consultants at specific times only, and would include more local inputs to the data preparation process.

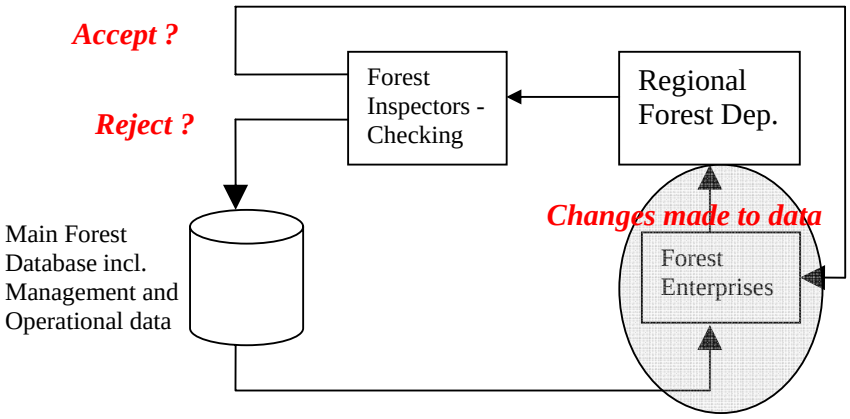


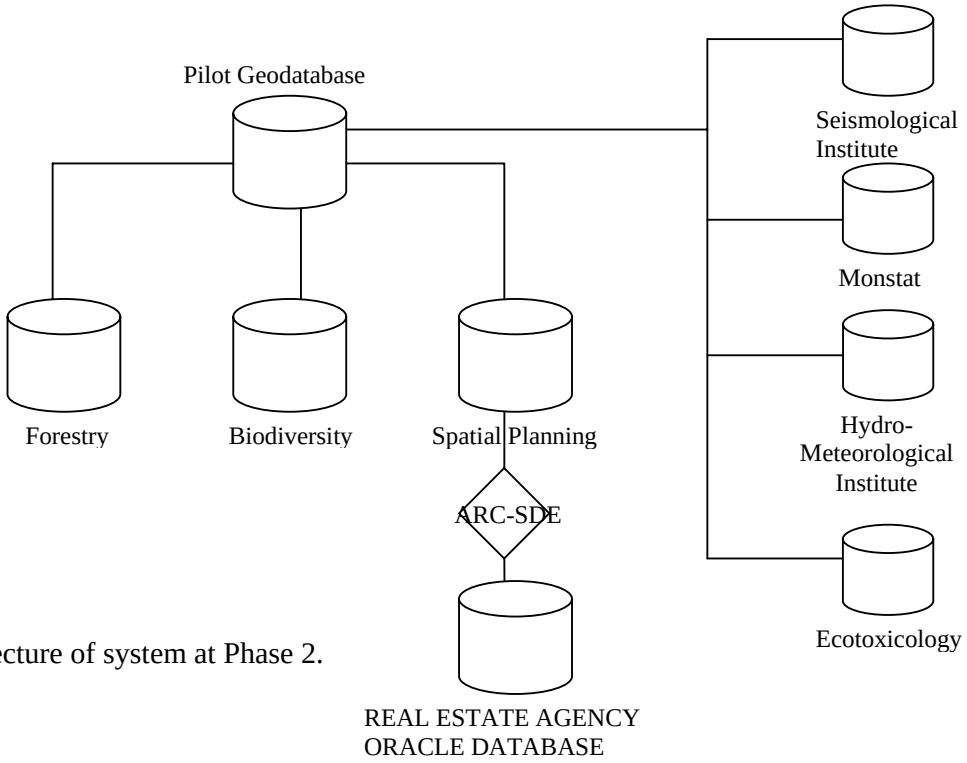
Fig 3. Monitoring and checking functions in maintenance of forest database

Phase II would address the need for monitoring procedures in forestry, biodiversity and spatial planning. Specific technical solutions are implemented for monitoring and control of forest enterprises.

Within Phase II, biodiversity agencies are closely involved in determining appropriate land use classes to be mapped and in creating data sets that allow habitat monitoring according to EU Natura 2000 guidelines. Technical solutions are implemented that integrate field monitoring with a central GIS for management planning: Appropriate field data gathering techniques are introduced together with robust procedures for editing and updating GIS data.

OUPUTS FROM PHASE II	
Forestry	**Spatial Planning**
Revised Forest Management Plans, including Forest Compartment Maps: • Forest Functions • Management Classes	Detailed mapping of settlements, roads and urban areas. National Spatial Development Structure Plans

The use of consultants is recommended to oversee the effective introduction of advanced methods in remote sensing and spatial analysis. The needs of the forest sector to link spatial data with financial, production and operational systems are taken into account. Methodologies are established for updating the GIS with data acquired on mobile devices during fieldwork for all sectors. Data from the other main producers of environmental spatial data within Government (Institutes of Seismology, Hydro-meteorology) are included. Basic training for new users and workshops are held to coordinate the main users of the GIS, in harmonization of data and establishment of metadata standards.



Architecture of system at Phase 2.

Main Components of phase II

Spatial Planning

- Establishment of a physical network link from the REA to the GoM Vectra building
- Installation of a Server running ARC-SDE at Real Estate Agency providing direct access to ORACLE cadastral database from the MEPSP-DUP computer
- ARC-SDE is configured to serve a 'view' of cadastral data to MEPSP - DUP

Forestry

- Simple GIS viewing capacity is provided to 14 Forest offices
- GIS data are linked with operational, and financial data
- Advanced techniques (object oriented image segmentation algorithms) are used to automatically extract detailed data from satellite imagery, rather than visual interpretation.

All sectors

- GPS & DGPS enabled mobile systems are used acquire data and edit the main database.
- Local GIS capacity in data analysis and spatial modelling is developed through on the job training

Preparation for Integrated system

- GIS management team is set up
- Preparation and development of the main Geo-database
- GIS h/w and s/w installed with main spatial data producers in the environmental sector including Hydro-Meteorology, Eco-toxicology, Seismology, Monstat, Institute for the Protection of Nature, National Parks
- GIS training provided to 4 agencies
- Additional data digitized & captured

3.1.5 Phase 3: System integration and expansion to include all users in the environmental sector.

Phase 3 would involve provision of computer facilities and GIS software for the remaining government agencies immediately concerned with environmental monitoring and management.

The critical assumption is made that local networks will have been physically expanded to cover these organisations. Installation of ArcGIS at Real Estate Agency is also anticipated to provide REA with access to the main geo-database and ability to serve this data to its 21 provincial offices.

Principal components of this stage would be setting up administration of the pilot geo-database and its transfer to a permanent location and its change in status from a pilot project to a functional source of accurate and reliable environmental data. Principal outputs include: Detailed Habitat maps within and outside protected areas Conservation management plans Watersheds, Landscape elements Habitats mapped within Landscape unit.

The completed geo-database would be established within a competent agency responsible for its regular management and administration. Owing to the requirement for a DBA with systems administration skills the Development Secretariat would be a potentially suitable location, as there is an existing capacity in this field. An alternative location would be the forthcoming Agency for Environmental Protection. Full time responsibility for data management, system administration and backup would be transferred to the IT / Systems manager at the location chosen.

Another installation of the server side program ArcSDE is required to serve the main geo-database to all users within government. ArcSDE will provide the means by which users may access and

upload changes to the databases that they are responsible for in a structured and protected manner. Configuration of the existing ArcSDE connection to the REA cadastral data in phase III will be modified from just the MEPSP so that the server makes REA data available to all other relevant agencies.

Once the main geo-database is in a completed state, web mapping applications will be designed and implemented using ArcIMS or a compatible product such as Autodesk Mapguide. At least two applications would be required, one specifically to display all the data relevant to spatial planning, another to serve environmental data.

Development of web mapping applications is seen as a crucial output, particularly the ability for certain users to download the digital files in GIS ready format of the information that appears in the Internet browser window. This is a specific requirement to satisfy the needs of individuals who need to use data in the preparation of urban and municipal development plans according to government regulations. Protection and restriction of access to the data could be provided by placing a login and permission rights, which would require an additional effort on the IT administrator / DBA.

Serving of data on the Internet will require additional hardware resources, skills and administration. Skills in setting up server side applications will not be available within GoM and a consultant specializing in ArcIMS applications should be recruited to assist in design and implementation.

Specialist training is required in

- ARC-SDE database configuration and management
- ArcIMS or equivalent system

3.1.6 Risks and assumptions

Phase	Assumptions	Risks
1	GoM staff from 3 agencies assigned are from appropriate technical background and are available	Staff assigned are given additional responsibilities that conflict with project work. GIS duties not considered priority tasks.
2	Real Estate Agency is willing to participate by serving the ORACLE cadastral database to MEPSP. Government LAN is extended to all participating agencies.	Real Estate Agency declines to participate in project or fabricates 'technical difficulties' Agencies are unable or unwilling to reach a workable agreement on the sharing of digital data
3	Availability of Database Administrator (DBA) to manage server side programs	Government is unable to support highly skilled IT staff and provide long term administration of the system

3.1.7 Programme Monitoring and Evaluation (PME)

Within three months from entering into force of the Agreement, upon recruiting local project manager, UNDP will provide a specified work plan for the first year and an outline for the remaining period of the Agreement, which, at a later stage, will be specified in more detail. The work plan for the first year will specify the composition and work plan of the project management board.

PME will be through the production of deliverable outputs, and reporting at specified intervals to a project management board composed of donor representatives and appropriate GoM appointed staff.

In Part I of the Phase 1 UNDP will recruit a local project manager who will be managing the project including reporting to the donor through UNDP. Local project manager will be supervised by the Head of UNDP Liaison Office in Montenegro.

Workshops, seminars will be held at regular intervals throughout the project.

3.1.8 Legal Context

This project document shall be the instrument referred to such as in Article 1 of the Standard Basic Agreement a copy of which is available at RBEC.

The following types of revisions may be made to this project document provided UNDP is assured that other signatories of the project document have no objections to the proposed changes:

a) Revisions in, or addition to, any of the annexes of the project document;
b) Revisions which do not involve significant changes in the immediate objectives, outputs or activities of a project, but are caused by the rearrangement of inputs already agreed to or by cost increases due to inflation, and mandatory annual revisions which rephrase the delivery of agreed project inputs or reflect increased expert or other costs due to inflation, or take into account agency expenditure flexibility.