

Uruguay

SPATIAL INFORMATION SYSTEM FOR NATIONAL INFRASTRUCTURE MANAGEMENT AND PLANNING

TC 9811911-UR

September, 2000

Terms of Reference

I. PROJECT OBJECTIVES

- 1.1 The proposed project will strengthen and expand existing analysis and planning capabilities of the National Highway Directorate (Dirección Nacional de Vialidad - DNV) and the National Topography Directorate (Dirección Nacional de Topografía - DNT) of the Ministry of Transportation and Public Works (Ministerio de Transporte y Obras Públicas - MTOP). The expanded capacity will be achieved through the development and implementation of a GIS-based (Geographic Information System) Information System for National Infrastructure Management and Planning to assist in highway planning and management.
- 1.2 The project will include the development of applications that will support specific analytical and decision-making requirements, as well as integration of spatial databases to support highway planning, pavement management and regional transportation analyses. The existing Highway Inventory System will be enhanced using satellite-based GPS (Global Positioning System) technologies and prototype solutions will be developed to support property expropriation and integration corridors and rural roads projects using updated socio-economic, environmental and cadastral databases.
- 1.3 This project will integrate work being developed for DNV's Infrastructure Management System, Highway Inventory System, and other GIS-based projects in Uruguay and throughout the Mercosur region.
- 1.4 In addition, the Dirección Nacional de Arquitectura, the Dirección Nacional de Hidrografía, the Dirección Nacional de Transportes, and the Instituto de Planificación de Transporte Interurbano (IPTI), all within the Ministerio de Transportes y Obras Públicas (MTOP), will also participate in the proposed project. They will benefit, as future GIS users, by being able to receive training and technical support to develop applications for basic and social infrastructure management and planning, focusing on providing analytical capabilities for location/allocation studies, impact analysis and routing studies.

- 1.5 The Ministerio de Transportes y Obras Públicas (MTO), through the Dirección Nacional de Topografía, has been implementing a National Geographic Data Clearinghouse to reduce data management costs through elimination of redundant data collection and maintenance efforts. This is an initial and major step towards developing and implementing a National Geographic Information System (following the same concept of a National Spatial Data Infrastructure). This proposed operation will build upon these activities, providing additional capabilities as described in the scope of work, and which at the same time will support Mercosur-level transportation studies and regional analyses of integration corridors.

II. SCOPE OF WORK

- 2.1 This technical cooperation includes two phases, 'Systems Design' and 'Systems Development and Implementation, Spatial Data Compilation and Training'. These phases are further divided into ten tasks, all to be performed by the Consulting Team.

A. Phase I – Systems Design

- 2.2 The first Phase has two tasks as follows:

- a. Task 1 - Institutional Assessment of the MTO, focusing primarily on the DNV and the DNT, and a survey of available spatial data in Uruguay in Government and Non-Government Institutions. This assessment will lead to a 'Statement of Needs' and a comprehensive 'Conceptual Design' and also a proposal for a 'National Spatial Data Infrastructure'; and
- b. Task 2 - Introductory Project Seminar and GIS Workshop.

B. Phase II - Systems Development and Implementation, Spatial Data Compilation and Training

- 2.3 Phase II is broken down into eight (8) task as follows:

- a. Task 3 – Development of the technical specifications for a system solution to the 'GIS-based Spatial Information System for National Infrastructure Management and Planning'. The following applications should be conceptualized and integrated into this system: Highway Inventory System (including dynamic segmentation capabilities), Infrastructure Management System, Pavement Management System, Property Expropriation and Corridor Analysis. Also, prototype solutions should be developed for each one of the Directorates mentioned in Paragraph 1.4;
- b. Task 4 - Spatial Data Compilation;
- c. Task 5 - Applications Development, Integration and Implementation;

- d. Task 6 – Implementation of Dynamic Segmentation Capabilities and a GPS-based Inventory System;
- e. Task 7 - Software and Hardware Acquisition and Installation;
- f. Task 8 - GIS Implementation Seminar, Training and Workshop;
- g. Task 9 – Workshop on the National Spatial Data Infrastructure, and;
- h. Task 10 - Preparation of Terms of Reference and Final Report.

C. Description of Phase I Tasks: Systems Design

1. Task 1 - Institutional Assessment, Statement of Needs and Conceptual Design

- 2.4 The Consulting Firm must analyze the work processes, information flow and current planning and decision-making capabilities of the MTOP. Based on questionnaire interviews to be carried out, which should include a discussion of flow of information, existing and planned hardware and software solutions, and network capabilities (WAN, LAN, etc.), the consulting team must provide an assessment of the present situation and develop a ‘Statement of Needs’ and a ‘Conceptual Design’. The Conceptual Design must include all activities already planned within the scope of this operation and activities that should be included in future operations. This report must also define and specify the hardware and software to be acquired for the project.
- 2.5 Activities to be included as part of this concept design are the following:
 - a. Development of **specific software solutions** as listed in Paragraph 2.13 (items b), c), d), e) and f);
 - b. Development of the **User Interface** to access the above applications (Paragraph 2.13, item a);
 - c. Development of the **prototype applications** for the various Directorates listed in Paragraph 1.4;
 - d. Incorporation of the **GIS-based Decision Support System** for supporting the study of the integration corridors. This includes updating the GDSS specifically with data available for Uruguay (spatial data and the attribute data needed to run the models). This decision-support system was developed by the Bank to support regional transportation studies within the extended Southern Cone (Mercosur) region;
 - e. Implementation of **Network Analysis** and **3-D Visualization** capabilities;

- f. Compilation and integration into the system of the existing and additional **spatial databases** as listed in Paragraph 2.21 (items a), b), c), d) e) and g) and the development and integration of the **DTM (Digital Elevation Model)** specified in Paragraph 2.23;
 - g. Provision and inclusion for an area to be specified (at least 500 km²) of a **mosaic of high-resolution satellite imagery**. Ikonos or equivalent as specified in Paragraph 2.25;
 - h. Provision and inclusion for the total area coverage of Uruguay of a mosaic of **Landsat 7 imagery or equivalent** as detailed in Paragraph 2.26;
 - i. Update the **geometric information** of highways of the national and departmental networks. This information will be updated initially by the interpretation of the satellite imagery (Landsat and Ikonos). Also, for a total length of 1,000 km of the network an inventory will be carried out utilizing GPS. This GPS-based inventory will be done together with MTOP professionals who will thus have the opportunity of on-the-job training; and
 - j. **Dynamic segmentation** capabilities must be included in the final system to be implemented. This will include defining a linear referencing system for the national road network (red nacional) and provide a system solution for implementing the linear referencing system and for geo-referencing related attribute data such as highway projects and accidents.
- 2.6 An inventory of the existing spatial data in both government and non-government organizations will be carried out. The objective of this inventory is two-fold: first provide a list of existing spatial data available that could be used by the MTOP. Second provide the basis for a proposal of a framework for a 'National Spatial Data Infrastructure (NSDI)'. Through a questionnaire survey and targeted interviews with spatial data users and providers, provide a report on the status of the use of spatial data (in both analog and digital format) in Uruguay and a structured framework for implementing a National Spatial Data Infrastructure, discussing identified priorities within this framework that would positively impact the GIS activities being carried out at the MTOP. This proposed framework must build upon the activities being developed by the Dirección Nacional de Topografía for the National Geographic Data Clearinghouse and the National Geographic Information System.
- 2.7 Ensure during the development of all activities that there is direct consideration for all environmental regulations, sectoral environmental units and environmental authorities at the decentralized level (Departments and Municipalities), to ensure that their needs are understood and considered in the developments of the various tasks of this project. The Bank will make available to these sectors the spatial data being compiled and the applications developed. The consulting firm should also ensure that these authorities, experts and technicians are included in the planning of the workshop on the National Spatial Data Infrastructure and participate in it.

- 2.8 The 'Discovery and Needs Analysis (DNA) Report' and 'National Spatial Data Infrastructure (NSDI) Proposal Report' will be prepared and delivered. The first report (DNA) will present the results of the Institutional Assessment, Statement of Needs and the Conceptual Design and include a refinement and scheduling of the tasks to be developed during Phase II. The second report will present the results of the inventory carried out and the proposal for a NSDI. This report must be made available on the Project web page and will be revised before the conclusion of the project, updating and incorporating the comments received.
- 2.9 The Consulting Firm must take into consideration MTOP's present and planned GIS and system capabilities (hardware, software, databases, network configurations).

2. Task 2 Introductory Project Seminars and GIS Workshop

- 2.10 At least one introductory one-day **GIS Workshop** and one **Project Seminar** should be planned for Phase I. The workshop will focus on bringing together various guest speakers and experts in the field that will help promote, through their presentations, a common understanding of the benefits and advantages of GIS and its use for highway planning and management. The workshop will provide a forum for receiving comments and feedback, and an opportunity to discuss related topics. A large audience is expected and the consulting firm will be responsible for organizing the workshop including the distribution of invitations.
- 2.11 The **Project Seminar** will be restricted to those within MTOP that will benefit from the project. During this seminar the '**Discovery and Needs Analysis Report**' will be presented focusing on the Conceptual Design of what is being proposed. It will provide an opportunity for discussing with the beneficiaries the proposal being put forward.
- 2.12 All seminars and workshops are to be conducted in Spanish and all presentations and material distributed at the GIS Workshop must be made available on the web.

D. Description of Phase II Tasks – Systems Development and Implementation, Spatial Data Compilation and Training

1. Task 3 Development of the Technical Specifications of all GIS-based applications, including hardware and software solutions, and database model

- 2.13 With the approval of the beneficiaries and the Bank of the '*DNA Report*', the Consulting Firm will build upon the Concept Design, detailing the data model, the functionality of the applications to be developed, the technical specifications of the user interface, and propose and justify the software and hardware solution. These topics should be included in the '*Applications Design Report*'. The following applications are envisioned:

- a. Interface of the GIS-based Spatial Information System for National Infrastructure Management and Planning;
 - b. Highway Inventory System (building upon the existing information and including dynamic segmentation capabilities). The Consulting Firm must also integrate available Traffic Information;
 - c. Infrastructure Management System (including project management capabilities);
 - d. Pavement Management System;
 - e. Property Expropriation Analysis Application;
 - f. Corridor Analysis Application (Integration Corridors and Rural Roads), and
 - g. Prototype Applications to support the Directorates listed in Paragraph 1.4.
- 2.14 The User Interface will enable the end-user to directly access and use the applications presented in items b), c), d), e) and f) above. It is envisioned that the integrated system after implementation should enable the sharing and access of the same data (spatial and non-spatial) and the user interface should enable any networked computer to access and use these data.
- 2.15 For the Property Expropriation Analysis and Corridor Analysis Applications the focus will be on defining needed spatial data for running the applications, the compilation of available and additional needed spatial data and the development of the analytical tools that will be part of the systems proposed.
- 2.16 The first application will focus on supporting the implementation of rural roads in the CONAPROLE pilot-project area (Departments of San José, Canelones and Colonia). This application must support the direct access and use of the digital database on cadastral information, which will be developed as described in Paragraph 2.24.
- 2.17 For the Corridor Analysis Application the DTMs (Digital Elevation Models) and Ikonos images will be compiled and integrated as described in Paragraphs 2.23 and 2.25. The 3-D visualization tools to be provided to the project must make use of both the DTM and Ikonos imagery being provided.
- 2.18 The prototypes of the individual application solutions for the Directorates listed in Paragraph 1.4 will be detailed and if pertinent each Directorate should be informed of the spatial data that they should be responsible for compiling in order to implement the prototype application.
- 2.19 The Consulting Firm should also discuss the tasks to be carried out for the updating of the GDSS database with specific data for Uruguay (spatial and attribute data) needed to run the GDSS. This spatial database was initially

developed with existing sources at 1:1,000,000 scale. For updating, the Consulting Firm must propose the use of the most complete existing digital data. Updating of attribute data implies that the actual information needed to run the GDSS models should be identified, compiled and included in the decision system.

- 2.20 The hardware/software design specifications should take into consideration the need for an integrated solution accessible to the various users and building upon the existing system configuration. The Systems Design section of the report should include a detailed description of the existing system configuration and a description of proposed new hardware and software within the referenced system configuration.

2. Task 4 Spatial Data Compilation

- 2.21 The following spatial databases will be compiled and integrated into the system:
- a. Existing national spatial data already compiled and maintained by the DNT;
 - b. Transportation Infrastructure – focusing on the transportation network and updating with the information that can be interpreted from the satellite imagery that will be acquired and from the GPS inventory. This dataset will form the basis of the transportation network data to be used in the applications listed in Paragraph 2.13;
 - c. Regional Spatial Database – specifically put together to support the CONAPROLE area (Departamentos de San José, Canelones and Colonia) with regard to the implementation of rural roads and integration corridors;
 - d. DTM - Digital Terrain (or Elevation) Model – to be developed by the consulting firm and covering the same area as the Ikonos imagery to be purchased;
 - e. Digital Cadastre Database – to be developed by the MTOP as described in Paragraph 2.24 and incorporated and used in the Property Expropriation Application;
 - f. Satellite Imagery – mosaic of Landsat 7 (or equivalent) and Ikonos (or equivalent) as described in Paragraphs 2.25 and 2.26; and
 - g. Mercosur database – to be used by the GDSS as discussed in Paragraph 2.19.
- 2.22 The Regional Spatial Database will be compiled for the CONAPROLE project area (Departamentos of San Jose, Canelones and Colonia) and will be used for both the Property Expropriation Application and the Corridor Analysis Application. Data layers initially envisioned are: regional infrastructure, administrative boundaries (with linked census data), land use, environmental data, DTMs and satellite imagery. The Consulting Firm must propose during the development of Task 3 the spatial data to be compiled and integrated.

- 2.23 A DTM (Digital Terrain Model) covering the same area of the Ikonos imagery to be acquired (area still to be defined) will be developed by the Consulting Firm. A technical standard for DTMS and also a discussion of methodological approaches (supporting the chosen approach) should be elaborated prior to initiating the DTM. The DTM, the Ikonos imagery and the Regional Spatial Database will be used for demonstrating the use 3-D visualization tools for supporting corridor studies.
- 2.24 Specifically for the Property Expropriation Analysis, cadastre information for the CONAPROLE pilot project area is required. A separate Technical Cooperation project is developing standards and specifications for a digital cadastral database and implementing conversion and vectorization of existing microfilm cadastre records, to meet the requirements of DNV and DNT. This digital dataset should be incorporated and used in the application.
- 2.25 Ikonos imagery for an area of at least 500km² should be acquired and incorporated into the spatial database (merged 1-meter panchromatic and 4-meter multi-spectral). Equivalent imagery, if available, will also be considered as an option.
- 2.26 A mosaic of Landsat 7 imagery covering all of Uruguay will be acquired and included in the spatial database. A minimum Level One G product is required. Equivalent imagery if available will also be considered as an option.
- 2.27 All existing and/or acquired satellite imagery must be geo-referenced individually and be included in the spatial database as additional layers.
- 2.28 All spatial data to be included in the system should be checked with regard to spatial data quality and an evaluation of the suitability of the data should be made before incorporating into the spatial database. Specific metadata information for each dataset should be included.

3. Task 5 Applications Development, Integration and Implementation

- 2.29 All modeling applications listed in Task 3 and detailed in the '*Applications Design Report*' shall be developed and delivered to the beneficiaries. The Consulting Firm will also be responsible for installation of the applications and training as discussed in Tasks 7 and 8.

4. Task 6 – Implementation of Dynamic Segmentation Capabilities and GPS-based Inventory System

- 2.30 A GPS-based system for gathering geo-referenced data to be used for highway inventory must be developed and provided. This system is to be used to gather specific geo-referenced attribute data that can be downloaded straight into the GIS-based Highway Inventory System. Extensive hands-on training to a group of up to 10 MTOP professionals shall be provided on the use of this system and one GPS unit with the developed software solution shall be provided by the

Consulting Firm and delivered to the beneficiary. Also, the GPS inventory of 1,000 km of part of the national network shall be carried out and incorporated into the spatial database.

- 2.31 During the training to be provided the Consulting Firm should also demonstrate the use of GPS-based systems for transportation planning, pavement management, transportation of hazardous materials and highway safety.
- 2.32 Dynamic segmentation capabilities are to be included into the present GIS system, including the definition and proposal of a national linear referencing system.

5. Task 7 - Software and Hardware Acquisition and Installation

- 2.33 Hardware and applicable GIS software to be used for implementing and running the various applications will be purchased by the Consulting Firm and installed. These computers are to be networked into existing LAN. Details of the hardware and software to be purchased are included in the 'Specific Guidelines', which will be made available to the short-listed firms. The Consulting Firm will be responsible for installing the computers at which time all the applications developed during Task 5 will be installed.

6. Task 8 - GIS Implementation Seminar, Training and Workshop

- 2.34 After the development and conclusion of the preceding activities the following training and workshop will be provided:
 - a. Final Workshop – a one-day workshop to be given to the same audience of the initial workshop, presenting the final solution implemented and demonstrating the possible uses of the tools and the spatial data in supporting other government needs; and
 - b. GIS Training – Eighty (80) hours of hands-on training will be provided to a group of up to 10 professionals from the MTOP on the following topics: Geographic Information Technologies, Spatial Analysis and Network Analysis. Focus will be on providing the necessary understanding on how the spatial database developed and the tools being provided can support the activities of the DNV.

- 2.35 For the training, all needed *User Manuals* must be completed for distribution. Also, the Data Dictionary and the Metadata must be completed and distributed prior to training. All seminars, workshops and training will be conducted in Spanish and related materials will be prepared in Spanish.

7. Task 9 – Workshop on the National Spatial Data Infrastructure

- 2.36 The community of GIS Users in Uruguay (from the decision level down to the everyday users) will be invited to this one-day workshop to be held in Montevideo and the objective is to provide a forum where the proposal for the

NSDI can be presented and the group can further discuss the proposal being put forward, providing a feedback to this proposal. It is expected that this one-day workshop will contribute significantly to the objectives of the National Geographic Data Clearinghouse and the National Geographic Information System.

8. Task 10 - Preparation of Terms of Reference and Final Report

- 2.37 Terms of Reference will be developed to allow for identification of further enhancements to the system and the components to be incorporated into other Bank supported projects. Given the need to provide continuation to the implementation of technology-based solutions the Consulting Firm should be open to the possibility of delivering these Terms of Reference as soon as additional tasks are identified, such as at the end of Phase I.
- 2.38 A Draft Final Report and subsequent Final Report must be prepared summarizing the previous reports together with an analysis and feedback from the implementation seminars and workshops, and recommendations for future activities.

III. PRODUCTS AND SERVICES

- 3.1 The products and services described in this paragraph are part of the deliverables. All of the reports shall be presented to the beneficiaries and to the Bank for review in a total of 7 copies in both hard copy and digital format. For the permanent report (Final Report) an additional 25 copies will be presented after acceptance and approval.

A. Reports

- 3.2 The following reports will be prepared in the course of the study.
- 3.3 Inception Report (15 days after contract signing) - The Inception Report will present the Consultant's Work Plan and Personnel Allocation Plan for the project, with any modifications to the technical proposal agreed to during negotiations. This report should also indicate any special circumstances that might affect the timing or the successful development of the work.
- 3.4 National Spatial Data Infrastructure Proposal Report (Task 1) – to include the inventory carried out of existing spatial data in both government and non-government organizations and the proposal of the structure for a National Spatial Data Infrastructure. The beginning point for this discussion must be the existing National Geographic Data Clearinghouse and the National Geographic Information System. This Report must be made available on the web. It must be revised with the pertinent comments and suggestions received at the NSDI workshop (Task 9).

- 3.5 Discovery and Needs Analysis (DNA) Report (Phase I) - This report will present the results of the Institutional Assessment, Statement of Needs and the Conceptual Design and include a refinement and scheduling of the tasks to be developed during Phase II. Approval of this report by the Bank and the beneficiaries is needed before beginning the activities of Phase II.
- 3.6 Applications Design Report (Task 3) – to include the technical specifications of the application to be developed. Also, to be included in this report are the outlines of the Data Dictionary and Metadata information to be developed for the digital data produced.
- 3.7 Draft Final Report (Task 10) - A Draft Final Report will be prepared summarizing the three previous reports, a description of the activities carried out during the development of the project, together with an analysis and feedback from the implementation seminars and workshops, including also recommendations for future activities.
- 3.8 Final Report (Task 10) - The Final version of the Report will be presented after review and comments from the beneficiaries and the Bank of the draft version and will include all of the spatial data and additional printed and digital copies of reports. The Final Report must also include a separate, detachable Executive Summary in both Spanish and English.
- 3.9 Monthly Progress Reports - During the first ten (10) calendar days of each month the Consulting Firm should deliver a brief report covering the activities of the prior month, which should specify the personnel allocated, advances in the period by category of the work detail schedule and present graphic presentations of the progress in the project and the projections for completion. This report should be delivered in digital format only by e-mail using a standard pdf or similar format.

B. Databases (Task 6)

- 3.10 The following databases will be compiled:
- a. Spatial Data – the spatial data compiled for Tasks 4 and 6.
 - b. GDSS Database – the spatial and non-spatial data compiled for the GDSS.
 - c. Satellite Imagery - all satellite imagery products acquired during the development of the project.

C. Spatial Applications and User Interface

- 3.11 The study will include the following applications and user interface:
- a. Interface developed (Tasks 3 and 5) – the user interface developed, including the *User Manuals*; and

- b. Other Applications (Task 5) – the applications and solutions developed for Task 5 (besides the one above), including the *User Manuals*.

D. Hardware and Software

- 3.12 The consulting firm will provide the following software and hardware:
 - a. GPS hardware and software solution (Task 6) - one (1) GPS unit and application developed; and
 - b. Computer Hardware and Software Acquisition and Installation - (Task 7) as detailed in the ‘Specific Guidelines’.

E. Training and Other Materials

- 3.13 Training Materials (Tasks 2, 6 and 8) - all training materials utilized for the various seminars, training and workshops should be delivered in both the original format and in HTML format (a set of training materials should be provided to each trainee and 7 sets of training material in both hard copy and digital format should be provided to the Bank and the beneficiaries).
- 3.14 Data Dictionary and Metadata - a Data Dictionary must be developed with the listing of all the data written to the CD-ROM (as indicated below) and with Metadata information for the digital data produced by the consultant (7 sets of Data Dictionary and Metadata in both hard copy and digital format).
- 3.15 Terms of Reference (Task 10) - all terms of references should be provided in both digital and hard copy formats (7 copies of each).

F. Project Web Site

- 3.16 Project Web Site – The Consulting Firm must develop and maintain for the duration of this Technical Cooperation a project web site. This web site will make available to the public the proposal for the National Spatial Data Infrastructure and also all other information that should be shared. It is suggested also that all reports produced be included in a password-protected area and made accessible to all project participants (Consulting Team, Beneficiaries and Bank). The project web page should be linked through the Clearinghouse and any other MTOP web pages.

G. Ownership

- 3.17 All reports and relevant data such as maps, images, diagrams, plans, statistics and supporting data acquired, compiled or prepared in the course of the services shall be confidential and shall be the absolute property of the Bank and the beneficiaries. Also, the Bank and the beneficiaries, to the extent permitted by the vendor, will own the copyright to any spatial data, including remote sensing

- imagery, created or acquired for use in the Project, including the right to reproduce, distribute, disseminate and publish the same.
- 3.18 The Bank and the beneficiaries will also own the copyright of programs written to implement all applications (including the User Interface application) except for existing previous applications already developed by the Consulting Firm and if specifically stated in the technical proposal, in which case the beneficiaries' rights will be limited to using such applications for its needs and the Bank's rights will be limited to using the application in similar GIS projects.
- 3.19 All spatial data and the National Spatial Data Infrastructure Proposal and Final Reports will be delivered in digital format, written to CD-ROM, to the Bank and to the beneficiaries, in the spatial data structure in which it was created, as well as in an industry-standard export format. (A total of 25 copies shall be made available after approval of the draft version). All data included in the CD-ROM must have associated metadata information. The Consulting Firm shall deliver all these materials to the Bank and to the beneficiaries upon completion of the services, together with the Final Report.
- 3.20 The Consulting Firm may retain a copy of such materials but may not use the same for purposes unrelated to this contract without prior written permission from the Bank.

IV. QUALIFICATIONS OF CONSULTING FIRM AND CONSIDERATIONS FOR THE TECHNICAL PROPOSAL

- 4.1 Given the nature of the work the Consulting Firm must have extensive expertise and familiarity in the development of GIS solutions for Regional Transportation Planning and Infrastructure Management and the current status of GIS technology. The utilization of integrated teams drawing from local and international expertise is expected. The consultants will allocate the personnel necessary for the successful completion of the project in accordance with the methodology, work program and staff allocation, which will form part of the proposal and, as such, it is the exclusive responsibility of the Consulting Firm to determine the specialties and timing of the professionals to be used. The following table may be considered to be a minimum composition of an acceptable project team and presents an estimate of professional involvement. This estimate is made for orientation purposes only. Estimate of Consulting Firm involvement totals 43 consultant/months:

Professional Expertise	Estimated Time (months)
Project Director	4
Transportation Planner	3
GIS-T Analyst	8
GIS/Systems Programmer	8
GIS/Remote Sensing Specialist	2
RDBMS Analyst/Programmer	3
Systems Analyst	3
GIS Database Technician	12

- 4.2 The Project Director should have no less than 10 years international experience in managing projects of similar content and complexity. The Director should have had demonstrable experience in the development and implementation of GIS-based solutions and working ability to communicate in Spanish. The post of Director may be combined with one of the other senior positions listed.
- 4.3 The listed senior professionals (excluding GIS Database Technicians) should have at least 5 years of relevant experience. Those professionals that will be working in Uruguay should be able to communicate adequately in Spanish.
- 4.4 In the *Proposal* the Consulting Firm should give special attention to the following items (additional proposal considerations are included in the ‘Specific Guidelines’):
- a. Seminars, Workshops and Training - provide descriptions of the format of the seminars and the approach to the training environment;
 - b. Digital data - indicate understanding of the existing data to be used in compiling the digital data (spatial and non-spatial) and discuss the methodology for developing each spatial database (specifying hardware, software, data sources and procedures to be used);
 - c. Map projection and referencing system - provide an understanding of the issues of having different sources of spatial data utilizing different map projections and different referencing systems;
 - d. Satellite Imagery - discussion of existing satellite imagery, indicating the methodological approach to processing the imagery and producing the mosaic. Satellite imagery must be recent (within the previous 12 months of delivery) and with minimum cloud coverage. Indicate and discuss the choice of control points for correcting the imagery and the level of accuracy expected after final processing;

- e. GPS-based system for gathering geo-referenced data - discussion of the system to be provided and also an outline of the training to be provided.
- f. User Interface Application - indicate design considerations for the User Interface and the conceptual issues for providing a networked solution for accessing spatial and non-spatial data to be used in the various applications.
- g. Quality Assurance and Quality Control - describe issues of quality of the spatial data being compiled and of the applications being developed and describe how QA/QC will be incorporated into the project. As part of the discussion of quality control of the spatial data indicate any metadata and cartographic standards that shall be followed.
- h. User Manuals and Help Capabilities for the applications developed and for the system- provide a description of the format of the User Manuals and also the Help capabilities to be included in the system.
- i. Schedule of Deliverables - provide a schedule of deliverables. In the development of this schedule the proponent must consider that the Bank and the beneficiaries need to have up to 30 days to analyze and approve both the *Discovery and Needs Analysis Report* and the *Draft Final Report*.
- j. Schedule of Personnel Allocation - provide a schedule of personnel allocation, indicating extent of involvement and location.
- k. Spanish - All reports, user manuals, and all other materials shall be produced in Spanish (the consultant may provide additional versions or copies in English).
- l. Budget - The proponent must provide a budget broken-down by tasks. Both the satellite imagery and the hardware and software should be budgeted as separate budget items: a total estimate of the number of scenes to be acquired should be provided together with a unitary price.

V. DURATION OF PROJECT

- 5.1 The work should be conducted in a period of no longer than 12 months. The Draft Final Report should be scheduled for delivery 10 months after the contract signing date. During the final 2 months the Bank will review that Draft Final Report (30 days) and subsequently the consulting firm will elaborate and deliver the Final Report (final 30 days).

VI. REPORTING RELATIONSHIPS

- 6.1 The local counterparts for the study will be the Dirección Nacional de Vialidad and the Dirección Nacional de Topografía of the Ministerio de Transportes y Obras Públicas, Uruguay.
- 6.2 The supervision of the study by the Bank will be the responsibility of the Finance and Basic Infrastructure Division 1 (RE1/FI1) in coordination with the Country Office in Uruguay.