Jamaican GIS Services Capability and Needs Assessment

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1 Introduction

This report describes the tasks associated with a short-term (five days) Geographic Information System (GIS) consultancy to the Chemonics Jamaica Small Business Export Development (SBED) project, which was conducted June 24-28, 1996 in Kingston, Jamaica The consultancy included meeting with several private sector firms to discuss their interests in GIS and conducting a preliminary needs assessments addressing their aspirations to diversify and expand their operations to include GIS products and services The meetings included a discussion of business operations, current products and services, technical aspects of various GIS software products, computer systems, and staff credentials

This scope of work represents an ambitious undertaking in that a thorough assessment of a firms' capabilities to move toward GIS specialization cannot easily be accomplished in several hours or days Although three meetings were conducted with one of the firms, the time constraints of the consultancy did not allow for any other follow-up visits During these meetings, technical assistance and advice were disseminated and are included in the Diagnostic Assessment Report for each firm that was visited This report reflects conclusions and recommendations based solely on these brief visits It is highly recommended that this consultancy serve as a commencement for additional assessment, more detailed evaluations, and technical assistance assignments with any interested firms

2 Scope of Work Activities

The following Kingston firms were visited

Mona Informatix, Limited
Environmental Solutions Limited/Smith Warner International
E D H Wilson & Associates
Conrad Douglas & Associates

As outlined in the scope of work for this consultancy, a Diagnostic Assessment Report for each firm is included It should be noted that the time spent with each firm varied greatly, therefore the level of detail in each report reflects the amount of time spent with the staff of each firm

In addition to meeting with the private sector firms, other major tasks associated with this assignment included

- Attendance at a World Bank seminar entitled "Information Processing and Services Opportunities in the Caribbean," prior to traveling to Jamaica
- Meeting with the national GIS Coordinator (Ms Cheryl Gopaul) and other members of the

committee, to gain information on their GIS capabilities, lab, and training program
- Participation in a Kingston radio program (The Breakfast Club) to discuss GIS technology and the potential for providing profitable value-added services
- Meeting with computer science professors from the University of the West Indies and the University of Technology to assess the level of university computer training provided, particularly in the UNIX operating system, and tour the lab facilities
- Meeting with Mrs Diane Gordon, GIS staff member with the Jamaica Bauxite Institute, to gain information on the industry's GIS activities
- Presentation of an overview of GIS technology and markets in conjunction with a half day seminar entitled "Geographic Information Systems Seminar," sponsored by the Jamaica Exporters Association (JEA) and the SBED project

3 Background

There is no single accepted definition of Geographic Information Systems For purposes of this report, a GIS is a computer system that manages the input, editing, output, and analysis of spatial or geographically-referenced data in digital form Spatial data sets have two basic components, graphics and attributes The graphic data essentially represents a map in computer form, showing features such as elevation, roads, water bodies, and property boundaries There is also an associated database which contains attributes or descriptive data about the graphics, such as property ownership information, area, and crop type It is the marriage of these two components--computerized map and associated, descriptive database--that enables GIS users to employ this tool to improve resource planning and decision making GIS applications, commonly referred to as spatial analysis, provide the user with the ability to query or question the contents of the graphic data and associated databases and retrieve a set of answers or solutions to the decision-making process Examples of some of these questions include

- *Who owns that property?*
- *Where are all the water and sewer mains that have not been serviced in the past year?*
- *What is the soil suitability for sustainable development of {agriculture, vegetation, housing}?*
- *Where do we locate services, such as health education centers?*

There are numerous possibilities for value-added services within the field of GIS As the technology grows, evolves, and advances, the need for specialized service providers also increases and becomes more specialized These services include

- Data entry and conversion services (includes both the map and the database)
- Database design
- Application development
- Consulting
- Training

GIS is a technically challenging field that requires a combination of relevant education,

training, and hands-on experience to develop a suitable level of expertise A comprehensive software package usually has a considerably steep learning curve It is not uncommon for the average GIS user to require between one and one and a half years of hands-on experience to feel comfortable with most of the software modules within a GIS package Many times the use of such packages also requires staff to be versed in the fundamentals of the UNIX operating system and associated system administration duties Therefore, staffing and training requirements associated with these comprehensive GIS software packages must be considered carefully and thoroughly, particularly in terms of cost and time investments

4 Diagnostic Assessment Report - Mona Informatix Limited

4 1 Introduction

The equivalent of approximately two days was spent with Mona Informatix Limited, located on the campus of the University of the West Indies Mr Michael P HoSue is the General Manager and the point of contact for the majority of discussions related to GIS services Currently, Mona has a contract with the Boeing corporation to scan and digitize large engineering drawings of their airplanes The computer operations consist of Sun Microsystems UNIX-based workstations and a variety of Computer-Aided Drafting and Design (CADD) and customized software to accomplish the tasks Mona is interested in expanding into the GIS market in two areas--GIS data conversion and some area(s) of yet undefined high-end, value-added services

The firm has completed several map data conversion projects for the Jamaican public and private sectors, utilizing the same technology of scanning and using raster to vector data conversion software as the Boeing work Other than these projects, the staff has limited knowledge in the field of GIS

4 2 Value-Added Services.

This section addresses two areas of high-end, value added services--GIS data conversion and application development--that Mona Informatix may be interested in pursuing and are recommended for further study Data conversion services are a natural expansion and enhancement of the current work Mona produces under the Boeing contract It does, however, require additional specialized skills and training

Application development involves high level computer programming skills and represents the most technical and high-end GIS service a supplier can provide The firm will need to develop a very well structured plan to implement this type of high-end value added GIS service, and realize that this type of specialization takes several years to develop

4 2 1 Data Conversion

The tasks that Mona Informatix currently engages in for the Boeing contract are engineering or CADD-based data conversion The drawings are scanned by the appropriate hardware, then converted from a raster or cell-based image to vector or line-based data files through the use of various types of engineering or CADD-based software Traditionally, GIS data conversion consists of two distinct operations--converting the map to digital form and populating the associated database with tabular data, which is accomplished through the modules included in the GIS software package for these operations Map conversion is accomplished either through scanning (fundamentally the same techniques performed at Mona) or "tracing" the map through the use of a digitizer, a large table with a reference or coordinate grid embedded underneath the surface, which records the location of each feature on the map and converts it into a digital file

The methodology used to populate the database is a function of the specific GIS software package and the design of the GIS database For example, some GIS software packages allow the user to set up and populate a large number of attribute files as related entities, as opposed to one large database file for each graphic or map layer Therefore, the successful GIS data conversion vendor must have an understanding not only of the GIS software package and its software conversion modules, but also a knowledge of the concepts related to database design and management in order to develop a database that allows for rapid access and efficient storage of the data

The ability to design an efficient GIS database is a skill that adds a great deal of value to the services a vendor can provide to the GIS user community GIS data conversion goes beyond rudimentary data entry In order to provide value-added data conversion services, a vendor must have the technical knowledge related to the operation of the database component of the GIS package, as well as a basic understanding of the concepts of relational database design and database structures The GIS database must be designed with the end-user in mind, so that the data are organized to ensure that the systems and databases are easily understood by these-users and easily maintained and updated by the system administration staff

4 2 2 Application Development

High-end, value added services within the field of GIS usually relate to developing computer programs or modeling algorithms to solve a variety of GIS applications Most GIS software packages include a programming language to develop and implement these applications The successful application developer must possess a thorough knowledge of the basic concepts of computer science, the common operating systems utilized in GIS--particularly the UNIX operating system environment, and proficiency in a programming language associated with scientific applications, such as FORTRAN or C In addition to a thorough understanding of GIS concepts, an understanding of the data structures utilized and manipulated within a GIS, knowledge of topology--a technique used to record and manipulate the logical relationships of these data, and database management systems is essential

4 3 Constraints

Two major constraints related to developing and implementing high-end GIS services are staffing and training Factors such as costs, attrition rates, and recruitment will directly affect the ability of a firm to develop and maintain the level of expertise needed to provide these value-added services

4 3 1 Staffing.

One of the most important elements in developing expertise in GIS is in recruiting and maintaining staff Mona currently has a staff that works well at the Boeing data conversion procedures but has a limited knowledge of GIS technology It may be difficult to recruit local

expertise with the education and experience needed to successfully implement the high-end services Mona aspires to develop In addition, as current or recruited staff members become proficient in the GIS technology, there is some probability that they may find more lucrative positions both locally and abroad

4 3 2 Training

Several levels of training must be provided in order to develop the skills necessary to perform various GIS services activities The need for technical training will vary according to the level of specialized skills the firm aspires to develop and excel in For example, the training plan developed for a staff member to become proficient in the use of Environmental Systems Research Institute's (ESRI) ARC/INFO GIS software for purposes of data conversion will be quite different from the training needed to achieve application development proficiency In addition, computer operations training, such as UNIX system administration, should be considered

Costs must also be carefully considered Some average representative costs for basic GIS hardware and software training include

- Five day ESRI-certified ARC/INFO course - $1500 (United States)
- Five-day UNIX system administration course - $1,750 (United States)
- UNIX-based ARC/INFO GIS software license - $24,000 (Jamaica)

It will be important to develop several levels of staffing profiles and training requirements to satisfy the particular needs related to the desired level and type of GIS specialization

4 4 Conclusions and Recommendations

It is likely that the bulk of the business effort at Mona Informatix will continue with the core business of data conversion for Boeing They have been highly successful in providing these data conversion services and have plans to expand their scope of work, which may result in additional business with other airlines and companies who have similar needs This does not preclude Mona from beginning to plan, train, and develop GIS specialization skills The operational atmosphere appears to allow for the ability to begin to develop some diversified and concurrent activities The GIS specialization goals should be based on the formation of a realistic action plan and time frame It is recommended that Mona begin to develop this expertise gradually while continuing to reassess the plan, conduct additional market research, and implement a training program Once these steps are taken and under way, the company may want to embark upon a pilot project or program to assess and analyze the plan and the potential for success in GIS services For example, one of the past GIS data conversion output products could be used to gain experience in populating and developing an associated database in a specific GIS software package format

The following recommendations related to developing GIS expertise are divided into the areas of standardization, market research, training, and providing GIS services

4 4 1 Standardization of Hardware and Software

The initial task related to standardization that Mona must undertake is to decide upon the specific hardware platform, specific software product or products, and area of GIS specialization they will focus on It is strongly recommended that Mona examine the ESRI line of software products, particularly ARC/INFO and ArcView The Jamaican government agencies that are developing GIS products and applications have adopted ARC/INFO as the national standard ESRI is regarded as one of the GIS leaders with a very large base of worldwide installations, which greatly increases the scope of opportunities for vendors to develop products and applications that interface with this suite of software In addition, Mona has already invested in the acquisition of a large number of UNIX-based workstations, the platform of choice for ARC/INFO software Appendix A is a description of ESRI's ArcScan product, a software module that provides raster-to-vector conversion and raster editing capabilities within ARC/INFO and is considered a valuable tool in ARC/INFO GIS data conversion tasks

4 4 2 Market Research

Mona has not conducted any substantial market research in three years It is highly recommended that they embark upon additional analyses of the GIS market and the emerging applications Acquiring an additional understanding of the market will help to identify the niches that may be potentially profitable areas for Mona to develop Appendix B includes information about several market research and technology assessment firms that specialize in the GIS market

Another recommendation is for Mona staff to identify and communicate with current GIS developers in order to gain insight into their respective GIS activities Appendix C is a copy of the cover of the ESRI Business Partner Catalog, a comprehensive guide to GIS services vendors for the ESRI line of software The section on products and services is organized according to specific niche or vertical markets

An information packet on Nautical Data International, Inc of Newfoundland, Canada, was presented to Mona during this consultancy It is highly recommended that Mona explore the potential for GIS business with this firm Mr Brian Terry, president of the company, has a contract to digitize, update and maintain a system for updating electronic charts They are interested in finding partners who will set up local operations to do the GIS work

4 4 3 Staffing.

A logical first step would be to identify the staff who could be trained and utilized for the initial specialization of GIS data conversion While concurrently identifying those staff seen as the most suited for training and specialization in this area of GIS, it is recommended that Mona recruit at least one staff member who is already well-versed in a broad number of areas in GIS The ideal candidate should have the following qualifications and skills

Bachelor's Degree in Geography, Engineering, or Computer Science, with experience in Geographic Information Systems
Minimum of two years experience (can be combined with education) working with GIS software on UNIX or PC-based equipment
Additional skills in computer science (language, database) and GIS application development
Additional skills in System Administration, preferably UNIX workstations

The GIS staff member can be responsible for a variety of start-up tasks, including development and formulation of the training and general business plans, aiding staff in understanding the fundamental concepts of GIS, and providing an overall jump start to developing a GIS specialization within the organization In order to develop a baseline set of GIS data conversion skills, selected staff can be trained in GIS concepts, the fundamentals of a specific GIS software package (specifically related to data conversion), or a type of specialized approach to the data entry (both map and database) procedures

Incentives should be provided to staff who show an aptitude for learning and attaining the necessary GIS skills These incentives may include attendance at GIS conferences and workshops, as well as other events sponsored by professional societies, universities, and commercial firms This sends a message to the staff that the company is committed to their advancement These incentives may also help to reduce the attrition rate and provide potential for Mona to develop additional GIS specialization skills

4 4 4 Training.

Mona has many training options available Each option must be assessed in terms of costs and applicability to the specific GIS specialization goals Mona training plans may include

•Enrolling selected staff in the introductory level course offered through the national GIS training program The course may help to assess the general level of staff comprehension and target specific staff for the next level of basic training The course may result in forming the foundation to build a specific training plan that will adhere to the areas of specialization that are desired

•Contracting with a consulting firm to conduct additional user needs assessment to provide a training plan that will accelerate the GIS efforts The contractor could provide a tailored, rather than generic, training approach and plan

•Taking the five day ESRI-certified Introduction to ARC/INFO course at the nearest U S regional office in Charlotte, North Carolina This training teaches the basics of the ARC/INFO, including command level software related to the input, output, and database modules of the software

•Working with a consulting firm to develop an overall training plan which may include a mix of vendor and customized training An example would be to tailor the basic ARC/INFO training course contents to focus on specific software modules, such as data conversion and database population, that adhere to the specialization plan Mona develops

4 4 5 Providing GIS Services

It is important to note that many GIS service vendors or suppliers usually focus on developing only one specialization skillset It is incorrect to assume that an organization in need of GIS services will opt to work with only one vendor For example, in the United States, an organization that is developing a GIS will write and issue requests for proposals (RFPs) addressing different needs, such as data conversion, application development, and consulting services It is therefore better to develop a limited area or number of specializations It was observed that this may not be the perception Mona has of the GIS market or that GIS business is conducted in a manner akin to the one vendor approach Mona has apparently witnessed in Jamaica

5 Appendices.

The following appendices provide additional sources of GIS information and are provided as aids to the recommendations made in this report

5 1 Data Conversion

- •Product information on ESRI's ArcScan - Appendix A
  - a software module that provides raster-to-vector conversion and raster editing capabilities within ARC/INFO

5 2 Market Research.

- •Covers of several GIS industry analysis organizations (Dataquest and Daratech) Appendix B
- •Business Geographics cover - Appendix C
  - GIS professional publication that highlights GIS applications in many types of businesses, such as retail, banking, utilities, and telecommunications
- •GIS World Sourcebook - Appendix D
  - a compendium of worldwide GIS activities, including vendor profiles and
- •Cover of the ESRI Business Partner Catalog - Appendix E
  -a comprehensive guide to GIS services vendors for the ESRI line of software

6 Diagnostic Assessment Report - Environmental Solutions and Smith Warner International Limited

6 1 Introduction.

Approximately one hour was spent with Environmental Solutions and Smith Warner International Limited, two environmental firms who occupy the same building and work closely with each other lasted on selected projects Mrs Eleanor Jones, Managing Director of Environmental Solutions, and Dr David Smith and Mr Philip Warner, principals of Smith Warner, attended the meeting The meeting began with a discussion on the work that Smith Warner and Environmental Solutions have completed in Jamaica and other areas of the Caribbean Some of the projects which included a GIS component were either contracted out to a consultant or assumed by Smith Warner using Environmental Systems Research Institute's (ESRI) PC-based ArcView and ArcCAD GIS software These operations included populating the GIS database, performing basic query and analysis functions, and producing a series of thematic maps Mrs Jones then posed a question about where the current growth areas within GIS currently existed An explanation was provided related to the rapid growth in desktop or PC-based, business-related GIS applications It was explained that GIS technology was now being discovered by many businesses, such as banks, insurance companies, and retail firms These sectors do not fit the stereotypical characteristics normally attributed to the GIS user community Business GIS applications include regulatory compliance (banks), demographic analysis (retail, health), demand potential (retail), and competitive analysis (many businesses) The firms were encouraged to attend the GIS seminar that would be held later in the week to gain more information on the GIS growth markets and their associated profitability The trip concluded with a tour of the firms' facilities

6 2 Recommendations.

Environmental Solutions and Smith Warner have expressed interests in partnering with Chemonics International on environmental projects where appropriate and gaining additional expertise in GIS It is clear that the meeting attendees are already well-versed in the concepts of GIS, as well as some of the fundamental operations of specific PC-based software packages It was mentioned that most of the work with GIS software was for the development of thematic maps, with little emphasis on the analysis functions capabilities Therefore, it is suggested that the firms may want to examine the means by which they can acquire training in database design and data analysis to improve their base of GIS skills and form the foundation for proficiency in value-added GIS services

Environmental Solutions and Smith Warner have many training options available Each option must be assessed in terms of costs and applicability to specific specialization goals These training plans could include

•Enrolling selected staff into the GIS Data Bases and GIS Data Analysis courses offered through the national GIS training program

•Contracting with consultants such as Chemonics to provide training in the specialized areas

of data base design and data analysis to accelerate their specialization efforts The firms may also want to contract with consultants to provide a tailored, rather than generic, training approach and plan

•Working with a consulting firm to develop an overall training plan, which may include a mix of vendor and customized training

In addition to providing any training or consulting services to either firm, Chemonics would consider utilizing their environmental applications expertise in partnership on appropriate projects

7 Diagnostic Assessment Report - E H D Wilson and Associates

7 1 Introduction.

Approximately one hour was spent with Mr Hugh Wilson, owner of E H D Wilson and Associates, a photogrammetric firm The discussion focused on the photogrammetric work that the company has completed in Jamaica and other areas of the Caribbean Mr Wilson employs twenty nine staff, including approximately seven photogrammetric technicians and four draftsmen, who would be the most likely candidates for GIS training Mr Wilson explained that most of the photogrammetric staff who work at the firm come from the three year Diploma course offered at the University of Technology in Kingston After one or two years performing licensed surveying work, they enter into a three month apprenticeship, followed by additional training, usually overseas Mr Wilson is interested in learning more about GIS and providing some form of training to his staff The visit concluded with a tour of the operations, including the photogrammetric equipment and examples of typical output map products

7 2 Recommendations

Mr Wilson's firm produces hard copy (paper) maps, derived from accurate photogrammetric practices Photogrammetry is closely related to GIS in that the production of photogrammetrically-derived maps, provided in digital form, comprise the graphic or mapping component of a GIS

GIS is a technically challenging field that requires a combination of relevant education, training, and hands-on experience to develop a suitable level of expertise A comprehensive software package usually has a considerably steep learning curve It is not uncommon for the average GIS user to require between one and one and a half years of hands-on experience to feel comfortable with most of the software modules within a GIS package Many times the use of such packages also requires staff to be versed in the fundamentals of the UNIX operating system and associated system administration duties Therefore, staffing and training requirements associated with these comprehensive GIS software packages must be considered carefully and thoroughly, particularly in terms of cost and time investments

Mr Wilson expressed an interest in providing his staff a course in Environmental Systems Research Institute's (ESRI) ARC/INFO and how it relates to survey data, photogrammetry, and global positioning systems (GPS) It is agreed that a two week course of half-day sessions would serve as a good introduction to the technology and some of the specialized functions of the GIS software as it relates to those three related areas This course could be developed and customized by Chemonics and provided to the Wilson staff in Kingston It is recommended, should this option be considered, that Chemonics staff perform some preliminary user needs assessment work prior to the actual training This assessment would consist of an analysis of the staff to understand their current job functions, familiarity with computer systems, educational and technical backgrounds, and staff expectations of the GIS training The course would be based on the results of this needs assessment exercise

During the tour, several map products derived for the sugar and banana industries were

observed These products, in digital form, could easily be incorporated into one of the PC-based GIS software packages, such as ArcView Mr Wilson may want to purchase this package and experiment with its capabilities (a tutorial comes with the software package) to perform thematic mapping and simple spatial analysis utilizing these maps or data sets It is feasible that these capabilities could be shown to the sugar and banana clientele in order to solicit this type of GIS work These applications could include the monitoring of individual fields related to production and crop yields These are simple yet powerful GIS applications that may currently being implemented through purely manual calculations and mapping efforts

Traditionally, many photogrammetric firms choose to provide GIS services when there are sufficient requests from clients for output products in a specific format, such as ARC within ARC/INFO An example in Jamaica includes the land titling GIS work to be performed within the Surveys Department, which may in time be contracted out to an experienced firm with knowledge of ARC/INFO Therefore, it may be useful to study the needs these agencies may have in the future for the production of specific map products Upon completion of the training that has been proposed, which can serve as a foundation for understanding the fundamentals of GIS technology, as well as an understanding of potential clients' needs, Mr Wilson can better assess the level of effort and experience he may aspire to develop within GIS

8 Diagnostic Assessment Report - Environmental Science and Technology Limited (ESTECH) - (a division of Conrad Douglas and Associates Limited)

8 1 Introduction

The majority of the one hour long meeting was conducted with Ms Kelly Scott, Project manager, and Mr Wayne Goldson, Technical Officer of ESTECH Mr Conrad Douglas, Chairman and Chief Executive Officer, spent some time introducing his company and their environmental work, as well as stressing his support for establishing GIS expertise within the company The firm is over ten years old and has completed environmental projects in Africa as well as the Caribbean Both Kelly and Wayne have a very good mix of education and experience in the use of GIS and attended the GIS seminar sponsored by the Jamaica Small Business Export Development (SBED) project the day before the meeting

The bulk of the discussion focused on technical elements of Environmental Systems Research Institute's (ESRI) ARC/INFO and ArcView product line Kelly and Wayne are responsible for specifying the GIS hardware and software configurations and establishing the system in-house They asked questions related to choosing the best hardware platform--UNIX workstation versus PC, the capabilities of and differences between the UNIX and PC ARC/INFO software products, and some of the new capabilities in the ArcView product Technical aspects of both platforms and their relationship to the associated ARC/INFO software were discussed in detail As the firm is interested in developing a GIS client base in both the public and private sectors, it will be important to consider the reality of expected business that will be driven by UNIX and PC based products and applications For example, the Surveys Department, the government agency responsible for the national Land Titling Project, which will reform the current systems of cadastral land management, is utilizing a UNIX-based workstation ARC/INFO solution ESRI training was also briefly discussed and they were informed that ESRI-certified ARC/INFO training was available at the ESRI regional office in Charlotte, North Carolina, as opposed to having to travel to the company headquarters in California

8 2 Recommendations.

Both Kelly and Wayne expressed interest in the possibility of working with Chemonics in developing their in-house GIS This may include training, installation of hardware and software, and other services, such as conducting presentations or seminars to help the GIS staff sell the technology in-house Preliminary plans were made to provide Chemonics with a written description of three of the projects they have completed or are working on that shows a strong GIS component From there, further discussions could be held to exchange information and investigate the possibilities of working together

Appendix A

ArcScan Product Information

- a software module that provides raster-to-vector conversion and raster editing capabilities within ARC/INFO

Appendix B

GIS Market Research Firms

Appendix C

Business Geographics

Appendix D

GIS World Sourcebook

- a compendium of worldwide GIS activities, including vendor profiles and services
- published by GIS World, Inc Fort Collins, Colorado, 970-223-4848

Appendix E

ESRI Business Partner Catalog

- a comprehensive guide to GIS services vendors for the ESRI line of software