FRAMEWORK DATA SETS FOR THE NSDI

Steven M. Frank

Michael F. Goodchild

Harlan J. Onsrud

Jeffrey K. Pinto

Technical Report 95-1

Acknowlegements

We wish to acknowledge and give special thanks to Jeffrey Johnson and Xavier Lopez for the many hours they spent in helping to mail the questionnaire and compile its results.

FRAMEWORK DATA SETS FOR THE NSDI

Steven M. Frank, Michael F. Goodchild, Harlan J. Onsrud, Jeffrey K. Pinto

Appendices

A. Framework Data Survey Questionnaire

B. Stratification of Potential GIS Users Using US Bureau of Labor Statistics

C. Estimated Stratification of Sample population Across Employment Sectors by Geographic Region and by Occupation

D. Estimated Sample Weights Based on Geographic Regions, GIS Application Uses, and User Employment Sector

E. Stratification of Responses Across Employment Sectors by Geographic Region and by Occupation

F. Respondents Background

G. Respondents Use, Future Use, and Need for Better Geospatial Data

H. Data Contents

I. Data Tasks

J. Data Formats

K. Data Geocoding Schemes

L. Data Positional Accuracy

M. Data Vertical Accuracy

N. Data Updating Interval

O. Historical Data Needs

P. Data Sources

1.

Background

There appears to be a growing agreement among the users of geographic and land information systems that common sets of geographic data on which users could build to their own particular data needs would promote greater data sharing among the various players in the geographic information system (GIS) community (NRC 1994). They would thus present a significant cost savings to federal, state, and local government agencies and an economic stimulus to American industry by reducing the costs of collecting and processing useful digital geographic data. Such common data sets, referred to as "core" or "framework" data sets, could be collected by designated government agencies or by participating members of the private sector and added to the public domain, via the National Spatial Data Infrastructure (NSDI), for the use of any and all interested parties.

There are many existing digital geographic data sets that enjoy great popularity among various members of the GIS community. However, there appears to be no clear consensus of which geographic data sets would be of greatest value to these government agencies and private businesses. There is a need to identify which sets of geographic and land data are being used and who is using them. There is also a need to discover if these data sets meet the expectations of those who are using them.

This report is concerned with the identification and prioritization of framework data sets. We have already defined framework data sets as valuable because they serve as the foundation for a wide range of activities. For example, the national geodetic framework is valuable because it allows many users in a wide variety of applications to determine the position of geographic features by measuring with respect to accurately established monuments. Topographic maps often perform a similar function, but at a different level of accuracy.

We use the terms "digital geospatial data," "digital geographic data," and "GIS data" interchangeably within this report. Within the context of this study such terms may be considered synonymous. We are dealing with technical requirements of digital data that may be used within a GIS application, within a CAD/CAM application, or within a computer mapping application. We do not distinguish these uses, but assume that our sample population reflects the needs of GIS users who may or may not have need for CAD/CAM or computer mapping applications.

Within the US geographic information community there has been protracted debate in the past two years over the value of various data sets, and their importance in the National Spatial Data Infrastructure. A range of criteria for prioritization have been suggested, and strong arguments have been presented for the importance of the various types of data, in addition to the framework function described earlier. This report is not concerned with resolving these arguments, or even with establishing the relative value of various types of data to the user community. Rather, our objective is to help to clarify the debate by identifying the specific aspects of data sets that are perceived to be of most value to specific communities of users.

To help discover which framework data sets should be given priority for incorporation into the NSDI, the Federal Geographic Data Committee (FGDC) has funded a mail questionnaire survey that was conducted by the National Center for Geographic Information and Analysis (NCGIA) with oversight by a peer focus group.

1.1

Goal

The goal of this survey is to identify the technical criteria that may be used to identify and prioritize the framework data sets for the National Spatial Data Infrastructure. These framework data sets may be identified by defining the technical specifications required by the users of these data sets, including content, tasks for which the data are used, format, geocoding scheme, positional accuracy, vertical accuracy (if needed), updating interval, needs for historical data, and the sources for data currently being used.

It should be recognized that geographic information users may be required to use certain data not because of their technical merit, but because of political or organizational expedience. Organizations may have agreements to share or purchase geographic data from predetermined sources, thus forcing the use of certain types and qualities of data. This questionnaire does not investigate possible political or organizational factors.

Survey results will be analyzed and adjusted to reflect, as best as possible, the framework data needs of the GIS user community in general. It is expected that no single set of criteria will be appropriate for all GIS users, but that identifiable sets of criteria will emerge that can form the basis of selecting current digital geographic data sets that best meet such criteria as NSDI framework data sets and for improving such data sets to meet the full needs specified by the different sets of criteria.

1.2

Focus Group

A peer focus group to review the questionnaire, the survey sampling strategy, and the survey results was formed from diverse members of the GIS community. An internet list server program, called FRAME-L, was installed at the University of Maine to facilitate communication within the group. FRAME-L was also used for limited discussion of issues in the development of the questionnaire. Other discussions were held through normal electronic mail and by telephone or fax.

It was the intent to keep the focus group small and to keep discussions on materials up to date. Focus groups members were encouraged to consult with others outside the focus group and to forward comments or suggestions from others where appropriate. The investigating team members and appropriate Federal Geographic Data Committee (FGDC) members also had access to the list server.

Members of the focus group were:

Donald F. Cooke, Geographic Data Technology, Inc.
William J. Craig, University of Minnesota
Charles Dingman, US Bureau of Census
Cliff Kottman, Intergraph, Corp.
David Mark, State University of New York, Buffalo
Mike McDermott, US Geological Survey
Gerard Rushton, University of Iowa
Nancy von Meyer, Wisconsin Land Information Association

Investigating team members are:

Steven Frank, NCGIA / University of Maine
Harlan Onsrud, NCGIA / University of Maine
Michael Goodchild, NCGIA / University of California, Santa Barbara
Jeff Pinto, NCGIA / University of Maine

FGDC members involved with this survey are:

Nancy Tosta, US Geological Survey
Michael Domaratz, US Geological Survey

2. Survey Data Collection

Data collection was by a structured questionnaire sent and returned by mail. The questionnaire allowed data collection from a large group of people in a relatively short time at a relatively inexpensive cost. The questionnaire was designed to capture background information useful to correlate and aggregate data into meaningful units of comparison and to capture information on the technical details of digital geographic data used or needed by the respondents.

The unit of analysis for the questionnaire was an individual using geographic information. The term "geographic information" as used here is intended to include information about the spatial locations of objects on or near the Earth's surface. Collection of questionnaire data at the individual level allows aggregation of data by many different means, such as discipline, organization, experience, etc.

Other possible units of analysis considered were organizations, networks, and episodes of geographic information use. Aggregate use of geographic information by an organization or network is difficult to quantify and compare and would not allow the depth of data collection available at the personnel level. Episodes of geographic information use may be frequent in many cases, making them difficult to track other than by automated methods. Such methods are not available for the breadth of uses intended to be covered by this study.

Patterns of spatial data use are changing rapidly, and are expected to continue to do so in the future. Some application areas are relatively mature, with widespread use of spatial data, but in other areas, such as insurance, use of spatial data and GIS is only just beginning. The same general observation is true of geographic areas - some states and local governments have a long history of GIS use, while others are relative newcomers.

Instead, we have allowed accessibility and expedience to define the sampling frame for this study, rather than any coherent notion of a population. A list of 3222 potential respondents was obtained from the following sources:

GIS in Business '93 Conference Proceedings (1993);

Proceedings of AM/FM International 1993, 1992, 1991;

Proceedings of GIS/LIS 1993, 1992, 1991;

State Geographic Information Activities Compendium (1992), by Lisa Warnecke;

URISA Membership Directory 1993-1994 (1993) and 1992-1993 (1992);

1991-1992 International GIS SOURCEBOOK (1991), ed. H. Dennison Parker;

In this situation there is little to be gained by attempting to make statements about the U.S. as a whole, or the average GIS user, or the average potential user of GIS. An average forester may be familiar with GIS, but an average insurance broker may never have heard of it. The meaning and significance of "potential use" and "actual use" are thus specific to each sector of the economy, and there seems little point in trying to establish uniform meanings across such widely divergent contexts. These issues amount to problems in defining a population to be sampled, and thus in making inferences from a sample to such a population. We argue that there exists no effective definition of such a population.

Persons who use spatial data in a GIS context and who feel that this is an important part of defining themselves as professionals, often decide to belong to one or more professional organization that is identified with GIS and spatial data use. In the first category are persons listed in the GIS in Business '93 Conference Proceedings, persons listed in the Proceedings of AM/FM International, persons listed on the Proceedings of GIS/LIS, and persons listed in the URISA Membership Directory. We call this category of respondents the self-selected category. In other cases, there are professional groups who exist to serve professionals who use spatial data in a GIS context and these groups identify professionals to target their message. In the second category we developed our list of potential respondents from the State Geographic Information Activities Compendium and from the International GIS Sourcebook. These organizations are not the only professional organizations to which professionals who use spatial data and GIS choose to belong. We chose the groups in the first category because we believed they attracted professionals with a very wide variety of application areas, in contrast with other organizations which reflected more narrow application areas. For the same reasons we selected second category sources as organizations that identify spatial data users from a wide variety of application areas. Our sample is from individuals in these two groups. The result, we believe, gave us a list of potential respondents that reflected individuals with a professional interest in the characteristics and use of spatial data without bias with respect to any particular application area. Approximately sixty percent of the list were drawn from the self-selected category and approximately forty percent were drawn from the third-party identified category.

Each respondent was identified by state, and by a best estimate of occupation and category. Systematic samplings were then made within each state, occupation, and category to obtain a sample. While the objective of the drawing was to obtain approximately equal samples in each state, each occupation, and each category, the relative lack of potential respondents in certain occupations and states made this impossible. The final sample consisted of 1360 potential respondents. Appendix C gives an analysis of the numbers of the estimated occupations of federal, state, local, private, and academic GIS or GIS product users for both the master database and the final mailing list. Appendix D gives an analysis of the numbers of federal, state, local, private, and academic GIS or GIS product users in each state for both the master database and the final mailing list.

Stratified random samples are normally used in order to provide statements and inferences of equal reliability in each sector or stratum of a population, when such sectors or strata occur with unequal frequencies. In order to make statements and inferences about the population as a whole from a stratified sample, it is necessary to weight responses within each stratum by a factor reflecting the stratum's sampling intensity. Because there is little to be gained from constructing the average GIS user or average potential GIS user in the U.S. we have chosen in this study to report the results of various combinations of subgroups in detail and to not construct a weighting scheme for the entire sample. Various possible estimators for weighting the sample are given in Appendix D and may be useful in weighting responses within specific categories but are inappropriate to apply to the entire sample. The entire population of individuals using geographic information is so varied and diffuse that any attempt to arrive at generalized inferences for the entire population would be futile. For this reason we refer to our approach as a "balanced" rather than a "stratified" sampling, reflecting the impossibility of defining a population, and have not attempted to weight responses. For reasons already expressed, we believe it is easier to define the sampled population within each category, occupation, and state, but that severe differences between these sub-populations exist, particularly across occupations. All results from this study are stated as counts, proportions, or averages for the sample and its sub-samples, and while comparisons are made between proportions, no inferential statements are made regarding any larger population.

Although the initial attempt was to collect and analyze responses across each of the fifty states and the District of Columbia, small and possibly heavily biased samples from some states made this impractical. Instead, the states were aggregated into geographic regions corresponding to the US Census use of national regions. The nine resulting regions are: New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific (see Table 2.1).

The aggregate numbers of questionnaires sent to each region are given in Appendix C. Appendix C also lists the number of questionnaires sent to each individual state within a given region. Appendix E gives the number of usable questionnaire responses received from each region and from each state.

Each source of potential respondents was compiled as a separate database. A miscellaneous database was compiled from names that were collected from sources such as GIS World magazine, the GIS-L internet discussion group, Photogrammetric Engineering & Remote Sensing journal, and from a list of legal experts compiled for another NCGIA project, Initiative 16 -- Legal Issues in GIS. Less than 15 names were selected from any individual source. Only persons listing an identifiable company or agency mailing address were included in the databases. The individual databases were checked and duplicate names were deleted. These databases were then merged into a master database containing 3222 names and addresses (see Table 2.2).

Table 2.1. Regional Clustering of States Using the Census Bureau Method

New England	Middle Atlantic	East North Central
Connecticut	New Jersey	Illinois
Massachusetts	New York	Indiana
Maine	Pennsylvania	Michigan
New Hampshire		Ohio
Rhode Island		
Vermont		
West North Central	**South Atlantic**	**East South Central**
Iowa	Washington, DC	Alabama
Kansas	Delaware	Kentucky
Minnesota	Florida	Mississippi
Missouri	Georgia	Tennessee
North Dakota	Maryland	
Nebraska	North Carolina	
South Dakota	South Carolina	
	Virginia	
	West Virginia	
West South Central	**Mountain**	**Pacific**
Arkansas	Arizona	Alaska
Louisiana	Colorado	California
Oklahoma	Idaho	Hawaii
Texas	Montana	Oregon
	New Mexico	Washington
	Nevada	
	Utah	
	Wyoming	

Table 2.2. Master database sources.

State Compendium	1735	
URISA		1285
GIS Sourcebook	59	
Proceedings of AM/FM	43	
GIS in Business '93	42	
Proceedings of GIS/LIS	14	
Miscellaneous	44	
Total	3222	

Only users identified as GIS interest group members were selected from the URISA Membership directories. Only persons identifiable as GIS users were selected from the GIS Sourcebook. Persons affiliated with this project in any manner were excluded from the database.

A total of 27 duplicate names were found and deleted from the master database, leaving a total of 3195 names from which to choose. Only those names which had matching addresses were deleted. Similar names at different addresses were assumed to be different people. Although the possibility arises that two listings with the same name but different addresses could be the same person who has moved from one job to another, the difficulty in substantiating this led to the above assumption. The master database was then pared to a mailing list of 1360 individuals based upon a stratification strategy discussed below.

2.1 Sampling Method

Persons currently using geographic information systems or products generated from GIS were the target of the questionnaire. We focused on people using end products which they knew were produced by GIS as well as "hands on" GIS technicians and managers. We assumed that the breadth of future users of GIS is already reflected in the current users of GIS, although the proportion of future users in different categories may vary drastically (e.g., there may be a far greater number of business users in proportion to government users in the future, but these business users will be reflected in the current geographic/land information user community).

Sampling was stratified by three methods. First, it was stratified across the government, private, and academic sectors. Second, it was stratified across occupational sectors. Third, it was stratified by geographic area.

Priority was given to stratification across occupational sectors. Occupational sectors were stratified using U.S. Bureau of Labor Statistics bulletin information statistics giving the numbers of people employed in different sectors of the U.S. work place. A total of sixty occupations which seemed particularly suited for using GIS applications to solve everyday work problems were identified [see Appendix A] and were aggregated into thirty application areas listed in the questionnaire [see Appendix B, part 1, question 3]. Since users might be applying GIS in more than one area, they were allowed to respond with the frequency of GIS use in each of these thirty application areas.

The preliminary stratification involved creating twenty-eight lists of occupational areas for GIS use. Names and addresses were added to each list based upon an estimate of the potential respondent's probable primary use for GIS. These estimates were made on the basis of the potential respondent's affiliation included in his or her address. For example, if a person listed his or her address at a city planning agency, he or she was added to the list of urban and regional planners. It was difficult to separate those possibly using GIS for civil engineering from those possibly using GIS for other engineering tasks, so these two lists were combined. Similarly, the list for those possibly using GIS for law related or legislative uses was combined. In some cases, it was difficult to obtain sufficient occupational information to ensure that the sample population member is in fact in the category of occupation assigned. For example, if the respondent from a utility company (selected as a member of the utility operations list) was, in fact, a civil engineer, the respondent would perhaps identify himself or herself more strongly as using civil engineering applications rather than as using utility applications. In other cases, it was difficult to find many persons from the compiled database who might be using GIS for a particular application area. These occupational lists of potential respondents were then pared (if needed) to the best balance possible across government, private, and academic sectors.

After the lists of occupational areas were aggregated into a single database, the database was examined for the balance across geographic regions on a state by state basis. Where needed, additional names of respondents were added to achieve a better representation from an individual state. In many cases, it was not possible to estimate the primary possible GIS use of these individuals, so they were listed as "unknown." Certain regions, such as California, Florida, Texas, and New York, contained a much higher number of persons on the mailing list, but this was considered acceptable given the higher populations of these states. Similarly, certain occupational areas received a higher number of persons on the mailing list to help achieve a better geographic balance. Appendix E shows the numbers of samples in the master and final databases stratified across geographic regions, occupational areas, and employment sectors.

Each copy of the questionnaire was numbered and cross referenced to the name and address to which it was sent. Follow up letters were sent to those not responding within the first three weeks. Another copy of the questionnaire was mailed to those who did not respond to the second mailing after two weeks.

2.2 Questionnaire Content

The questionnaire was divided into two portions. The first portion gathered personal information from each respondent, including discipline, GIS applications area(s), employment level, organization background, and GIS experience. The occupational areas portion of the questionnaire was designed to be correlated to the U. S. Bureau of Labor Statistics bulletin information statistics giving the numbers of people employed in different sectors of the U. S. work place (see Appendix A).

The members of the sample population were assumed to be well versed in the technical aspects of GIS. The respondents were also assumed to be primarily professional or managerial level people with a high level of education. Respondents were first asked to list their occupation or profession. They were then asked if they used GIS or GIS derived products in their job-related activities. If they responded "no" they were then asked to return the questionnaire uncompleted. Since many users might use GIS in areas other than their occupation or profession, respondents were then asked to check the frequency with which they used GIS for any or all of the thirty occupational areas listed. For example, a GIS user's profession might be computer science or geography, but he or she might be using GIS on the job to solve transportation problems. A space was provided to fill in additional occupational areas if needed by the respondent. Respondents were next asked about their level of employment (clerical, technical, professional, middle-management, or upper management), the category of their organization in government (federal, state, county, city or town government, or other government -- e.g. tribal or regional government), private business (production, manufacturing, services, consulting, or non profit), or academia (education and research), their experience with geographic data in any form, their experience with digital geographic data, and the amount of work time they spent using digital geographic data.

The second portion of the questionnaire asked the respondents to detail their information needs for six classes of geographic information: 1) transportation feature data, 2) water feature data, 3) other well-defined cultural feature data, 4) elevation data, 5) land parcel data, and 6) boundary data. A glossary of terms used to define the technical features of framework data was included in the questionnaire. Use of the glossary was encouraged to resolve any ambiguities about the meanings of the terms described.

First, the respondent was asked if he or she used or foresaw a future need to use that class of data in their job. If the respondent answered no, they were requested to skip that class and respond to the next class of data. If the respondent answered yes, they were asked for further information regarding their data needs for that class, including content, tasks for which the data are used, format, geocoding scheme, positional accuracy, vertical accuracy (if needed), updating interval, needs for historical data, and the sources for data currently being used. These questions are standardized as much as possible for each class, except for the data content questions, which must differ according to the class of geographic data. In all cases, the respondent was allowed to fill in a response if he or she did not find the provided answers adequate. A complete copy of the questionnaire can be found in Appendix A.

3. Questionnaire Results

The survey responses were tabulated and analyzed using Statistical Program for Social Scientists (SPSS) software and custom developed software. Preliminary results reflect the data needs and uses of the aggregated respondents. Results have also been compiled for various user occupations, for various levels of government and private business, and for various geographic sections of the United States for certain survey questions. Data content, data tasks, data formats, data geocoding schemes, data positional accuracy, and data vertical accuracy are broken down into tables showing the response frequencies for each geographic region, for each application area, and for each employment sector. These tables can be found in Appendices H through M.

The application area responses are further broken down with separate tables showing the response frequencies across all application area users (those giving a response between 2 and 5 for using a certain application area) and across heavy application area users (those responding with a 4 or 5 for a certain application area use).

Responses in which persons replied that they did not use GIS or products generated from GIS in the performance of their jobs were not processed for technical contents, since such users were asked to not complete the questionnaire. Returned questionnaires which did not list any application areas of GIS use (see Appendix A, Sec. 1, Question 3) nor the type of organization that the respondent worked for (see Appendix A, Sec. 1, Question 5) were also not processed, since these two questions, along with the user's geographic location, form the basis for analysis of the questionnaire data. Three responses were eliminated in this manner. The respondent's geographic location was coded by state based on matching the questionnaire number against the original mailing database.

In some cases, the person to whom the questionnaire was originally sent was no longer at the company or agency address for which he or she was listed. In many of these instances the person who now occupied that address at the company or agency responded instead. These responses were included in the tabulations. In other cases, the person to whom the questionnaire was sent did not use GIS, but passed the questionnaire along to someone else in his or her organization who did use GIS. These responses were also included in the tabulations.

Initial tabulations show the application areas for which the respondents used GIS, the organizational category (i.e., government, private, or academic) of the respondent, and the technical criteria for the digital data that they use or that they see a future need to use. Later processing will apply statistical analysis to these responses in order to map possible technical requirements for digital data among communities of GIS users -- e.g. federal government employees using GIS for forestry applications. Certain application areas might not receive sufficient responses to credibly map their technical requirements back to the user community, but such gaps will be noted in the final tabulations.

3.1 Response Rates

The first wave of questionnaires were returned by mail during the first week of June, 1994, and were collected until mid-August, 1994. Thirty-five (2.6%) were returned by the U.S. Postal Service with notification of "forwarding order expired" or by the company or agency with a notice that the person addressed no longer worked at that address. This left a total of 1325 possible responses to the questionnaire.

A total of 760 of the possible 1325 responses were received (57.4%). Twelve responses were found to have duplicate questionnaire identification numbers. In one case, the respondent photocopied the questionnaire and passed a copy to each of two regional government bodies he or she oversaw. In another case, the individual receiving the replacement questionnaire passed the questionnaire on to another individual within his or her agency to complete. Both of these questionnaires were accepted, assigned a new identification number, and included in the final results. The remaining ten duplicate responses appear to have each been either filled out by the same individual or filled out by two individuals with heavily similar backgrounds within the same organization. These ten responses were not included in the final results.

Of the remaining 748 responses, 129 (9.7%) responded that they did not use GIS or products generated from GIS and returned the questionnaire uncompleted as requested. Twenty-one questionnaires (1.6%) were returned completely blank with no explanation from the respondent. The 598 completed responses included 3 responses which were unusable because they were incorrectly filled out, and 2 other responses which were unusable because their identification number had been removed by the respondent. Using the figure of 748 return non-duplicate responses, the questionnaire response rate was 56.5%.

A total of 595 usable responses (44.9%) were keyed into a raw data file by three individuals. The responses were cross-checked and validated against the range of response values for each question by use of custom software. The number of usable questionnaires was verified by a hand-count of the questionnaires.

Seven questionnaires were returned with missing pages. This was caused by an printing error. As a result, these seven could not complete the sections of the questionnaire pertaining to water feature data or elevation data. The questionnaires were otherwise acceptable. The responses from these questionnaires were included in the results but the response values for all of the water feature data and elevation data in these seven questionnaires were recorded as "not answered."

The numbers of usable responses were tabulated by geographic region, by the discipline of the respondent, and by the application areas that he or she is using GIS or products generated from GIS. These tables are contained in Appendix E.

3.2 Respondent’s Background

Respondent’s background was obtained through the questions in Section 1 of the questionnaire. Respondents were asked questions regarding the area of application for GIS, their level within their organization, the type of organization they were with, their total experience using geospatial data, their experience using digital geospatial data, and the amount of work time that they used such data on their job.

Some respondents replied that they filled out the questionnaire based on their organization’s use of GIS, not on their own individual use. This would seem to account for the large number of application areas seen on many responses. The response values ranged from 1 (never use) to 5 (often use). Of the 30 application areas listed, an average of 10.6 application area uses per respondent was noted. An average of 4.3 application areas were answered with a value of 4 or 5, indicating frequent use, while an average of 6.3 application areas were marked as being used less frequently (value of 2 or 3). An average of 9.9 application areas were marked as never being used by the respondent while an average of 9.5 application areas received no response. Five respondents did not select any of the 30 listed application areas, instead listing their individual primary uses of GIS or products derived from GIS as demographic analysis, emergency management, cartographic mapping, planning, and groundwater / drinking water supply. The application area uses are tabulated by frequency in Appendix E.

Other respondents wrote in answers for other application areas in which they used GIS or products derived from GIS. A total of 81 write in responses were received. Some respondents wrote in more than one additional application area. Eighteen of these write in responses concerned water studies or water management in some form. Ten write in responses addressed environmental issues. Eight responses addressed property management concerns, while six stated mining interests. Most of the other write in responses were very discipline or task specific. For example, one person wrote in "military applications" while another person wrote in "crime analysis."

The respondents held primarily professional (46.1%) or middle-management (29.2%) positions within their companies or agencies. Fewer classified themselves as holding either upper-management (15.8%) or technical (8.7%) positions. No one with a clerical position responded to the survey. The aggregate response rate is shown in Appendix F, Figure 1.

Local government employees accounted for most of the responses, 36.3%. Of these, 15.0% worked for county governments, 15.6% worked for city governments, and 5.7% worked for other local government agencies, including regional and tribal government agencies. State government employees accounted for 35.8% of the responses, while federal government employees responses totaled 6.2%. Those involved in education and research (academia) comprised 4.7% of the responses. The remaining 17.0% of the responses were from the private sector, primarily consulting (7.6%) and services (7.2%) based companies. The response breakdowns are shown in Appendix F, Figures 2a, 2b, and 2c.

More than half the respondents had used geospatial data in some form for over 10 years. Roughly a fifth of the respondents had used geospatial data for 5 years or less. However, more than half the respondents had used digital geospatial data or products for 5 years or less, while roughly a fifth had used digital geospatial data for more than 10 years. The work time devoted to geospatial data broke down nearly evenly across 20% increments of the respondent's work day. The response rates are shown in Appendix F, Figures 3, 4, and 5.

3.3 Data Use and Need Responses

Section 2 of the questionnaire showed that transportation feature data was used or needed by 91.9% of the respondents while 85.3% used or needed water feature data, 83.3% used or needed other well-defined cultural feature data, 70.6% used or needed elevation data, 80.9% used or needed land parcel data, and 94.3% used or needed boundary data. In each of the data categories, people responded that they felt they needed better data by a three to one margin. Figures 1, 2, 3, and 4 in Appendix G show the responses for the use, future need, need for better data, and the combined current and future use for each of the six possible framework data sets.

3.4 Data Content Responses

More than half of all the respondents claimed a heavy use or need (heavy use or need corresponding to a response value of 4 or 5) for transportation data about freeways, highways, local trunk roads, and city or town streets. Slightly less than half need transportation data about railroads. One third or fewer had a heavy need for other transportation data. Figure 1 in Appendix H shows the response rates for the heavy users of transportation data contents while Figure 2 in Appendix H shows the aggregate frequency of need for transportation feature data contents.

Response rates tabulated for transportation feature data contents across geographic region, all occupational users, heavy occupational users, and employment sector are given in Appendix H, pages H-5 to H-12. These tables seem to show no significant deviation from the aggregate responses. Popular write in responses included recreational paths (n = 10) and transmission lines (n = 7).

More than half of the respondents noted a heavy use or need for water feature data about rivers / streams and lakes / ponds. Between 40% and 50% of respondents had a heavy use or need for water feature data about constructed waterways, wetlands, and water sheds. Approximately one-fifth had a heavy need or use for inshore ocean data while less than one-tenth had a heavy need for offshore ocean data. Figure 1 in Appendix H shows the heavy user response rates for water feature data contents. Figure 3 shows the aggregate response frequencies for water feature data contents.

Tables on pages H-13 to H-20 show the water feature content frequencies by geographic region, all application area users, heavy application area users, and by employment sector. As expected, those respondents living in a region near coastal waters did have a higher need for inshore and offshore ocean data than other regions. Also, as expected, those listing oceanography / marine as a GIS application area had significantly higher needs for ocean data. However, these responses seem to indicate a need for inshore, rather than offshore, ocean data. No other deviations in responses seem significant. Popular write in responses for additional water feature content were flood plains (n = 6) and water wells (n = 4).

Although more than 80% of the respondents replied that they used or needed data about other well-defined cultural features, fewer than 40% responded with a heavy use or need for any one particular feature. Responses for all of the listed cultural features were between 20% and 40% for heavy users. Appendix H, Figure 4, shows the aggregate response frequencies for other well-defined cultural feature data. Figure 1 shows the heavy users responses. Tables on pages H-21 to H-28 show stratified response frequencies. Deviations from the aggregate response rates were primarily application area oriented. For example, those listing medical / health applications had a higher than average need for hospital location data. Response frequencies across employment sectors did show a higher need for transmission line data in the private sector than in government and academic sectors.

Popular write in responses for other well-defined cultural feature data included parks or recreational sites (n = 20), commercial structures (n = 9), residential structures (n = 7), and all structures (n = 7)

Digital contours were the most popular content for elevation data with about 40% claiming a heavy use or need for digital contours. Heavy user rates are in Figure 1, Appendix H, while Figure 5 shows the responses for elevation data contents. Federal government employees were more frequent users of digital elevation models (DEMs) than the average user, but no other significant deviations are noted. Tabulated stratified responses are given on pages H-29 to H-34. The only write in response for additional elevation data contents was for building heights.

All of the land parcel data content items were very popular, with each item receiving a high frequency of use among aggregate respondents. More than half of the respondents had a heavy use or need for individual land parcels and public right-of-way data. Consolidated land ownership data public easement data, and private easement data were all cited by more than 40% of the heavy users. Results are shown in Figures 1 and 6, Appendix H. As expected, they are even more popular among those in property / real estate applications. They are also more frequently noted among administrators, architects, construction users, civil engineers, law applications, and surveyors -- and especially among those classified as heavy users in those applications. Predominant use of land parcel data is in local government, followed by private industry. Tables showing stratified responses are given on pages H-35 to H-42. Only two write in responses were received for additional land parcel data contents. One was for land use, the other for building set back lines.

City and county boundaries were the most frequently used or needed boundary content items among the aggregate users and each received a response rate of about 70% from heavy users. Other political jurisdiction boundaries were also popular with more than half the respondents citing a heavy use or need for data about states boundaries and other administrative boundaries. Census zone data was heavily used or needed by slightly fewer than half of the respondents. About one-third of the respondents had a heavy use or need for zoning boundary data. Fewer than one-fourth had a heavy need for ZIP code boundary data. Most of the write in responses appear to be to related to some special political boundary need, such as maintenance or service districts. Figures 1 and 7 in Appendix H compare the boundary data content items.

Tables on pages H-43 to H-50 show the stratified responses for boundary data contents. Census tracts and ZIP code boundaries are very popular among banking / finance, economics, insurance, legislative, marketing / advertising, medical / health, and social science / social services applications. Popular write in responses include national boundaries (n = 7), tribal / reservation boundaries (n = 5), congressional districts (n = 4), land use areas (n = 4), and traffic analysis zones (n = 4).

3.5 Data Tasks Responses

Address matching and site analysis were the most popular aggregate uses for transportation data. Approximately 40% of respondents claimed a heavy use or need for these two tasks. Only about 10% of the respondents had a heavy use or need for transportation feature data for accident analysis. Environmental monitoring, facility design, facility maintenance, inventorying, resource management, and vehicle routing tasks were claimed by 20% - 35% of the heavy users. Appendix I, Figure 1, shows the heavy user responses while Figure 2 shows aggregate responses for this category.

Although address matching was a popular response for transportation data tasks, it was much less frequently cited by users of natural science applications -- agriculture, biology, forestry, geology, oceanography, and wildlife. It was also much less frequently cited among federal, state, and academic sector employees. Environmental monitoring, a transportation data task less frequently cited overall, was significantly more popular among federal and state employees. There seem to be no significant variations among user preferences for other transportation data tasks. Popular write in responses include traffic analysis (n = 3) and planning (n = 3). Stratified responses are given on pages I-5 to I-12.

The most popular aggregate uses of water feature data were for environmental monitoring (about 30% of heavy users), inventorying (about 35% of heavy users), and site analysis tasks (about 40% of heavy users). Vehicle routing was the task least used for water feature data, a task performed by fewer than 10% of the heavy users. Facility design and water management tasks were cited by about 20% of the heavy users while facilities management tasks were heavily used by about 15% of the respondents. Figure 3, Appendix I, shows these aggregate responses while Figure 1 shows the heavy users' responses.

Tabulations of stratified water feature data responses are shown on pages I-13 to I-20. Environmental monitoring appeared to be more popular among users of natural science applications. Agriculture, biology, forestry, geology, meteorology / air quality, oceanography / marine, and wildlife application users cited this use much more frequently than other users. Users in these applications areas also responded more frequently to water management as a needed task. No other significant variations were noted. Write in responses were varied with only floodplain issues (n = 3) receiving more than one response.

Address matching and site analysis were the most popular aggregate tasks for other well-defined cultural feature data with more than 30% of the respondent's citing a heavy use or need. Slightly fewer than 30% claimed heavy use or need for inventorying tasks. All other well-defined cultural feature tasks were cited by between 10% and 20% of heavy users. These are shown in Appendix I, Figure 1. The aggregate responses are shown in Figure 4. The stratified responses, shown on pages I-21 to I-28, seem to correspond to the responses given to transportation feature data tasks. Only 6 write in responses were received, no two listing similar tasks.

Site analysis was clearly the most popular task for elevation data with about 40% of respondents claiming a heavy use or need. Fewer than 10% needed elevation data for heavy use with either facilities management or vehicle routing tasks. Other tasks ranged from 15% to 25% in heavy use or need. Heavy use responses are given in Figure 1 while aggregate responses are given in Figure 5, Appendix I. Stratified responses (pages I-29 to I-36) show site analysis to be especially popular among heavy users of architectural and insurance application users of elevation data. Five of the nine write in elevation data tasks responses concerned stormwater / flood issues.

Address matching, site analysis, and inventorying were the most cited aggregate tasks for land parcel data among heavy users, as shown in Figure 1, Appendix I. Approximately 15% to 25% heavily used all other land parcel tasks except vehicle routing, which was heavily used or needed by only about 10% of the respondents. Address matching appears to have the same approximate response rate among land parcel natural science application users as do transportation feature data or other well-defined cultural feature data tasks. Site analysis seems very popular among architectural and insurance application users. Aggregate land parcel task responses are in Figure 6, Appendix I. Tables of stratified responses are shown on pages I-37 to I-44. The most popular write in response was for property tax assessment (n = 4).

Address matching, demographic analysis, and site analysis were the most frequent aggregate uses of boundary data. About 40% of respondents cited a heavy need for these boundary data tasks. Fewer than about 15% of the respondents had a heavy use or need for boundary data for either facility management or vehicle routing. All other tasks frequencies fell between the 15% to 35% range among heavy users. Appendix I, Figure 1, shows the heavy use responses and Figure 7 shows aggregate boundary data task responses. Address matching responses corresponded to those given for other data categories. Demographic analysis was very frequently noted among users in architectural banking / finance, economics, education, insurance, legislative, marketing / advertising, public relations, shipping, and social science / social service applications. Stratified response tables are given on pages I-45 to I-52.

3.6 Data Format Responses

By a large margin, respondents used or preferred data in vector format. Over 60% of the respondents in each of the five data categories where vector format data was offered as a choice cited a heavy use or need for vector format data. Digital photography, including digital orthophotos, was the next most popular format with around 30% of heavy users responding. Imagery and other raster-based data were heavily used or needed by fewer than 20% of the respondents in each data category. Digital contours were the most used or favored format for elevation data with about 40% of heavy users responding. Grid and TIN elevation data formats had about 25% each of respondents with a heavy need or use. Heavy user responses are given in Figure 1, Appendix J. Aggregate user responses for each of the data categories are shown in Appendix J, Figures 2 to 7.

Tables on pages J-5 to J-40 show the stratified responses for each data category. No significant deviations from aggregate responses were noted. Only a few write in responses were received, each seeming to point to some type of attribute information format.

3.7 Data Geocoding Scheme Responses

State plane coordinates were highly popular as the geocoding unit for each of the six data categories. More than 50% of the respondents in each data categories cited a heavy use of state plane coordinate except elevation data, where about 40% of the respondents cited a heavy use or need. Where offered as a geocoding alternative, street addresses were also highly popular. About 50% of the respondents cited a heavy use or need for transportation data geocoded using street addresses while more than 40% cited a heavy use or need for land parcel street addresses and about one-third cited a heavy use or need for cultural feature data street addresses. Land parcel identification numbers were cited as heavily used or needed for land parcel data by more than 40% of the respondents. Latitude and longitude values were used or preferred in all categories over UTM coordinates. Appendix K details the response frequencies for geocoding schemes.

Stratified responses for geocoding schemes are shown on pages K-5 to K-48. As expected, those application area users who do not perform much address matching do not cite street addresses as a frequent need. As noted above, these seem to fall into the area of natural science users -- agriculture, biology, geology, meteorology, oceanography, and wildlife. Street addresses are highly cited among all categories by banking / finance, economics, emergency services, insurance, law, legislative, marketing / advertising, medical / health, property / real estate, public relations, shipping, and utility operations application users. Street addresses are also much more frequently cited among local government and private industry employees. Regionally, the US Public Lands Survey System (USPLSS) was not popular in areas where it is not used, such as New England and the Middle Atlantic states. Federal government employees appear to be the most frequent users of latitude and longitude geocodes.

Write in responses included USPLSS, Albers coordinates, and assessor's ID. Table 3.1 shows these responses.

Table 3.1. Write in Responses for Geocoding Schemes

Data Type	USPLSS	Albers coords.	Assessor's ID
Transportation	9	2	2
Water	5	1	0
Cultural	1	1	2
Elevation	0	1	0
Land Parcel	1	0	0
Boundary	4	0	0

3.8 Data Positional Accuracy Responses

Positional accuracy preferences were primarily in the 1 meter to 20 meter range for all data categories. Many respondents seemed to have trouble answering this question. Several respondents left this section blank, while a few other respondents marked each choice as "never" used with no write-in or other response to the question. Almost 40% of the respondents cited a heavy use or need for 1 meter positional accuracy for land parcel data while less than 30% cited 1 meter as the most popular heavily used or needed positional accuracy for elevation data. Boundary data and other well-defined cultural feature data showed heavy use or need frequencies most popular at both the 1 meter and 10 meter positional accuracy. Transportation feature data and water feature data were most popular at a 10 meter positional accuracy among the respondents citing a heavy use or need. Appendix L contains the graphs of heavy user and aggregate positional accuracy responses for each of the six data categories.

Stratified responses for positional accuracy show high response rates among architectural applications for 0.1 meter accuracy data across all data types. Construction, emergency services, civil engineering, other engineering, insurance, property / real estate, surveying, and utility operations applications respond with 1.0 meter accuracy most frequently. The natural science applications -- agriculture, biology, forestry, geology, meteorology / air quality, oceanography / marine, and wildlife -- seem to prefer data with 10 meter positional accuracy. Most other applications seem fairly evenly balanced in their responses to both 1 meter and 10 meter positional accuracy data. One meter accuracy data is also more popular among local government employees than among other employment sectors. Ten meter positional accuracy data seems to be the most popular need at state government, private sector, and academic levels. Tabulations for stratified responses can be found on pages L-5 to L-52.

Write in responses show some of the user confusion over positional accuracy. One respondent wrote in requirements as meeting the National Map Accuracy Standard. Another respondent required positional accuracy "the same as in TIGER." Other write in responses along this line include "whatever they give us," "not sure," "as accurate as possible," and "the more accurate the better." Those responding with write in values gave answers ranging from 1 foot to 30 meters as their required accuracy.

3.9 Data Vertical (Elevation) Accuracy Responses

The heavy use or need responses for vertical accuracy are shown in Appendix M, Figure 1. As with positional accuracy, many respondents seemed a little confused about their use or need for vertical accuracy. While nearly 30% of respondents cited a heavy use or need for elevation data with 1 meter vertical accuracy, only about 20% or fewer did so in the other data categories. The responses were nearly even for and against the need for elevations for transportation feature data, water feature data, and other well-defined cultural feature data. Figure 2 in Appendix M shows the responses for and against the need for elevations for these three data categories. This question was not asked for the other candidate framework data categories. Since vertical information is inherently a part of elevation data, respondents were simply asked to list their vertical accuracy requirements. Only those who used or needed elevation data for transportation feature data, water feature data, and other well-defined cultural feature data were asked for their vertical accuracy uses or needs.

The most frequent vertical accuracy requirements among aggregate users were slightly higher than the positional accuracy requirements, ranging from 0.1 meter to 10 meter. Further investigation may be warranted to examine a possible correlation between the need for elevation information and the accuracy requirements of those who need elevation information. Figures 3, 4, 5, and 6 of Appendix M list the aggregate responses for transportation feature data, water feature data, other well-defined cultural feature data, and elevation data.

Stratified response rates for vertical accuracy varied across application uses. As with positional accuracy, architectural applications required the most accurate data, with popular values ranging from 0.01 meter to 0.1 meter. Banking / finance applications also seem to fall within this interval. Construction, civil engineering, insurance, and surveying applications seem to fall into the range between 0.01 meter and 1 meter vertical accuracy. Communications, economics, emergency services, non civil (other) engineering, and utility services applications seem to fall into the 1 meter vertical accuracy range. The natural science applications (agriculture, biology, forestry, geology, meteorology / air quality, oceanography / marine, and wildlife) seem to fall in the 1 meter to 10 meter range. These responses are listed on pages M-5 to M-36.

3.10 Data Updating Interval Responses

The respondents did not prefer to have data updated on a periodic basis (e.g., weekly, monthly, or yearly). Land parcel data and boundary data were cited most frequently as needing updating as any changes occurred. Several write-in responses were received, but have not all been analyzed to date. Among the write-in answers, intervals of several years are often cited as an appropriate updating interval. However, some write-in responses were to the point, citing "as funds available" and "as funded" as their actual updating intervals. Updating interval responses are shown in Appendix N.

3.11 Historical Data Needs

The respondents' need for historical data varied from category to category. Historical land parcel data was needed by a margin of about 2 to 1. Historical boundary data was also needed more often than not. The need for historical transportation feature data, historical water feature data and historical other well-defined cultural feature data was nearly even. Historical elevation data was not needed by a margin of about 2 to 1. Historical data needs are shown in Appendix O.

3.12 Data Sources

The federal government was the source of most of the data used by the respondents, with the exception of land parcel data, which was obtained primarily from local government sources. State government sources were used to a lesser extent, while almost as many collected data in-house or through private data collecting sources.

Since users could cite more than one source for their currently used data, many did so. The totals for data sources may accordingly add up to more than 100% for any of the six data categories. User responses are shown in Appendix P.

3.13 Summary

The questionnaire respondents were predominantly professional or middle-management persons. Approximately one-third worked for local government while another third worked for state government. Of the remaining third, most worked for private companies. More than half of the respondents had ten or more years experience working with any type of geospatial data, however, more than half of the respondents had less than five years experience working with digital geospatial data. The respondents ranged roughly evenly from casual user of GIS to heavy users of GIS. The respondents' were spread across the United States and averaged more than ten different occupational uses of GIS with heavy frequency.

Boundary data was the most frequently cited framework data category with more than 94% of the respondents using or needing such data. The respondents primarily wanted boundary data for towns, cities, counties, and states in vector format, geocoded using state plane coordinates at a positional accuracy of 1 to 10 meters. This data is used primarily for address matching, demographic analysis, and site analysis.

Transportation feature data was the second most frequently cited data category with almost 92% of respondents using or needing such data. These respondents primarily wanted transportation data about freeways, highways, local trunk roads, rural roads, and city or town streets. They wanted this data in vector format, in state plane coordinates and with street address information, primarily at a positional accuracy of 1 to 20 meters. Only about half of the respondents needed elevation information about transportation data, primarily at a vertical accuracy of 1 to 10 meters. This data is used primarily for address matching and for site analysis.

Water feature data was the next most popular data category with about 85% of respondents using or needing water data primarily about rivers, streams, lakes, ponds, constructed waterways, wetlands, and water sheds. This data is used primarily for site analysis, inventorying, and environmental monitoring. The users primarily want the data in vector format, geocoded using state plane coordinates, at a positional accuracy of 10 meters.

Other well-defined cultural data was used or needed by over 83% of the respondents. This data was needed primarily for site analysis and address matching. It is needed in vector format, geocoded primarily using state plane coordinates at a positional accuracy of 1 to 10 meters.

Land parcel data was cited as being needed or used by over 80% of the respondents who wanted land parcel data about single and consolidated land ownership, easements, and right-of-ways. They wanted this data in vector format, primarily geocoded in state plane coordinates, parcel IDs, and street addresses at a positional accuracy of 1 meter. Land parcel data is used primarily for site analysis, address matching, and inventorying.

Elevation data was used or needed by over 70% of the respondents who wanted primarily digital contour data geocoded using state plane coordinates at 1 to 10 meter positional and 1 meter vertical accuracy for site analysis.

The respondents wanted data updated primarily as changes occurred and did need historical data. The primary source for digital geospatial data was from the federal government.

4. Conclusions

Many current GIS users appear to be using GIS across more than one disciplinary application area. An average number of almost ten applications were cited per user. This could mean that many of the problems being solved through GIS are interdisciplinary in nature. It could also signify that common uses of many data sets are being applied by centrally located GIS and that the respondent at that centrally located site performed tasks for a variety of other departments. It might also reflect user responses to organizational uses, rather than individual uses, of GIS. Since more than one application area was cited by many users, possible correlation in the answers stratified by occupational area use will need to be further investigated.

Many current GIS users appear to carry a map analogy into their technical knowledge of GIS. While maps have a limited use based on a given scale, GIS databases have a much wider range of functionality because of their ability to display data at many scales and their ability to perform routine analytical functions with little or no human intervention. This apparent lack of technical knowledge about GIS among many current users also becomes apparent when viewing the response rates for elevation data formats. Digital contours, an analogy carried directly from maps into GIS, are highly popular while grids and triangulated irregular networks (TINs), data formats with which most GIS databases address elevation information, are much less popular.

Consequently, technical issues such as data positional and vertical accuracy become of much greater concern in GIS databases (Goodchild and Gopal, 1989). However, many respondents had difficulty in addressing such issues. Several possibilities arise that might explain this phenomenon. First, users might not have documentation (metadata) that can readily give them answers to such technical questions. Second, users may depend on secondary positional and vertical accuracy measures, such as map scale and contour interval, to provide accuracy measures. Third, users might depend on the judgment of others to provide them with data of sufficient accuracy for their individual needs. Forth, users might be using whatever data sets they find available without worrying about the possible technical qualities of that data. Although much has been done to promote concerns about these issues -- such as the FGDC Metadata Content Standard and the recent International Symposium on the Spatial Accuracy of Natural Resource Data Bases held in Williamsburg, Virginia, in May 1994 -- perhaps more education and emphasis on understanding the implications of these issues may be in order.

Differences in user requirements appear to be primarily application oriented. Some regional differences were noted, primarily concerning proximity to oceans and the use of the US Public Lands Survey System. Differences among employment sectors seemed to be primarily in areas related to the amount or scale of data being used. This is particularly apparent in the geocoding scheme responses, where federal government employees, users of typically large spatial areas of analysis, seem to prefer a scheme that will deal effectively with the representation problems of those areas -- namely latitude and longitude coordinates. Street addresses, primarily a geocode useful for relatively small spatial areas of analysis, are not very popular among federal employees. However, street addresses, like state plane coordinates, are much more popular among users who typically deal with relatively small spatial areas of analysis, such as local government and private sector employees.

Future analyses planned for this data include a look at the possible clustering of GIS applications. As noted in the section relating the positional accuracy responses, it appears that certain GIS applications appear to have similar data technical needs with other applications. The question arises whether GIS users could naturally fall into a limited number of user categories.

We have attempted to find the current digital geospatial data technical requirements of users with this study. We do not attempt to predict future needs. While some technical requirements, such as data format and data contents, may remain stable for the foreseeable future, other technical requirements, such as positional and vertical accuracy, may increase in importance with time. This study attempts to define technical guidelines that may be useful for selecting current digital geospatial data sets that may be useful for the greatest numbers of users which may then be prioritized for inclusion in the National Spatial Data Infrastructure.

This study reflects perhaps the first large-scale effort to sample the U.S. population of GIS users in a systematic fashion, regarding their current and future uses of geospatial data and related technologies. The analyses reported here are a small fraction of the results which might be extracted from the data, and we anticipate that others may have specific questions they wish to ask of the database. NCGIA will provide copies of the database on request to any bona fide group or agency wishing to conduct further analyses.

References

Goodchild, M.F., and S. Gopal (1989). Accuracy of Spatial Databases. London: Taylor and Francis.

NRC (1994). Toward a Coordinated Spatial Data Infrastructure for the Nation. Washington, DC: National Research Council.

APPENDIX A

FRAMEWORK DATA SURVEY QUESTIONNAIRE

NSDI FRAMEWORK DATA QUESTIONNAIRE

INSTRUCTIONS

Please answer all the questions regarding your **own** job-related needs for framework geospatial data. Framework data are digital geospatial data showing the locations of objects on or near the Earthís surface along with a minimal set of attributes to identify those objects.

This survey is divided into two sections. Section 1 asks about background information. This information will be used to categorize different classes of geographic data users. Please answer question 1 in section 1 and proceed from there. Section 2 is divided into six parts: A through F. Each part refers to a different potential category of framework geospatial data. You will only be asked to answer questions about geospatial data that you may be familiar with. Please answer question 1 in each part (A through F). You will be further instructed in each of those six parts as to whether your responses to the remainder of the question in that part are needed or not.

There are no right or wrong answers; we are simply interested in your opinion. It is important to answer all the questions when you are asked to do so.

All responses to the questionnaire will be kept **completely confidential**. Only summary, aggregate information will be reported.

THANK YOU FOR YOUR HELP!

SECTION 1 - BACKGROUND INFORMATION

1. What is your discipline (e.g. civil engineering, geography, computer science, etc.)?

____

2. Do you use **GIS** or **products generated from GIS** in the performance of your current job? ___ YES ___ NO

If you answered **NO** to question 1, please return the questionnaire at this time. If you answered **YES**, please continue.

3. Please circle the responses that best describe your job related use of GIS or products generated from GIS for the following applications.

	Never				Often
a) Administration	1	2	3	4	5
b) Agriculture	1	2	3	4	5
c) Architecture	1	2	3	4	5
d) Banking / Finance	1	2	3	4	5
e) Biology	1	2	3	4	5
f) Communications	1	2	3	4	5
g) Construction	1	2	3	4	5
h) Economics	1	2	3	4	5
i) Education	1	2	3	4	5
j) Emergency services (police, fire, etc.)	1	2	3	4	5
k) Engineering (Civil)	1	2	3	4	5
l) Engineering (Other)	1	2	3	4	5
m) Forestry	1	2	3	4	5
n) Geology / Geophysics	1	2	3	4	5
o) Insurance	1	2	3	4	5
p) Law (except police services)	1	2	3	4	5
q) Legislative	1	2	3	4	5
r) Marketing / Advertising	1	2	3	4	5
s) Medical / Health	1	2	3	4	5
t) Meteorology / Air quality	1	2	3	4	5
u) Oceanography / Marine	1	2	3	4	5
v) Property / Real estate	1	2	3	4	5
w) Public relations	1	2	3	4	5
x) Shipping	1	2	3	4	5
y) Social science / Social services	1	2	3	4	5
z) Surveying	1	2	3	4	5
aa) Transportation	1	2	3	4	5
bb) Urban and regional planning	1	2	3	4	5

cc) Utility operations	1	2	3	4	5
dd) Wildlife	1	2	3	4	5

ee) Other (Please specify):____

____

4. Which **one** level best describes your current employment position?

___ a) Clerical
___ b) Technical
___ c) Professional
___ d) Middle-management
___ e) Upper-management

5. Which **one** category best describes your organization?

___ a) Federal government
___ b) State government
___ c) County government
___ d) City or town government
___ e) Other government
___ f) Private business -- production
___ g) Private business -- manufacturing
___ h) Private business -- services
___ i) Private business -- consulting
___ j) Non profit organization
___ k) Education & research

6. How many years have you been using **geospatial data in any form** (i.e. paper maps, aerial photographs, land parcel plats, digital geographic data, etc.) in the performance of your job?

___ a) less than 1
___ b) 1 - 5
___ c) 6 - 10
___ d) 11 - 20
___ e) more than 20

7. How many years have you been using **digital** geospatial data or products generated from digital geospatial data in the performance of your job?

___ a) less than 1
___ b) 1 - 5
___ c) 6 - 10
___ d) 11 - 20
___ e) more than 20

8. How much of your work time is spent using **digital** geospatial data or products generated from digital geospatial data in the performance of your job?

___ a) 0 - 20%
___ b) 21-40%
___ c) 41-60%
___ d) 61-80%
___ e) 81-100%

SECTION 2 - GEOGRAPHIC INFORMATION NEEDS

This section is divided into six parts: transportation facilities, water features, other well-defined features, elevations; land parcels, and boundaries. Please respond only to those parts where you are currently using or wish to use digital geospatial data.

GLOSSARY

The following are definitions of the terms used in this questionnaire. These definitions should be referred to in resolving ambiguities in questions.

Geographic content

Geographic content refers to the geographic features (theme) contained in the data set. For example, a data set containing road data could contain information about the location of freeways, highways, local roads, and city or town streets. It might also contain any subset of such features, such as freeways and highways.

Tasks

Tasks refer to the uses in which geographic data contribute to the performance of your job duties.

Data formats

Vector data**.** Geographic features are stored as geometric figures using points, lines, and areas (or nodes, edges, and surfaces). Examples of vector data are DLG and TIGER Line Files.

Raster data. Geographic space is divided into regular patterns, such as rectangular grids, and a normal or average geographic value is collected at each node of the pattern. An example of raster data is Digital Elevation Model (DEM) grids.

Digital photography. Geographic data are captured as photo images and stored as groups of pixels. An example of digital photography is digital orthophotos.

Imagery. Geographic data are captured by multi band sensors and stored as groups of pixels. Examples of imagery are Landsat, SPOT, and AHVRR images.

Grids. Grids are elevation data collected in a square or rectangular pattern.

Triangulated irregular networks (TINs). TINs are elevation data collected in irregular patterns, normally at locations where significant changes in elevation occur.

Digital contour lines. Digital contour lines are connected line or arc segments showing the locations of constant elevation

Geocoding scheme

Geocoding scheme refers to the method used to identify geographic locations. This may be as points or cells with geometric values such as latitude and longitude, Universal Transverse Mercator coordinates, or State Plane Coordinates. Other geocoding schemes divide space by non geometric values, such as land parcel numbers (e.g., tax assessor's parcel identifiers), US Public Land Survey System township and range, street addresses, or census tracts.

Positional accuracy

Positional accuracy refers to the acceptable positional error within the data set. With vector data, positional accuracy may be smaller than the spatial resolution. With raster data, digital photography, and imagery, positional accuracy is typically greater than the spatial resolution.

Vertical accuracy

Vertical accuracy refers to the acceptable elevation error at a well-defined spatial location within the data set.

Updating interval

Updating interval refers to the time frame for adding new geographic data to the data set and for deleting obsolete geographic data from the data set. This may be periodic (weekly, monthly, or yearly) or non periodic (as geographic changes occur).

Historic data

Historic data depict conditions prior to the most recently collected geospatial data. For example, historic data would show the old location of a road that has been reconstructed in a new location.

Digital data set

Digital data set refers to a geographic data set in digital form that is uniquely identifiable by a a data set name and the organization that produces it.

A. TRANSPORTATION FEATURES

1. Do you use digital data about the locations of transportation features in your job? ___ YES ___ NO

2. If you answered **NO** to question 1, do you foresee that you might need digital data about the locations of transportation features in the future? ___ YES ___ NO

If you answered **NO** to **both** questions 1 and 2, please **skip** to question 1 of WATER FEATURES on page 9

3. If you are using digital data about the location of transportation features, do you have a substantial need for better digital data? ___ YES ___ NO

4. How often do you use or need the following transportation facility data geographic contents in your job? (please circle the appropriate choice -- see page 4 for definition of "geographic contents")

	Never				Often
a) Interstate freeways	1	2	3	4	5
b) State and federal highways	1	2	3	4	5
c) Local trunk roads	1	2	3	4	5
d) Rural roads	1	2	3	4	5
e) City or town streets	1	2	3	4	5
f) Jeep trails / fire roads / farm roads	1	2	3	4	5
g) Railroads	1	2	3	4	5
h) Fixed rail transit (e.g. subways, cable cars)	1	2	3	4	5
i) Water ways and ports	1	2	3	4	5
j) Airports	1	2	3	4	5
k) Pipelines	1	2	3	4	5
l) Bus routes	1	2	3	4	5

m) Other. Please specify:____

5. How often do you perform or have a need to perform the following tasks with transportation facility location data? (please circle the appropriate choice -- see page 4 for definition of "tasks")

	Never				Often
a) Accident analysis	1	2	3	4	5
b) Address matching	1	2	3	4	5
c) Environmental monitoring	1	2	3	4	5
d) Facilities design / construction	1	2	3	4	5
e) Facilities maintenance	1	2	3	4	5
f) Inventorying	1	2	3	4	5
g) Site analysis	1	2	3	4	5
h) Vehicle routing	1	2	3	4	5

i) Other (Please specify):____

6. How often do you use or need the following transportation facility data formats? (please circle the appropriate choice -- see page 4 for definition of "data format")

	Never				Often
a) Vector data	1	2	3	4	5
b) Digital photography / orthophotos	1	2	3	4	5
c) Imagery	1	2	3	4	5
d) Other raster data	1	2	3	4	5

e) Other. Please specify:____

7. How often do you use or need the following transportation facility geocoding schemes? (please circle the appropriate choice -- see page 4 for definition of "geocoding")

	Never				Often
a) Latitude and longitude	1	2	3	4	5
b) UTM coordinates	1	2	3	4	5
c) State plane coordinates	1	2	3	4	5
d) Street address	1	2	3	4	5
e) Mile posts / Kilometer posts	1	2	3	4	5

f) Other. Please specify:____

8. How often do you use or need the following transportation facility positional accuracy? (see page 5 for definition of "positional accuracy")

	Never				Often
a) 0.01 meters	1	2	3	4	5
b) 0.1 meters	1	2	3	4	5
c) 1 meter	1	2	3	4	5
d) 10 meters	1	2	3	4	5
e) 20 meters	1	2	3	4	5
f) 50 meters	1	2	3	4	5
g) 100 meters	1	2	3	4	5
h) 250 meters	1	2	3	4	5
i) 500 meters	1	2	3	4	5
j) 1000 meters	1	2	3	4	5

k) Other. Please specify:____

9. Do you need information about the elevations of transportation features? ___ YES ___ NO

10. If you answered yes to question 9, how often do you use or need the following transportation facility vertical accuracy? (see page 5 for definition of "vertical accuracy")

	Never				Often
a) 0.01 meters	1	2	3	4	5
b) 0.1 meters	1	2	3	4	5
c) 1 meter	1	2	3	4	5
d) 10 meters	1	2	3	4	5
e) 20 meters	1	2	3	4	5
f) 50 meters	1	2	3	4	5
g) 100 meters	1	2	3	4	5
h) 250 meters	1	2	3	4	5
i) 500 meters	1	2	3	4	5

j) Other. Please specify:____

11. Which updating interval best describes your job related requirements for the transportation facility data? (see page 5 for definition of "updating interval")

___ a) No maintenance schedule
___ b) Ad hoc maintenance schedule
___ c) As any changes occur
___ d) As major changes occur
___ e) Weekly
___ f) Monthly
___ g) Yearly
___ h) Other (Please specify):____

12. Do you need historic data on transportation features? (see page 5 for definition of "historic data") ___ YES ___ NO

13. If you are currently using digital data about the location of transportation features, which digital geospatial data sets do you use? (check one or more and list the data set names, if known -- see page 5 for definition of "digital geospatial data set") **Examples**: USGS 1:24 000 DLG, TIGER, County of Lincoln digital property maps, City of Woodland 1:2 000 digital orthophotos.

___ a) Federal government data
Name:____
Name:____

___ b) State government data
Name:____
Name:____

___ c) Local government data
Name:____
Name:____

___ d) Private business - repackaged government data
Name:____
Name:____

___ e) In-house or private business - custom collected data
Name:____
Name:____

___ f) Other (Please specify):____

B. WATER FEATURES

1. Do you use digital data about the locations of water features in your job? ___ YES ___ NO

2. If you answered **NO** to question 1, do you foresee that you might need digital data about the locations of water features in the future? ___ YES ___ NO

If you answered **NO** to **both** questions 1 and 2, please **skip** to question 1 of OTHER WELL-DEFINED FEATURES on page 12

3. If you are using digital data about the location of water features, do you have a substantial need for better digital data? ___ YES ___ NO

4. How often do you use or need the following water features data geographic contents in your job? (please circle the appropriate choice -- see page 4 for definition of "geographic contents")

	Never				Often
a) Offshore ocean	1	2	3	4	5
b) Inshore ocean (e.g., harbors, bays, etc.)	1	2	3	4	5
c) Rivers and streams	1	2	3	4	5
d) lakes and ponds	1	2	3	4	5
e) Constructed facilities (e.g. dams, canals, levees)	1	2	3	4	5
f) Wetlands	1	2	3	4	5
g) Watershed or hydeologic units	1	2	3	4	5

h) Other. Please specify:____

5. How often do you perform or have a need to perform the following tasks with water feature location data? (please circle the appropriate choice -- see page 4 for definition of "tasks")

	Never				Often
a) Environmental monitoring	1	2	3	4	5
b) Facilities design / construction	1	2	3	4	5
c) Facilities maintenance	1	2	3	4	5
d) Inventorying	1	2	3	4	5
e) Site analysis	1	2	3	4	5
f) Vehicle routing	1	2	3	4	5
g) Water management	1	2	3	4	5

h) Other (Please specify):____

6. How often do you use or need the following water feature data formats? (please circle the appropriate choice -- see page 4 for definition of "data format")

	Never				Often
a) Vector data	1	2	3	4	5
b) Digital photography / orthophotos	1	2	3	4	5
c) Imagery	1	2	3	4	5
d) Other raster data	1	2	3	4	5

e) Other. Please specify:____

7. How often do you use or need the following water feature geocoding schemes? (please circle the appropriate choice -- see page 4 for definition of "geocoding")

	Never				Often
a) Latitude and longitude	1	2	3	4	5
b) UTM coordinates	1	2	3	4	5
c) State plane coordinates	1	2	3	4	5
d) Mile posts / Kilometer posts	1	2	3	4	5
e) EPA or state environmental quality ID number	1	2	3	4	5

f) Other. Please specify:____

8. How often do you use or need the following water feature positional accuracy? (see page 5 for definition of "positional accuracy")

	Never				Often
a) 0.01 meters	1	2	3	4	5
b) 0.1 meters	1	2	3	4	5
c) 1 meter	1	2	3	4	5
d) 10 meters	1	2	3	4	5
e) 20 meters	1	2	3	4	5
f) 50 meters	1	2	3	4	5
g) 100 meters	1	2	3	4	5
h) 250 meters	1	2	3	4	5
i) 500 meters	1	2	3	4	5
j) 1000 meters	1	2	3	4	5

k) Other. Please specify:____

9. Do you need information about the elevations of water features? ___ YES ___ NO

10. If you answered yes to question 9, how often do you use or need the following water feature vertical accuracy? (see page 5 for definition of "vertical accuracy")

	Never				Often
a) 0.01 meters	1	2	3	4	5
b) 0.1 meters	1	2	3	4	5
c) 1 meter	1	2	3	4	5
d) 10 meters	1	2	3	4	5
e) 20 meters	1	2	3	4	5
f) 50 meters	1	2	3	4	5
g) 100 meters	1	2	3	4	5
h) 250 meters	1	2	3	4	5
i) 500 meters	1	2	3	4	5

j) Other. Please specify:____

11. Which updating interval best describes your job related requirements for the water feature data? (see page 5 for definition of "updating interval")
___ a) No maintenance schedule
___ b) Ad hoc maintenance schedule
___ c) As any changes occur
___ d) As major changes occur
___ e) Weekly
___ f) Monthly
___ g) Yearly
___ h) Other (Please specify):____

12. Do you need historic data on water features? (see page 5 for definition of "historic data") ___ YES ___ NO

13. If you are currently using digital data about the location of water features, which digital data sets do you use? (check one or more and list the data set names, if known -- see page 5 for definition of "digital data set") **Examples**: USGS 1:24 000 DLG, TIGER, County of Lincoln digital property maps, City of Woodland 1:2 000 digital orthophotos.

___ a) Federal government data
  Name:____
  Name:____

___ b) State government data
  Name:____
  Name:____

___ c) Local government data
  Name:____
  Name:____

___ d) Private business - repackaged government data
  Name:____
  Name:____

___ e) In-house or private business - custom collected data
  Name:____
  Name:____

___ f) Other (Please specify):____

C. OTHER WELL-DEFINED CULTURAL FEATURES

1. Do you use digital data about the locations of <u>other well-defined cultural features</u> (other than transportation features and water features) in your job? ___ YES ___ NO

2. If you answered **NO** to question 1, do you foresee that you might need digital data about the locations of other well-defined cultural features in the future? ___ YES ___ NO

If you answered **NO** to **both** questions 1 and 2, please **skip** to question 1 of ELEVATION DATA on page 15

3. If you are using digital data about the location of other well-defined cultural features, do you have a substantial need for better digital data? ___ YES ___ NO

4. How often do you use or need the following cultural feature data <u>geographic contents</u> in your job? (please circle the appropriate choice -- see page 4 for definition of "geographic contents")

	Never				Often
a) Communication lines	1	2	3	4	5
b) Electirc power lines	1	2	3	4	5
c) Gas or oil pipe lines	1	2	3	4	5
d) Water lines	1	2	3	4	5
e) Wastewater lines	1	2	3	4	5
f) Airports	1	2	3	4	5
g) Commercial / government buildings	1	2	3	4	5
h) Residential buildings	1	2	3	4	5

i) Other. Please specify:____

5. How often do you perform or have a need to perform the following tasks with cultural feature location data? (please circle the appropriate choice -- see page 4 for definition of "tasks")

	Never				Often
a) Address matching	1	2	3	4	5
b) Environmental monitoring	1	2	3	4	5
c) Road design	1	2	3	4	5
d) Road inventorying	1	2	3	4	5
e) Site analysis	1	2	3	4	5
f) Vehicle routing	1	2	3	4	5

7) Other (Please specify):____

6. How often do you use or need the following cultural feature data formats? (please circle the appropriate choice -- see page 4 for definition of "data format")

	Never				Often
a) Vector data	1	2	3	4	5
b) Digital photography / orthophotos	1	2	3	4	5
c) Imagery	1	2	3	4	5
d) Other raster data	1	2	3	4	5

e) Other. Please specify:____

7. How often do you use or need the following cultural feature geocoding schemes? (please circle the appropriate choice -- see page 4 for definition of "geocoding")

	Never				Often
a) Latitude and longitude	1	2	3	4	5
b) UTM coordinates	1	2	3	4	5
c) State plane coordinates	1	2	3	4	5
d) US PLSS Township and Range	1	2	3	4	5
e) Land parcel number or identifier	1	2	3	4	5
f) Street address	1	2	3	4	5

g) Other. Please specify:____

8. How often do you use or need the following cultural feature positional accuracy? (see page 5 for definition of "positional accuracy")

	Never				Often
a) 0.01 meters	1	2	3	4	5
b) 0.1 meters	1	2	3	4	5
c) 1 meter	1	2	3	4	5
d) 10 meters	1	2	3	4	5
e) 20 meters	1	2	3	4	5
f) 50 meters	1	2	3	4	5
g) 100 meters	1	2	3	4	5
h) 250 meters	1	2	3	4	5
i) 500 meters	1	2	3	4	5
j) 1000 meters	1	2	3	4	5

k) Other. Please specify:____

9. Do you need information about the elevations of cultural features? ___ YES ___ NO

10. If you answered yeas to question 9, how often do you use or need the following cultural feature vertical accuracy? (see page 5 for definition of "vertical accuracy")

	Never				Often
	1	2	3	4	5
a) 0.01 meters	1	2	3	4	5
b) 0.1 meters	1	2	3	4	5
c) 1 meter	1	2	3	4	5
d) 10 meters	1	2	3	4	5
e) 20 meters	1	2	3	4	5
f) 50 meters	1	2	3	4	5
g) 100 meters	1	2	3	4	5
h) 250 meters	1	2	3	4	5
i) 500 meters	1	2	3	4	5

j) Other. Please specify:____

11. Which updating interval best describes your job related requirements for feature data? (see page 5 for definition of "updating interval")

___ a) No maintenance schedule
___ b) Ad hoc maintenance schedule
___ c) As any changes occur
___ d) As major changes occur
___ e) Weekly
___ f) Monthly
___ g) Yearly
___ h) Other (Please specify):____

12. Do you need historic data on cultural features? (see page 5 for definition of "historic data") ___ YES ___ NO

13. If you are currently using digital data about the location of cultural features, which digital data sets do you use? (check one or more and list the data set names, if known -- see page 5 for definition of "digital data set") **Examples**: USGS 1:24 000 DLG, TIGER, County of Lincoln digital property maps, City of Woodland 1:2 000 digital orthophotos.

___ a) Federal government data
Name:____________________
Name:____________________

___ b) State government data
Name:____________________
Name:____________________

___ c) Local government data
Name:____________________
Name:____________________

___ d) Private business - repackaged government data
Name:____________________
Name:____________________

___ e) In-house or private business - custom collected data
Name:____________________
Name:____________________

___ f) Other (Please specify):____________________

D. ELEVATION DATA

1. Do you use digital data about the locations of elevations in your job? ___ YES ___ NO

2. If you answered **NO** to question 1, do you foresee that you might need digital data about the locations of elevations in the future? ___ YES ___ NO

If you answered **NO** to **both** questions 1 and 2, please **skip** to question 1 of LAND PARCELS on page 18

3. If you are using digital data about the location of elevations, do you have a substantial need for better digital data? ___ YES ___ NO

4. How often do you use or need the following elevation data geographic contents in your job? (please circle the appropriate choice -- see page 4 for definition of "geographic contents")

	Never				Often
a) Digital elevation models (DEMs)	1	2	3	4	5
b) Digital terrain models (DTMs)	1	2	3	4	5
c) Digital contours	1	2	3	4	5
d) Bathymetric models	1	2	3	4	5

e) Other. Please specify:____

5. How often do you perform or have a need to perform the following tasks with elevation location data? (please circle the appropriate choice -- see page 4 for definition of "tasks")

	Never				Often
a) Environmental monitoring	1	2	3	4	5
b) Facilities design	1	2	3	4	5
c) Site analysis	1	2	3	4	5
d) Vehicle routing	1	2	3	4	5

e) Other (Please specify):____

5. How often do you use or need the following elevation data formats? (please circle the appropriate choice -- see page 4 for definition of "data format")

	Never				Often
a) Grids	1	2	3	4	5
b) Triangulated irregular networks (TINs)	1	2	3	4	5
c) Digital contour lines	1	2	3	4	5

d) Other. Please specify:____

7. How often do you use or need the following elevation geocoding schemes? (please circle the appropriate choice -- see page 4 for definition of "geocoding")

	Never				Often
a) Latitude and longitude	1	2	3	4	5
b) UTM coordinates	1	2	3	4	5
c) State plane coordinates	1	2	3	4	5

d) Other. Please specify:____

8. How often do you use or need the following elevation positional accuracy? (see page 5 for definition of "positional accuracy")

	Never				Often
a) 0.01 meters	1	2	3	4	5
b) 0.1 meters	1	2	3	4	5
c) 1 meter	1	2	3	4	5
d) 10 meters	1	2	3	4	5
e) 20 meters	1	2	3	4	5
f) 50 meters	1	2	3	4	5
g) 100 meters	1	2	3	4	5
h) 250 meters	1	2	3	4	5
i) 500 meters	1	2	3	4	5
j) 1000 meters	1	2	3	4	5

k) Other. Please specify:____

9. How often do you use or need the following elevation vertical accuracy? (see page 5 for definition of "vertical accuracy")

	Never				Often
a) 0.01 meters	1	2	3	4	5
b) 0.1 meters	1	2	3	4	5
c) 1 meter	1	2	3	4	5
d) 10 meters	1	2	3	4	5
e) 20 meters	1	2	3	4	5
f) 50 meters	1	2	3	4	5
g) 100 meters	1	2	3	4	5
h) 250 meters	1	2	3	4	5
i) 500 meters	1	2	3	4	5

j) Other. Please specify:____

10. Which updating interval best describes your job related requirements for the elevation data? (see page 5 for definition of "updating interval")

___ a) No maintenance schedule
___ b) Ad hoc maintenance schedule
___ c) As any changes occur
___ d) As major changes occur
___ e) Weekly
___ f) Monthly
___ g) Yearly
___ h) Other (Please specify):____

11. Do you need historic data on elevations? (see page 5 for definition of "historic data")
___ YES ___ NO

11. If you are currently using digital elevation data, which digital data sets do you use? (check one or more and list the data set names, if known -- see page 5 for definition of "digital data set") **Examples**: DOD World Mean Elevation Data, USGS 7.5 Minute DEM

___ a) Federal government data
Name:____
Name:____
___ b) State government data
Name:____
Name:____
___ c) Local government data
Name:____
Name:____
___ d) Private business - repackaged government data
Name:____
Name:____
___ e) In-house or private business - custom collected data
Name:____
Name:____
___ f) Other (Please specify):____

E. LAND PARCELS

1. Do you use digital data about the locations of land parcels in your job?
 ___ YES ___ NO

2. If you answered **NO** to question 1, do you foresee that you might need digital data about the locations of land parcels in the future? ___ YES ___ NO

If you answered **NO** to **both** questions 1 and 2, please **skip** to question 1 of BOUNDARIES on page 21

3. If you are using digital data about the location of land parcels, do you have a substantial need for better digital data? ___ YES ___ NO

4. How often do you use or need the following land parcel data geographic contents in your job? (please circle the appropriate choice -- see page 4 for definition of "geographic contents")

	Never				Often
a) Land ownership parcel boundaries	1	2	3	4	5
b) Consolidated (single ownership) boundaries	1	2	3	4	5
c) Public easement boundaries	1	2	3	4	5
d) Private easement boundaries	1	2	3	4	5
e) Public right-of-way boundaries	1	2	3	4	5

f) Other (Please specify):____

5. How often do you perform or have a need to perform the following tasks with land parcel location data? (please circle the appropriate choice -- see page 4 for definition of "tasks")

	Never				Often
a) Address matching	1	2	3	4	5
b) Environmental monitoring	1	2	3	4	5
c) Facilities design / construction	1	2	3	4	5
d) Facilities maintenance	1	2	3	4	5
e) Inventorying	1	2	3	4	5
f) Resource allocation	1	2	3	4	5
g) Resource manangement	1	2	3	4	5
h) Site analysis	1	2	3	4	5
i) Vehicle routing	1	2	3	4	5

j) Other (Please specify):____

6. How often do you use or need the following land parcel data formats? (please circle the appropriate choice -- see page 4 for definition of "data format")

	Never				Often
a) Vector data	1	2	3	4	5
b) Digital photography / orthophotos	1	2	3	4	5
c) Imagery	1	2	3	4	5
d) Other raster data	1	2	3	4	5

e) Other. Please specify:____

7. How often do you use or need the following land parcel geocoding schemes? (please circle the appropriate choice -- see page 4 for definition of "geocoding")

	Never				Often
a) Latitude and longitude	1	2	3	4	5
b) UTM coordinates	1	2	3	4	5
c) State plane coordinates	1	2	3	4	5
d) US PLSS Township and Range	1	2	3	4	5
e) Land parcel number or identifier	1	2	3	4	5
f) Street address	1	2	3	4	5

g) Other. Please specify:____

8. How often do you use or need the following land parcel positional accuracy? (see page 5 for definition of "positional accuracy")

	Never				Often
a) 0.01 meters	1	2	3	4	5
b) 0.1 meters	1	2	3	4	5
c) 1 meter	1	2	3	4	5
d) 10 meters	1	2	3	4	5
e) 20 meters	1	2	3	4	5
f) 50 meters	1	2	3	4	5
g) 100 meters	1	2	3	4	5
h) 250 meters	1	2	3	4	5
i) 500 meters	1	2	3	4	5
j) 1000 meters	1	2	3	4	5

k) Other. Please specify:____

9. Which updating interval best describes your job related requirements for the land parcel data? (see page 5 for definition of "updating interval")

___ a) No maintenance schedule
___ b) Ad hoc maintenance schedule
___ c) As any changes occur
___ d) As major changes occur
___ e) Weekly
___ f) Monthly
___ g) Yearly
___ h) Other (Please specify):____

10. Do you need historic data on land parcels? (see page 5 for definition of "historic data") ___ YES ___ NO

11. If you are currently using digital data about the location of land parcels, which digital data sets do you use? (check one or more and list the data set names, if known -- see page 5 for definition of "digital data set") **Examples**: USGS 1:24 000 DLG, TIGER, County of Lincoln digital property maps, City of Woodland 1:2 000 digital orthophotos.

___ a) Federal government data
Name:____
Name:____
___ b) State government data
Name:____
Name:____
___ c) Local government data
Name:____
Name:____
___ d) Private business - repackaged government data
Name:____
Name:____
___ e) In-house or private business - custom collected data
Name:____
Name:____
___ f) Other (Please specify):____

F. BOUNDARIES

1. Do you use digital data about the locations of boundaries in your job? ___ YES ___ NO

2. If you answered **NO** to question 1, do you foresee that you might need digital data about the locations of boundaries in the future? ___ YES ___ NO

If you answered **NO** to **both** questions 1 and 2, please **send in this questionnaire now.**

3. If you are using digital data about the location of boundaries, do you have a substantial need for better digital data? ___ YES ___ NO

4. How often do you use or need the following boundary data geographic contents in your job? (please circle the appropriate choice -- see page 4 for definition of "geographic contents")

	Never				Often
a) Census tracts / blocks	1	2	3	4	5
b) Post office ZIP+4 code areas	1	2	3	4	5
c) Post office ZIP code areas	1	2	3	4	5
d) Voting precinct boundaries	1	2	3	4	5
e) Zoning district boundaries	1	2	3	4	5
f) Other government administrative boundaries (e.g. school districts, water districts, etc)	1	2	3	4	5
g) City or town boundaries	1	2	3	4	5
h) County boundaries	1	2	3	4	5
i) State boundaries	1	2	3	4	5

j) Other. Please specify:____

5. How often do you perform or have a need to perform the following tasks with boundary location data? (please circle the appropriate choice -- see page 4 for definition of "tasks")

	Never				Often
a) Address matching	1	2	3	4	5
b) Demographic analysis	1	2	3	4	5
c) Environmental monitoring	1	2	3	4	5
d) Facilities design / construction	1	2	3	4	5
e) Facilities maintenance	1	2	3	4	5
f) Inventorying	1	2	3	4	5
g) Resource allocation	1	2	3	4	5
h) Resource management	1	2	3	4	5
i) Site analysis	1	2	3	4	5
j) Vehicle routing	1	2	3	4	5

k) Other (Please specify):____

6. How often do you use or need the following boundary data formats? (please circle the appropriate choice -- see page 4 for definition of "data format")

	Never				Often
a) Vector data	1	2	3	4	5
b) Digital photography / orthophotos	1	2	3	4	5
c) Imagery	1	2	3	4	5
d) Other raster data	1	2	3	4	5

e) Other. Please specify:____

7. How often do you use or need the following boundary geocoding schemes? (please circle the appropriate choice -- see page 4 for definition of "geocoding")

	Never				Often
a) Latitude and longitude	1	2	3	4	5
b) UTM coordinates	1	2	3	4	5
c) State plane coordinates	1	2	3	4	5
d) Street address	1	2	3	4	5

e) Other. Please specify:____

8. How often do you use or need the following boundary positional accuracy? (see page 5 for definition of "positional accuracy")

	Never				Often
a) 0.01 meters	1	2	3	4	5
b) 0.1 meters	1	2	3	4	5
c) 1 meter	1	2	3	4	5
d) 10 meters	1	2	3	4	5
e) 20 meters	1	2	3	4	5
f) 50 meters	1	2	3	4	5
g) 100 meters	1	2	3	4	5
h) 250 meters	1	2	3	4	5
i) 500 meters	1	2	3	4	5
j) 1000 meters	1	2	3	4	5

k) Other. Please specify:____

9. Which <u>updating interval</u> best describes your job related requirements for the boundary data? (see page 5 for definition of "updating interval")

___ a) No maintenance schedule
___ b) Ad hoc maintenance schedule
___ c) As any changes occur
___ d) As major changes occur
___ e) Weekly
___ f) Monthly
___ g) Yearly
___ h) Other (Please specify):_______________________________________

10. Do you need historic data on boundaries? (see page 5 for definition of "historic data")
___ YES ___ NO

11. If you are currently using digital data about the location of boundaries, which <u>digital data sets</u> do you use? (check one or more and list the data set names, if known -- see page 5 for definition of "digital data set") **Examples**: USGS 1:24 000 DLG, TIGER, City of Woodland 1:2 000 digital orthophotos.

___ a) Federal government data
Name:_______________________________________
Name:_______________________________________
___ b) State government data
Name:_______________________________________
Name:_______________________________________
___ c) Local government data
Name:_______________________________________
Name:_______________________________________
___ d) Private business - repackaged government data
Name:_______________________________________
Name:_______________________________________
___ e) In-house or private business - custom collected data
Name:_______________________________________
Name:_______________________________________
___ f) Other (Please specify):_______________________________________

APPENDIX B

STRATIFICATION OF POTENTIAL GIS USERS USING US BUREAU OF OF LABOR STATISTICS

Employment statistics used to determine which occupational disciplines to question are derived from the U.S. Bureau of Labor Statistics bulletin Outlook: 1990-2005: Occupational Employment (Bureau of Labor Statistics 1992). This bulletin lists several hundred individual occupations and provides employment numbers for each occupation based on 1990 Census information. The occupations are divided into nine major employment groups: 1) Executive, administrative, and managerial; 2) Professional specialty; 3) Technicians and related support occupations; 4) Marketing and sales; 5) Administrative support occupations (including clerical); 6) Service occupations; 7) Agricultural, forestry, fishing, and related occupations; 8) Precision production, craft, and repair; and 9) Operators, fabricators, and laborers (see Table 1). Each group lists from eleven to over a hundred individual occupations. Some individual occupations that might conceivably lie in more than one employment group are included only at the highest level employment group. For example, marketing and sales managers are not including in group 4, marketing and sales, but instead are placed in group 1, executive, administrative, and managerial.

A total of fifty nine individual occupations were identified as having at least a potential use for GIS (see Table 2). These individual occupations were chosen as having a potential to use GIS to solve everyday work-related problems. Certain individual occupations which might have access to GIS, such as librarians, were not included among the potential users because they were presumed not to be using GIS to solve work related problems. Each of the employment groups was found to have at least one potential GIS user occupation among the individual occupation listings for that group. Althought the total number of people in each individual occupation are included in the number of potential GIS users, it is probable that many members of certain individual occupations do not encounter GIS related problems in their day to day work. For example, certain cost estimators (group 1) might use GIS to analyze equipment and material haul distances and times while many other cost estimators may not need to consider such matters or any other matters which might be solvable using GIS. The total number of people in individual occupations who might be current or potential GIS users were 25.0 million out of a U.S. working force of 122.6 million (approximately 20 percent of the U.S. working population) (see Table 3).

The major difficulty of surveying the GIS data needs of the current and potential GIS user community among the individual occupations will be to identify who the current users of GIS are within each individual occupation. In some cases, the GIS data needs may be derived from other individual occupations that share a common discipline. For example, the GIS data needs of engineering technicians may be best obtained by querying engineering managers and professionals who would be directing the work of those technicians. Although the survey questionnaire is designed to include each of the individual occupations of potential GIS users, it is anticipated that sufficient numbers of users in certain individual occupations cannot or will not be found to establish credible results for those occupations.

Of the nine employment groups identified by the Bureau of Labor Statistics, four appear to be major users or potential users of GIS: 1) Group 1 -- executive, administrative, and managerial; 2) Group 2 -- professional specialty; 3) Group 4 -- marketing and sales; and Group 7 -- agricultual, forestry, fishing, and related occupations. GIS users and potential GIS users in in the remaining employment groups will most probably have their GIS needs dictated by persons working in one of these four groups.

The number of potential respondents will need to be further culled to find the number of persons actually using GIS or GIS products. While the method for doing so has not yet been established, one possible remedy would be to obtain lists of customers from GIS software and hardware vendors. This will not identify all users, since it appears that many users may be using CAD/CAM software adapted for GIS applications. Another possible approach is to obtain lists from professional organizations and perform the survey in two stages. The first stage would include a short questionnaire asking if the respondent uses GIS and would like to participate in the survey. The second stage would gather the actual framework data needs informal. A third possible approach would be to blanket these users and hope that sufficient numbers of GIS users respond.

REFERENCES

Bureau of Labor Statistics (1992). Outlook: 1990-2005: Occupational Employment. Washington, DC : The United States Bureau of Labor Statistics (May, 1992).

Table 1. Employment by major occupational group, 1990 (from Bureau of Labor Statistics, p. 61)

	Number of Employed (1000)
1. Executive, administrative, and managerial	12 451
2. Professional specialty	15 800
3. Technicians and related support occupations	4 204
4. Marketing and sales	14 088
5. Administrative support occupations (including clerical)	21 951
6. Service occupations	19 204
7. Agricultural, forestry, fishing, and related occupations	3 506
8. Precision production, craft, and repair	14 124
9. Operators, fabricators, and laborers	17 245
Total, all occupations	122 573

Table 2. Individual occupations with current or potential uses for GIS

	Number of Employed (1000)
1. Executive, administrative, and managerial	
Administrative services managers	221
Communications, transportation, and utilities operations	143
Construction managers	183
Education administrators	348
Engineering, mathematical, and natural science managers	135
Financial managers	701
General managers and top executives	3 086
Government chief executives and legislators	71
Marketing, advertising, and public relations managers	427
Property and real estate managers	225
Claims examiners, property and casual insurance	30
Construction and building inspectors	60
Cost estimators	173
Loan officers and counselors	172
Tax examiners, collectors, and revenue agents	62
Total (Executive, administrative, and managerial GIS users)	6 037
Total (Executive, administrative, and managerial)	12 451
2. Professional specialty	
Civil engineers, including traffic engineers	198
Mining engineers, including mine safety engineers	4
Petroleum engineers	17
All other engineers [except electrical, industrial, and mechanical engineers]	347
Architects, except landscape and marine	108
Landscape architects	20
Surveyors	108
Agricultural and food scientists	25
Biological scientists	62
Foresters and conservations scientists	29
Medical scientists	19
All other life scientists	39
Geologists, geophysicists, and oceanographers	48
Meteorologists	5
Economists	37
Urban and regional planners	23
Other social scientists (excluding psychologists)	38
Human services workers	145

Social workers	438
Lawyers	587
	————
Total (Professional specialty GIS users)	2 297
Total (Professional specialty)	15 800

3. Technicians and related support occupations

Engineering and science technicians and technologists	1,327
Aircraft pilots and flight engineers	90
	————
Total (Technicians and related support GIS users)	1 417
Total (Technicians and related support)	4 204

4. Marketing and sales

Insurance sales workers	439
Real estate brokers	69
Real estate appraisers	44
Real estate sales agents	300
	————
Total (Marketing and sales GIS users)	852
Total (Marketing and sales)	14 088

5. Administrative support occupations (including clerical)

Adjusters, investigators, and collectors	1 058
Dispatchers	209
Reservation and transportation ticket agents and travel clerks	150
Postal clerks and mail carriers	439
Traffic, shipping, and receiving clerks	762
	————
Total (Administrative support occupations (including clerical) GIS users)	2 618
Total (Administrative support occupations (including clerical))	21 951

6. Service occupations

Ambulance drivers and attendants	12
Firefighting occupations	280
Law enforcement occupations	886
Other protective service workers	1 101
Total (Service occupation GIS users)	2 279
Total (Service occupation)	19 204

7. Agricultural, forestry, fishing, and related occupations

Farm operators and managers	1 223
Fishers, hunters, and trappers	61
Forestry and logging occupations	148
Supervisors, farming forestry, and agricultural related occupations	65
Total (Agricultural, forestry, fishing, and related GIS users)	1 497
Total (Agricultural, forestry, fishing, and related occupations)	3 506

8. Precision production, craft, and repair

Communications equipment mechanics, installers, and repairers	125
Electrical and electronic equipment mechanics, installers, and repairers	530
Machinery and related mechanics, installers, and repairers	1 675
Other mechanics, installers, and repairers	1 002
Total (Precision production, craft, and repair GIS users)	3 332
Total (Precision production, craft, and repair)	14 124

9. Operators, fabricators, and laborers

Transportation and material moving machine and vehicle operators	4 730
Total (Operators, fabricators, and laborers GIS users)	4 730
Total (Operators, fabricators, and laborers)	17 245

Table 3. GIS users by major occupational group, 1990

	Number of Employed (1000)
1. Executive, administrative, and managerial	6 307
2. Professional specialty	2 297
3. Technicians and related support occupations	1 417
4. Marketing and sales	852
5. Administrative support occupations (including clerical)	2 618
6. Service occupations	2 279
7. Agricultural, forestry, fishing, and related occupations	1 497
8. Precision production, craft, and repair	3 332
9. Operators, fabricators, and laborers	4 370
Total, all occupations	24 969

APPENDIX C

Estimated Stratification of Sample Population Across Employment Sectors by Geographic Region and by Occupation

Table 1. Stratification of master database of government, private and academic users by application area.

Occupation area	Federal	State	Local	Private	Academic	Total
Administration	5	100	31	0	0	136
Agriculture	3	78	1	0	4	86
Architecture	0	2	0	0	3	5
Banking / Finance	2	90	4	3	0	99
Biology	4	37	3	18	3	65
Communications	0	34	2	19	0	55
Construction	1	4	29	6	1	41
Economics	3	63	3	0	3	72
Education	1	72	2	0	0	75
Emergency services	3	35	4	2	0	44
Engineering*	2	12	20	39	3	76
Forestry	6	68	1	0	5	80
Geology / Geophysics	1	108	0	5	16	129
Insurance	1	2	0	3	0	6
Law / Legislative**	3	38	7	5	1	54
Marketing / Advertising	0	6	1	14	2	23
Medical / Health	0	63	2	2	1	68
Meteorology	2	9	2	2	0	16
Oceanography	2	13	1	4	2	22
Property / Real Estate	0	65	47	10	1	123
Public relations	0	0	0	0	0	0
Shipping	0	0	1	2	0	3
Social sci / Social srv	8	92	21	6	6	133
Surveying	8	21	12	26	8	75
Transportation	4	130	25	15	3	177
Urban & Regional Pl	0	42	146	5	7	200
Utility operations***	0	75	71	10	0	156
Wildlife	6	79	1	0	2	88
Unknown	19	367	320	292	104	1088
Totals	84	1700	755	487	173	3195

* Separated into Engineering (civil) and Engineering (other) in final version of questionnaire
** Separated into Law and Legislative in final version of questionnaire
*** Many utility operations people may, in fact, be private rather that local government as shown in the table

Table 2. Stratification of final mailing list of government, private and academic users by application area.

Occupation area	Federal	State	Local	Private	Academic	Total
Administration	5	18	15	0	0	38
Agriculture	3	36	1	0	4	44
Architecture	0	1	0	0	2	3
Banking / Finance	1	29	4	3	0	37
Biology	4	10	3	16	2	35
Communications	0	22	2	14	0	38
Construction	1	0	25	5	1	32
Economics	3	38	3	0	2	46
Education	1	48	2	0	0	51
Emergency services	3	29	4	2	0	38
Engineering*	2	9	16	31	3	61
Forestry	6	42	1	0	3	52
Geology / Geophysics	1	32	0	4	10	47
Insurance	1	2	0	3	0	6
Law / Legislative**	3	21	7	5	1	37
Marketing / Advertising	0	6	1	14	2	23
Medical / Health	0	39	2	2	1	44
Meteorology	2	2	2	2	0	8
Oceanography	2	1	1	4	1	9
Property / Real Estate	0	13	31	10	0	54
Public relations	0	0	0	0	0	0
Shipping	0	0	1	2	0	3
Social sci / Social srv	8	18	17	6	0	49
Surveying	8	15	8	14	4	49
Transportation	4	50	18	8	3	83
Urban & Regional Pl	0	16	79	5	4	104
Utility operations***	0	21	41	3	0	65
Wildlife	3	46	1	0	2	52
Unknown	13	2	136	100	1	152
Totals	74	566	421	253	46	1360

* Separated into Engineering (civil) and Engineering (other) in final version of questionnaire

** Separated into Law and Legislative in final version of questionnaire

*** Many utility operations people may, in fact, be private rather that local government as shown in the table

Table 3. Stratification of master database of government, private and academic users by state and region.

Region & States	Federal	State	Local	Private	Academic	Total
New England	*3*	*176*	*36*	*34*	*17*	*266*
CT (Connecticut)	0	37	10	6	7	60
MA (Massachusetts)	3	34	14	20	5	76
ME (Maine)	0	35	1	3	2	41
NH (New Hampshire)	0	27	7	2	2	38
RI (Rhode Island)	0	17	0	2	1	20
VT (Vermont)	0	26	4	1	0	31
Middle Atlantic	*2*	*112*	*58*	*71*	*8*	*251*
NJ (New Jersey)	0	32	8	21	2	63
NY (New York)	2	50	28	26	5	111
PA (Pennsylvania)	0	30	22	24	1	77
East North Central	*2*	*182*	*67*	*46*	*29*	*326*
IL (Illinois)	2	64	17	14	7	104
IN (Indiana)	0	29	9	6	3	47
MI (Michigan)	0	22	15	14	5	56
OH (Ohio)	0	41	12	5	5	63
WI (Wisconsin)	0	26	14	7	9	56
West North Central	*3*	*217*	*56*	*29*	*20*	*325*
IA (Iowa)	0	29	6	3	0	38
KS (Kansas)	0	33	15	3	7	58
MN (Minnesota)	1	42	19	5	6	73
MO (Missouri)	1	25	9	14	2	51
ND (North Dakota)	0	25	0	1	1	27
NE (Nebraska)	0	33	6	1	3	43
SD (South Dakota)	1	30	1	2	1	35

Table 3. Stratification of master database of government, private and academic users by state and region. (continued)

Region & States	Federal	State	Local	Private	Academic	Total
South Atlantic	*50*	*254*	*207*	*108*	*25*	*644*
DC (Wash., DC)	31	0	6	11	1	49
DE (Delaware)	0	29	4	0	0	33
FL (Florida)	1	32	68	18	5	124
GA (Georgia)	1	35	22	20	1	79
MD (Maryland)	3	30	14	21	2	70
NC (North Carolina)	0	21	52	10	4	87
SC (South Carolina)	1	36	13	3	4	57
VA (Virginia)	13	46	27	24	7	117
WV (West Virginia)	0	25	1	1	1	28
East South Central	*5*	*162*	*30*	*13*	*16*	*226*
AL (Alabama)	0	47	12	6	7	72
KY (Kentucky)	0	53	5	4	5	67
MS (Mississippi)	0	41	4	1	3	49
TN (Tennessee)	5	21	9	2	1	38
West South Central	*1*	*168*	*50*	*25*	*22*	*266*
AR (Arkansas)	0	35	3	3	8	52
LA (Louisiana)	1	48	7	5	2	63
OK (Oklahoma)	0	35	2	1	3	41
TX (Texas)	0	50	38	16	9	113
Mountain	*8*	*248*	*83*	*49*	*15*	*403*
AZ (Arizona)	0	26	21	8	3	58
CO (Colorado)	3	35	32	31	1	102
ID (Idaho)	1	28	6	4	1	40
MT (Montana)	2	45	3	0	2	52
NM (New Mexico)	0	22	2	3	5	32
NV (Nevada)	0	28	15	2	2	47
UT (Utah)	2	37	4	1	0	44
WY (Wyoming)	0	27	0	0	1	28

Table 3. Stratification of master database of government, private and academic users by state and region. (continued)

Region & States	Federal	State	Local	Private	Academic	Total
Pacific	*10*	*178*	*168*	*107*	*25*	*488*
AK (Alaska)	1	25	2	6	2	36
CA (California)	7	39	99	76	7	228
HI (Hawaii)	0	30	3	4	4	41
OR (Oregon)	1	30	25	9	3	68
WA (Washington)	1	54	39	12	9	115
Totals	84	1700	755	487	173	3195

Table 4. Stratification of final mailing list of government, private and academic users by state and region.

Region & States	Federal	State	Local	Private	Academic	Total
New England	*3*	*64*	*27*	*23*	*5*	*122*
CT (Connecticut)	0	13	8	6	1	28
MA (Massachusetts)	3	15	10	11	3	42
ME (Maine)	0	12	1	3	1	17
NH (New Hampshire)	0	9	4	1	0	14
RI (Rhode Island)	0	8	0	1	0	9
VT (Vermont)	0	7	4	1	0	12
Middle Atlantic	*0*	*42*	*39*	*35*	*1*	*117*
NJ (New Jersey)	0	15	6	12	0	33
NY (New York)	0	18	19	12	1	50
PA (Pennsylvania)	0	9	14	11	0	34
East North Central	*1*	*59*	*38*	*28*	*7*	*133*
IL (Illinois)	1	18	8	6	3	36
IN (Indiana)	0	14	8	5	0	27
MI (Michigan)	0	6	9	10	2	27
OH (Ohio)	0	11	6	2	1	20
WI (Wisconsin)	0	10	7	5	1	23
West North Central	*3*	*72*	*36*	*23*	*5*	*139*
IA (Iowa)	0	13	5	3	0	21
KS (Kansas)	0	8	7	3	2	20
MN (Minnesota)	1	12	12	3	0	28
MO (Missouri)	1	9	7	10	0	27
ND (North Dakota)	0	6	0	1	1	8
NE (Nebraska)	0	9	4	1	2	16
SD (South Dakota)	1	15	1	2	0	19

Table 4. Stratification of final mailing list of government, private and academic users by state and region. (continued)

Region & States	Federal	State	Local	Private	Academic	Total
South Atlantic	*46*	*80*	*92*	*54*	*8*	*280*
DC (Wash., DC)	28	0	1	7	0	36
DE (Delaware)	0	5	4	0	0	9
FL (Florida)	1	11	30	9	1	52
GA (Georgia)	1	10	10	13	1	35
MD (Maryland)	3	9	8	6	1	27
NC (North Carolina)	0	11	21	2	1	35
SC (South Carolina)	1	15	6	3	0	25
VA (Virginia)	12	12	11	13	3	51
WV (West Virginia)	0	7	1	1	1	10
East South Central	*2*	*52*	*18*	*4*	*2*	*78*
AL (Alabama)	0	14	5	0	1	20
KY (Kentucky)	0	18	5	1	1	25
MS (Mississippi)	0	11	2	1	0	14
TN (Tennessee)	2	9	6	2	0	19
West South Central	*1*	*50*	*24*	*15*	*8*	*98*
AR (Arkansas)	0	14	2	1	1	18
LA (Louisiana)	1	14	2	2	0	19
OK (Oklahoma)	0	12	2	0	1	15
TX (Texas)	0	10	18	12	6	46
Mountain	*8*	*75*	*47*	*26*	*5*	*161*
AZ (Arizona)	0	8	10	6	0	24
CO (Colorado)	3	13	18	14	1	49
ID (Idaho)	1	7	4	3	1	16
MT (Montana)	2	10	2	0	1	15
NM (New Mexico)	0	7	1	3	1	12
NV (Nevada)	0	6	10	0	1	17
UT (Utah)	2	12	2	0	0	16
WY (Wyoming)	0	12	0	0	0	12

Table 4. Stratification of final mailing list of government, private and academic users by state and region. (continued)

Region & States	Federal	State	Local	Private	Academic	Total
Pacific	*10*	*72*	*100*	*45*	*5*	*232*
AK (Alaska)	1	13	2	3	0	19
CA (California)	7	16	65	33	4	125
HI (Hawaii)	0	14	3	2	0	19
OR (Oregon)	1	11	12	3	0	27
WA (Washington)	1	18	18	4	1	42
Totals	74	566	421	253	46	1360

APPENDIX D

Estimated Sample Weights Based on Geographic Regions, GIS Application Uses, and User Employment Sector

Estimatations are computed in the following tables for possible *a priori* sample weights based on regional population, regional employment, regional gross income, GIS occupational area, and employment sector.

These weights are computed in standard format with each assigned weight representing a fractional part of the whole sample. For example, a regional population figure of 13,200,000 people out of a possible total of 255,082,000 U.S. population is assigned a weight of 19.3. If one wished to use regional population figures to weight the survey responses, a value of 1 / 19.3, or 0.052 (5.2%), would be applied to all responses from this region to arrive at a weighted response.

Although weighting schemes can prove very useful in evaluating statistical data, none of the weighting schemes listed here were used in the results of this study. These schemes are only suggested for possible future evaluation of this study.

Table 1. Estimated *A Priori* Weights by Population, Employment, and Income by Region. Numbers are derived from 1992 US Census figures.

Region & State	1992 Population (1000)	1992 Employment (1000)	1991 State Income ($1,000,000)
New England	*13 200*	*6 500*	*175 248*
WEIGHTS	**19.3**	**18.1**	**16.2**
CT (Connecticut)	3 281	1 656	50 821
MA (Massachusetts)	5 998	2 862	80 253
ME (Maine)	1 235	615	12 835
NH (New Hampshire)	1 111	586	13 830
RI (Rhode Island)	1 005	481	11 102
VT (Vermont)	570	300	6 407
Middle Atlantic	*37 918*	*17 018*	*479 456*
WEIGHTS	**6.7**	**6.9**	**5.9**
NJ (New Jersey)	7 789	3 666	109 951
NY (New York)	18 119	7 798	234 026
PA (Pennsylvania)	12 009	5 554	135 479
East North Central	*42 753*	*20 146*	*494 093*
WEIGHTS	**6.0**	**5.8**	**5.7**
IL (Illinois)	11 631	5 659	148 888
IN (Indiana)	5 662	2 663	59 976
MI (Michigan)	9 437	4 205	109 856
OH (Ohio)	11 016	5 093	120 210

WI (Wisconsin)	4 892	2 526	55 163
West North Central	*17 960*	*9 082*	*196 033*
WEIGHTS	**14.2**	**12.9**	**14.5**
IA (Iowa)	2 812	1 479	29 119
KS (Kansas)	2 523	1 274	26 757
MN (Minnesota)	4 480	2 306	55 254
MO (Missouri)	5 193	2 543	57 388
ND (North Dakota)	636	299	5 421
NE (Nebraska)	1 606	831	16 098
SD (South Dakota)	711	350	5 996

Table 1. Estimated *A Priori* Weights by Population, Employment, and Income by Region (continued).

Region & State	1992 Population (1000)	1992 Employment (1000)	1991 State Income ($1,000,000)
South Atlantic	*45 061*	*20 847*	*436 147*
WEIGHTS	**5.7**	**5.6**	**6.5**
DC (Washington, DC)	589	253	8 999
DE (Delaware)	689	352	9 028
FL (Florida)	13 488	6 017	132 320
GA (Georgia)	6 751	3 008	29 677
MD (Maryland)	4 908	2 450	63 602
NC (North Carolina)	6 843	3 281	69 186
SC (South Carolina)	3 603	1 662	33 970
VA (Virginia)	6 377	3 145	74 864
WV (West Virginia)	1 812	679	14 501
East South Central	*15 529*	*6 791*	*147 018*
WEIGHTS	**16.4**	**17.3**	**19.3**
AL (Alabama)	4 136	1 796	44 137
KY (Kentucky)	3 755	1 624	33 666
MS (Mississippi)	2 614	1 086	19 994
TN (Tennessee)	5 024	2 285	49 221
West South Central	*27 554*	*12 372*	*280 857*
WEIGHTS	**9.3**	**9.5**	**10.1**

AR (Arkansas)	2 399	1 066	20 263
LA (Louisiana)	4 287	1 778	38 229
OK (Oklahoma)	3 212	1 440	30 194
TX (Texas)	17 656	8 088	192 171

Table 1. Estimated *A Priori* Weights by Population, Employment, and Income by Region (continued)

Region & State	1992 Population (1000)	1992 Employment (1000)	1991 State Income ($1,000,000)
Mountain	*14 381*	*6 427*	*140 921*
WEIGHTS	**17.7**	**18.3**	**20.1**
AZ (Arizona)	3 832	1 605	35 642
CO (Colorado)	3 470	1 652	39 617
ID (Idaho)	1 067	485	9 549
MT (Montana)	824	384	7 161
NM (New Mexico)	1 581	674	13 665
NV (Nevada)	1 327	629	14 519
UT (Utah)	1 813	771	16 094
WY (Wyoming)	466	227	4 674
Pacific	*40 726*	*18 415*	*487 187*
WEIGHTS	**6.3**	**6.4**	**5.8**
AK (Alaska)	587	238	5 066
CA (California)	30 867	13 805	379 624
HI (Hawaii)	1 160	547	13 185
OR (Oregon)	2 977	1 422	31 779
WA (Washington)	5 136	2 403	57 533
Totals	255 082	117 598	2 836 960

Table 2. Estimated *A Priori* Weights by Aggregate GIS Users by Occupation Area. Numbers are derived from values supplied in Appendix B, Table 2.

	Number of Employed (1000)
a) Administration	
Administration services managers	221
General managers and top executives	3 086
Total	3 307
WEIGHT	**7.6**
b) Agriculture	
Agriculture and food scientists	25
Farm operators and managers	1 223
Supervisors, farming, forestry, and agriculture related occupations (1 / 3 of 65,000)	22
Total	1 270
WEIGHT	**19.7**
c) Architecture	
Engineering, mathematical, and natural science managers (1 / 9 of 135,000)	15
Architects, except landscaped and marine	108
Landscape architects	20
Engineering and science technicians and technologists (1 / 9 of 1,327,000)	147
Total	290
WEIGHT	**86.1**
d) Banking / Finance	
Financial mangers	701
Loan officers and counselors	172
Tax examiners, collectors, and revenue agents	62
Total	935
WEIGHT	**26.7**

Table 2. Estimated *A Priori* Weights by Aggregate GIS Users by Occupation Area. (continued)

	Number of Employed (1000)
e) Biology	
Engineering, mathematical, and natural science managers (1 / 9 of 135,000)	15
Biological scientists	62
Engineering and science technicians and technologists (1 / 9 of 1,327,000)	147
Total	224
WEIGHT	**111.5**
f) Communications	
Communications, transportation, and utilities managers (1 / 3 of 143,000)	47
Communications equipment mechanics, installers, and repairers	125
Total	172
WEIGHT	**145.2**
g) Construction	
Construction managers	183
Construction and building inspectors	60
Cost estimators	173
Total	416
WEIGHT	**60.0**
h) Economics	
Economists	37
Total	37
WEIGHT	**674.8**

Table 2. Estimated *A Priori* Weights by Aggregate GIS Users by Occupation Area. (continued)

	Number of Employed (1000)
i) Education	
Education administrators	348
Total	348
WEIGHT	**71.8**
j) Emergency services	
Dispatchers	209
Ambulance drivers and attendants	12
Firefighting occupations	280
Law enforcement occupations	886
Other protective service workers	1 101
Total	2 488
WEIGHT	**10.0**
k) Engineering (Civil)	
Engineering, mathematical, and natural science managers (1 / 9 of 135,000)	15
Civil engineers, including traffic engineers	198
Engineering and science technicians and technologists (1 / 9 of 1,327,000)	148
Total	361
WEIGHT	**69.2**

Table 2. Estimated *A Priori* Weights by Aggregate GIS Users by Occupation Area. (continued)

	Number of Employed (1000)
l) Engineering (Other)	
Engineering, mathematical, and natural science managers	
(1 / 9 of 135,000)	15
Mining engineers, including mine safety engineers	4
Petroleum engineers	17
All other engineers [except electrical, industrial, and mechanical]	347
Engineering and science technicians and technologists	
(1 / 9 of 1,327,000)	148
Total	531
WEIGHT	**47.0**
m) Forestry	
Engineering, mathematical, and natural science managers	
(1 / 9 of 135,000)	15
Foresters and conservation scientists	29
Engineering and science technicians and technologists	
(1 / 9 of 1,327,000)	148
Forestry and logging occupations	148
Supervisors, farming, forestry, and agriculture related occupations	
(1 / 3 of 65,000)	21
Total	361
WEIGHT	**69.2**
n) Geology Geophysics	
Engineering, mathematical, and natural science managers	
(1 / 9 of 135,000)	15
Geologists, geophysicists, and oceanographers	
(2 / 3 of 48,000)	32
Engineering and science technicians and technologists	
(1 / 9 of 1,327,000)	147
Total	194
WEIGHT	**128.7**

Table 2. Estimated *A Priori* Weights by Aggregate GIS Users by Occupation Area. (continued)

	Number of Employed (1000)
o) Insurance	
Claims examiners, property and casual insurance	30
Insurance sales workers	439
Adjusters, investigators, and collectors	1 058
Total	1 527
WEIGHT	**16.4**
p) Law (except police services)	
Lawyers	587
Total	587
WEIGHT	**42.5**
q) Legislative	
Government chief executives and legislators	71
Total	71
WEIGHT	**351.7**
r) Marketing / Advertising	
Marketing, advertising, and public relations managers (2 / 3 of 427,000)	285
Total	285
WEIGHT	**87.6**
s) Medical / Health	
Medical scientists	19
All other life scientists	39
Total	190
WEIGHT	**131.4**

Table 2. Estimated *A Priori* Weights by Aggregate GIS Users by Occupation Area. (continued)

	Number of Employed (1000)
t) Meteorology / Air Quality	
Engineering, mathematical, and natural science managers (1 / 9 of 135,000)	15
Meteorologists	5
Engineering and science technicians and technologists (1 / 9 of 1,327,000)	147
Aircraft pilots and flight engineers	90
Total	257
WEIGHT	**97.2**
u) Oceanography / Marine	
Engineering, mathematical, and natural science managers (1 / 9 of 135,000)	15
Geologists, geophysicists, and oceanographers (1 / 3 of 48,000)	16
Engineering and science technicians and technologists (1 / 9 of 1,327,000)	147
Total	178
WEIGHT	**140.3**
v) Property/ Real estate	
Property and real estate managers	225
Real estate brokers	69
Real estate appraisers	44
Real estate sales agents	300
Total	638
WEIGHT	**39.1**

Table 2. Estimated *A Priori* Weights by Aggregate GIS Users by Occupation Area. (continued)

	Number of Employed (1000)
w) Public relations	
Marketing, advertising, and public relations managers (1 / 3 of 427,000)	142
Total	142
WEIGHT	**175.8**
x) Shipping	
Postal clerks and mail carriers	439
Traffic, shipping, and receiving clerks	762
Total	1 201
WEIGHT	**20.8**
y) Social Science / Social Services	
Other social scientists (excluding psychologists)	38
Human service workers	145
Social workers	438
Total	621
WEIGHT	**40.2**
z) Surveying	
Engineering, mathematical, and natural science managers (1 / 9 of 135,000)	15
Surveyors	108
Engineering and science technicians and technologists (1 / 9 of 1,327,000)	147
Total	270
WEIGHT	**92.5**

Table 2. Estimated *A Priori* Weights by Aggregate GIS Users by Occupation Area. (continued)

	Number of Employed (1000)
aa) Transportation	
Communications, transportation, and utilities managers (1 / 3 of 143,000)	48
Transportation and material moving machine and vehicle operators	4 730
Reservation and transportation ticket agents and travel clerks	150
Total	4 928
WEIGHT	**5.1**
bb) Urban and regional planning	
Urban and regional planners	23
Total	23
WEIGHT	**1085.6**
cc) Utility operations	
Communications, transportation, and utilities managers (1 / 3 of 143,000)	48
Electrical and electronic equipment mechanics, installers, and repairers	530
Machinery and related mechanics, installers, and repairers	1 675
Others mechanics, installers, and repairers	1 002
Total	3 255
WEIGHT	**7.7**
dd) Wildlife	
Fishers, hunters, and trappers	61
Supervisors, farming, forestry, and agriculture related occupations (1 / 3 of 65,000)	22
Total	83
WEIGHT	**300.8**

Table 3. Estimated *A Priori* Weights by Employment Sector. Numbers are derived from 1992 Census figures.

Federal Gov't (1000)	State Gov't (1000)	Local Gov't (1000)	Private (1000)	Academic (1000)	Total (1000)
3 112	3 829	9 356	100 564	737	117 598
37.8	**30.7**	**12.6**	**1.2**	**159.6**	

APPENDIX E

Stratification of Responses
Across Employment Sectors by Geographic
Region and by Occupation

Table 1. Stratification of questionnaire responses by government, private and academic users by state and region.

Region & States	Federal	State	Local	Private	Academic	Total
New England	*3*	*22*	*13*	*12*	*3*	*53*
CT (Connecticut)	0	5	4	3	0	12
MA (Massachusetts)	2	2	3	5	1	13
ME (Maine)	0	7	1	2	1	11
NH (New Hampshire)	1	2	3	0	1	7
RI (Rhode Island)	0	4	0	0	0	4
VT (Vermont)	0	2	2	2	0	6
Middle Atlantic	*0*	*20*	*20*	*15*	*1*	*56*
NJ (New Jersey)	0	6	1	4	0	11
NY (New York)	0	9	11	7	1	28
PA (Pennsylvania)	0	5	8	4	0	17
East North Central	*3*	*22*	*18*	*14*	*3*	*60*
IL (Illinois)	2	9	5	3	1	20
IN (Indiana)	0	5	4	2	1	12
MI (Michigan)	1	2	2	4	0	9
OH (Ohio)	0	2	3	1	0	6
WI (Wisconsin)	0	4	4	4	1	13
West North Central	*1*	*32*	*16*	*9*	*4*	*62*
IA (Iowa)	0	6	1	2	0	9
KS (Kansas)	0	4	4	1	2	11
MN (Minnesota)	0	7	5	0	0	12
MO (Missouri)	1	4	4	4	0	13
ND (North Dakota)	0	3	0	0	0	3
NE (Nebraska)	0	2	2	1	1	6
SD (South Dakota)	0	6	0	1	1	8

Table 1. Stratification of questionnaire responses by government, private and academic users by state and region. (continued)

Region & States	Federal	State	Local	Private	Academic	Total
South Atlantic	*18*	*27*	*51*	*22*	*5*	*123*
DC (Wash., DC)	11	0	0	6	0	17
DE (Delaware)	0	2	1	0	0	3
FL (Florida)	0	4	13	3	0	20
GA (Georgia)	1	2	3	7	1	14
MD (Maryland)	1	2	5	2	1	11
NC (North Carolina)	0	4	18	1	1	24
SC (South Carolina)	0	8	2	1	0	11
VA (Virginia)	5	2	8	1	2	18
WV (West Virginia)	0	3	1	1	0	5
East South Central	*1*	*19*	*12*	*1*	*3*	*36*
AL (Alabama)	0	3	3	0	1	7
KY (Kentucky)	0	5	3	0	1	9
MS (Mississippi)	0	6	0	0	1	7
TN (Tennessee)	1	5	6	1	0	13
West South Central	*1*	*14*	*16*	*3*	*6*	*40*
AR (Arkansas)	0	2	2	0	1	5
LA (Louisiana)	1	2	2	1	0	6
OK (Oklahoma)	0	5	1	0	1	7
TX (Texas)	0	5	11	2	4	22
Mountain	*6*	*31*	*20*	*8*	*2*	*67*
AZ (Arizona)	0	3	5	3	0	11
CO (Colorado)	2	5	7	3	0	17
ID (Idaho)	0	4	2	2	0	8
MT (Montana)	2	4	1	0	2	9
NM (New Mexico)	1	4	0	0	0	5
NV (Nevada)	0	1	4	0	0	5
UT (Utah)	1	5	1	0	0	7
WY (Wyoming)	0	5	0	0	0	5

Table 1. Stratification of questionnaire responses by government, private and academic users by state and region. (continued)

Region & States	Federal	State	Local	Private	Academic	Total
Pacific	*4*	*26*	*50*	*16*	*2*	*98*
AK (Alaska)	0	5	0	2	0	7
CA (California)	3	7	34	10	2	56
HI (Hawaii)	0	6	1	0	0	7
OR (Oregon)	1	4	6	1	0	12
WA (Washington)	0	4	9	3	0	16
Totals	37	213	216	101	28	595

Table 2. Stratification of questionnaire responses by occupational application areas across government, private and academic users -- All users (response values 2 - 5)

Occupation area	Federal	State	Local	Private	Academic	Total
Administration	18	113	137	31	6	305
Agriculture	14	84	78	22	13	211
Architecture	4	23	64	15	4	110
Banking / Finance	5	24	37	21	6	93
Biology	12	80	49	23	8	172
Communications	10	74	89	38	4	215
Construction	9	58	119	45	4	235
Economics	11	79	96	31	10	227
Education	10	93	94	25	15	237
Emergency srvcs	18	68	138	36	7	267
Engineering (Civil)	12	67	142	50	9	280
Engineering (Other)	11	63	98	46	7	225
Forestry	13	96	71	30	9	219
Geology / Geoph.	14	96	77	26	12	225
Insurance	3	18	47	14	2	84
Law (except police)	9	33	59	15	2	118
Legislative	13	90	86	22	9	220
Marketing / Advert.	5	43	54	44	5	151
Medical / Health	5	44	50	17	7	123
Meteorology / Air	9	58	46	20	7	140
Oceanog. / Marine	8	43	22	16	4	93
Property / Real estate	17	82	171	51	12	333
Public relations	10	71	122	25	5	233
Shipping	5	16	16	9	2	48
Social sci / srvcs	9	49	90	16	9	173
Surveying	17	83	146	49	9	304
Transportation	19	106	156	51	14	346
Urban & Regional Pl	21	122	185	57	13	398
Utility operations	11	55	147	62	8	283
Wildlife	15	93	78	25	11	222
Totals	337	2024	2764	932	233	6290

Table 3. Stratification of questionnaire responses by occupational application areas across government, private and academic users -- Heavy users (response values 4 or 5)

Occupation area	Federal	State	Local	Private	Academic	Total
Administration	8	36	57	5	1	107
Agriculture	2	29	19	2	8	60
Architecture	1	1	8	2	2	14
Banking / Finance	1	2	5	13	0	21
Biology	7	38	8	8	4	65
Communications	4	15	16	19	1	55
Construction	4	21	51	20	1	97
Economics	3	23	24	11	2	63
Education	3	32	21	6	14	76
Emergency srvcs	10	27	82	17	2	138
Engineering (Civil)	7	29	83	38	1	158
Engineering (Other)	4	19	39	25	2	89
Forestry	8	41	7	11	7	74
Geology / Geoph.	6	50	17	9	6	88
Insurance	0	0	8	7	1	16
Law (except police)	3	8	13	5	0	29
Legislative	4	33	21	8	2	68
Marketing / Advert.	0	6	9	22	2	39
Medical / Health	1	13	13	8	3	38
Meteorology / Air	2	12	3	7	2	26
Oceanog. / Marine	3	20	6	7	0	36
Property / Real estate	10	34	126	27	4	201
Public relations	2	18	36	5	0	61
Shipping	0	1	2	2	0	5
Social sci / srvcs	3	16	28	7	6	60
Surveying	10	32	93	29	3	167
Transportation	12	54	112	29	9	216
Urban & Regional Pl	12	57	159	32	8	268
Utility operations	4	13	94	43	1	155
Wildlife	9	48	15	10	6	88
Totals	143	728	1175	434	98	2578

Table 4. Application Areas by Region -- All Users

	New Eng.	Mid. Atl.	E.N.C.	W.N.C.	S. Atl.	E.S.C.	W.S.C.	Mtn.	Pac.
Administration	25	26	30	30	68	19	15	37	55
Agriculture	22	15	22	28	48	15	12	21	28
Architecture	9	11	11	12	24	7	9	8	19
Banking / Finance	9	8	13	8	18	6	6	9	16
Biology	18	11	16	17	37	13	9	20	31
Communications	18	18	23	25	52	13	12	20	34
Construction	21	23	27	22	50	15	13	22	42
Economics	21	17	25	22	57	17	13	16	39
Education	22	17	27	26	50	17	14	27	37
Emergency Services	26	23	26	21	67	14	18	25	47
Engineering (Civil)	27	23	29	29	60	20	17	31	44
Engineering (Other)	21	16	21	23	51	13	14	30	36
Forestry	29	15	24	19	46	17	12	26	31
Geology / Geophysics	23	16	23	26	41	17	11	31	37
Insurance	8	8	9	9	23	3	4	5	15
Law	10	10	12	11	33	11	4	9	18
Legislative	19	18	24	28	53	12	11	21	34
Marketing / Advertising	13	13	22	16	34	9	9	13	22
Medical / Health	12	10	14	13	30	11	4	10	19
Meteorology / Air Quality	16	11	13	15	29	12	4	16	24
Oceanography / Marine	17	12	9	3	25	4	3	2	18
Property / Real Estate	28	29	38	34	76	21	24	31	52
Public Relations	18	17	23	25	53	15	17	27	38
Shipping	5	5	6	4	15	4	2	1	6
Social Science / Services	12	13	18	21	47	8	11	13	30
Surveying	26	27	35	29	67	18	17	37	48
Transportation	33	33	34	33	74	24	21	36	58
Urban & Regional Planning	39	35	42	34	89	25	25	36	73
Utility Operations	26	21	32	28	62	17	18	23	56
Wildlife	25	12	21	27	47	14	11	30	35

Table 5. Application Areas by Region -- All Users (Percentages)

	New Eng.	Mid. Atl.	E.N.C.	W.N.C.	S. Atl.	E.S.C.	W.S.C.	Mtn.	Pac.
Administration	8.2%	8.5%	9.8%	9.8%	22.3%	6.2%	4.9%	12.1%	18.0%
Agriculture	10.4%	7.1%	10.4%	13.3%	22.7%	7.1%	5.7%	10.0%	13.3%
Architecture	8.2%	10.0%	10.0%	10.9%	21.8%	6.4%	8.2%	7.3%	17.3%
Banking / Finance	9.7%	8.6%	14.0%	8.6%	19.4%	6.5%	6.5%	9.7%	17.2%
Biology	10.5%	6.4%	9.3%	9.9%	21.5%	7.6%	5.2%	11.6%	18.0%
Communications	8.4%	8.4%	10.7%	11.6%	24.2%	6.0%	5.6%	9.3%	15.8%
Construction	8.9%	9.8%	11.5%	9.4%	21.3%	6.4%	5.5%	9.4%	17.9%
Economics	9.3%	7.5%	11.0%	9.7%	25.1%	7.5%	5.7%	7.0%	17.2%
Education	9.3%	7.2%	11.4%	11.0%	21.1%	7.2%	5.9%	11.4%	15.6%
Emergency Services	9.7%	8.6%	9.7%	7.9%	25.1%	5.2%	6.7%	9.4%	17.6%
17.6%									
Engineering (Civil)	9.6%	8.2%	10.4%	10.4%	21.4%	7.1%	6.1%	11.1%	15.7%
Engineering (Other)	9.3%	7.1%	9.3%	10.2%	22.7%	5.8%	6.2%	13.3%	16.0%
Forestry	13.2%	6.8%	11.0%	8.7%	21.0%	7.8%	5.5%	11.9%	14.2%
Geology / Geophysics	10.2%	7.1%	10.2%	11.6%	18.2%	7.6%	4.9%	13.8%	16.4%
Insurance	9.5%	9.5%	10.7%	10.7%	27.4%	3.6%	4.8%	6.0%	17.9%
Law	8.5%	8.5%	10.2%	9.3%	28.0%	9.3%	3.4%	7.6%	15.3%
Legislative	8.6%	8.2%	10.9%	12.7%	24.1%	5.5%	5.0%	9.5%	15.5%
Marketing / Advertising	8.6%	8.6%	14.6%	10.6%	22.5%	6.0%	6.0%	8.6%	14.6%
Medical / Health	9.8%	8.1%	11.4%	10.6%	24.4%	8.9%	3.3%	8.1%	15.4%
Meteorology / Air Quality	11.4%	7.9%	9.3%	10.7%	20.7%	8.6%	2.9%	11.4%	17.1%
Oceanography / Marine	18.3%	12.9%	9.7%	3.2%	26.9%	4.3%	3.2%	2.2%	19.4%
Property / Real Estate	8.4%	8.7%	11.4%	10.2%	22.8%	6.3%	7.2%	9.3%	15.6%
Public Relations	7.7%	7.3%	9.9%	10.7%	22.7%	6.4%	7.3%	11.6%	16.3%
Shipping	10.4%	10.4%	12.5%	8.3%	31.2%	8.3%	4.2%	2.1%	12.5%
Social Science / Services	6.9%	7.5%	10.4%	12.1%	27.2%	4.6%	6.4%	7.5%	17.3%
Surveying	8.6%	8.9%	11.5%	9.5%	22.0%	5.9%	5.6%	12.2%	15.8%
Transportation	9.5%	9.5%	9.8%	9.5%	21.4%	6.9%	6.1%	10.4%	16.8%
Urban & Regional Planning	9.8%	8.8%	10.6%	8.5%	22.4%	6.3%	6.3%	9.0%	18.3%
Utility Operations	9.2%	7.4%	11.3%	9.9%	21.9%	6.0%	6.4%	8.1%	19.8%
Wildlife	11.3%	5.4%	9.5%	12.2%	21.2%	6.3%	5.0%	13.5%	15.8%

Table 6. Application Areas by Region -- Heavy Users

	New Eng.	Mid. Atl.	E.N.C.	W.N.C.	S. Atl.	E.S.C.	W.S.C.	Mtn.	Pac.
Administration	7	7	13	13	29	7	3	10	18
Agriculture	6	5	5	12	11	5	3	5	8
Architecture	0	2	1	1	2	1	2	3	2
Banking / Finance	0	2	5	1	3	1	0	5	4
Biology	6	5	7	5	14	5	5	7	11
Communications	5	5	7	3	16	4	1	6	8
Construction	8	8	19	9	19	7	3	8	16
Economics	4	3	8	5	21	4	4	6	8
Education	4	8	10	9	14	7	5	9	10
Emergency Services	13	9	8	4	41	9	11	12	31
Engineering (Civil)	17	19	18	11	33	8	11	17	24
Engineering (Other)	6	7	8	7	22	6	4	17	12
Forestry	10	6	8	8	7	10	6	10	9
Geology / Geophysics	8	7	13	14	14	8	2	13	9
Insurance	1	2	1	1	5	1	3	1	1
Law	1	1	1	4	10	3	1	4	4
Legislative	6	1	11	11	15	4	3	3	14
Marketing / Advertising	1	5	10	3	8	3	1	3	5
Medical / Health	1	4	7	3	10	3	1	2	7
Meteorology / Air Quality	3	2	3	3	6	1	2	2	4
Oceanography / Marine	6	6	5	0	10	0	1	1	7
Property / Real Estate	15	18	26	18	56	12	9	21	26
Public Relations	1	9	8	10	12	4	6	5	6
Shipping	0	1	1	0	1	1	0	0	1
Social Science / Services	3	7	6	8	18	2	2	5	9
Surveying	16	17	25	15	37	7	10	16	24
Transportation	24	20	24	15	51	12	13	21	36
Urban & Regional Planning	29	23	30	21	63	12	17	21	52
Utility Operations	13	12	17	10	40	11	13	14	25
Wildlife	8	7	8	10	16	6	6	11	16

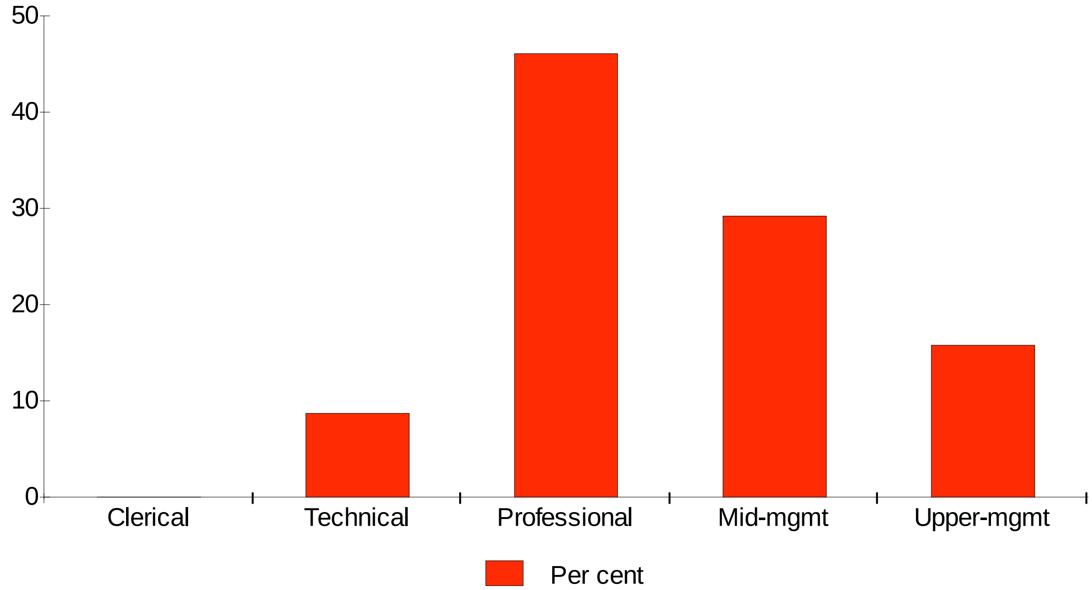
Table 7. Application Areas by Region -- Heavy Users (Percentages)

	New Eng.	Mid. Atl.	E.N.C.	W.N.C.	S. Atl.	E.S.C.	W.S.C.	Mtn.	Pac.
Administration	6.5%	6.5%	12.1%	12.1%	27.1%	6.5%	2.8%	9.3%	16.8%
Agriculture	10.0%	8.3%	8.3%	20.0%	18.3%	8.3%	5.0%	8.3%	13.3%
Architecture	0.0%	14.3%	7.1%	7.1%	14.3%	7.1%	14.3%	21.4%	14.3%
Banking / Finance	0.0%	9.5%	23.8%	4.8%	14.3%	4.8%	0.0%	23.8%	19.0%
Biology	9.2%	7.7%	10.8%	7.7%	21.5%	7.7%	7.7%	10.8%	16.9%
Communications	9.1%	9.1%	12.7%	5.5%	29.1%	7.3%	1.8%	10.9%	14.5%
Construction	8.2%	8.2%	19.6%	9.3%	19.6%	7.2%	3.1%	8.2%	16.5%
Economics	6.3%	4.8%	12.7%	7.9%	33.3%	6.3%	6.3%	9.5%	12.7%
Education	5.3%	10.5%	13.2%	11.8%	18.4%	9.2%	6.6%	11.8%	13.2%
Emergency Services	9.4%	6.5%	5.8%	2.9%	29.7%	6.5%	8.0%	8.7%	22.5%
Engineering (Civil)	10.8%	12.0%	11.4%	7.0%	20.9%	5.1%	7.0%	10.8%	15.2%
Engineering (Other)	6.7%	7.9%	9.0%	7.9%	24.7%	6.7%	4.5%	19.1%	13.5%
Forestry	13.5%	8.1%	10.8%	10.8%	9.5%	13.5%	8.1%	13.5%	12.2%
Geology / Geophysics	9.1%	8.0%	14.8%	15.9%	15.9%	9.1%	2.3%	14.8%	10.2%
Insurance	6.2%	12.5%	6.2%	6.2%	31.2%	6.2%	18.8%	6.2%	6.2%
Law	3.4%	3.4%	3.4%	13.8%	34.5%	10.3%	3.4%	13.8%	13.8%
Legislative	8.8%	1.5%	16.2%	16.2%	22.1%	5.9%	4.4%	4.4%	20.6%
Marketing / Advertising	2.6%	12.8%	25.6%	7.7%	20.5%	7.7%	2.6%	7.7%	12.8%
Medical / Health	2.6%	10.5%	18.4%	7.9%	26.3%	7.9%	2.6%	5.3%	18.4%
Meteorology / Air Quality	11.5%	7.7%	11.5%	11.5%	23.1%	3.8%	7.7%	7.7%	15.4%
Oceanography / Marine	16.7%	16.7%	13.9%	0.0%	27.8%	0.0%	2.8%	2.8%	19.4%
Property / Real Estate	7.5%	9.0%	12.9%	9.0%	27.9%	6.0%	4.5%	10.4%	12.9%
Public Relations	1.6%	14.8%	13.1%	16.4%	19.7%	6.6%	9.8%	8.2%	9.8%
Shipping	0.0%	20.0%	20.0%	0.0%	20.0%	20.0%	0.0%	0.0%	20.0%
Social Science / Services	5.0%	11.7%	10.0%	13.3%	30.0%	3.3%	3.3%	8.3%	15.0%
Surveying	9.6%	10.2%	15.0%	9.0%	22.2%	4.2%	6.0%	9.6%	14.4%
Transportation	11.1%	9.3%	11.1%	6.9%	23.6%	5.6%	6.0%	9.7%	16.7%
Urban & Regional Planning	10.8%	8.6%	11.2%	7.8%	23.5%	4.5%	6.3%	7.8%	19.4%
Utility Operations	8.4%	7.7%	11.0%	6.5%	25.8%	7.1%	8.4%	9.0%	16.1%
Wildlife	9.1%	8.0%	9.1%	11.4%	18.2%	6.8%	6.8%	12.5%	18.2%

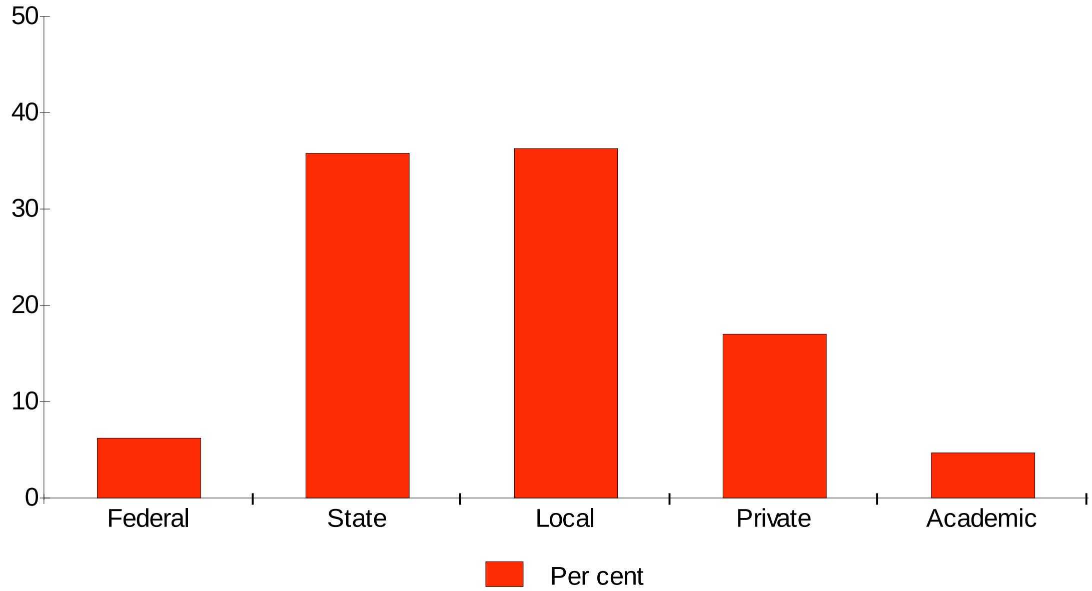
APPENDIX F

Respondents Backgrounds

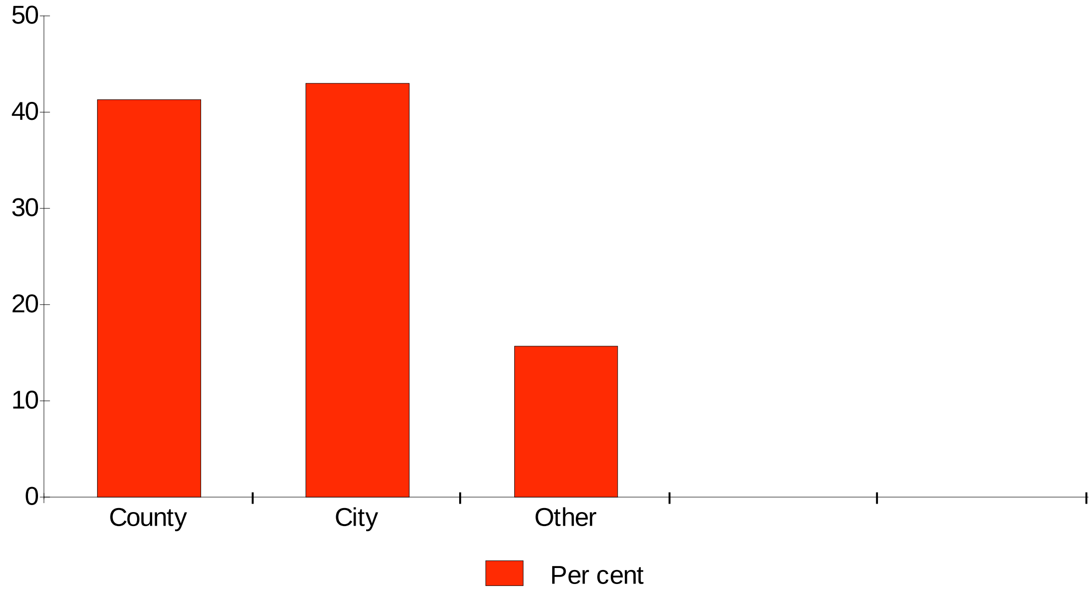
″



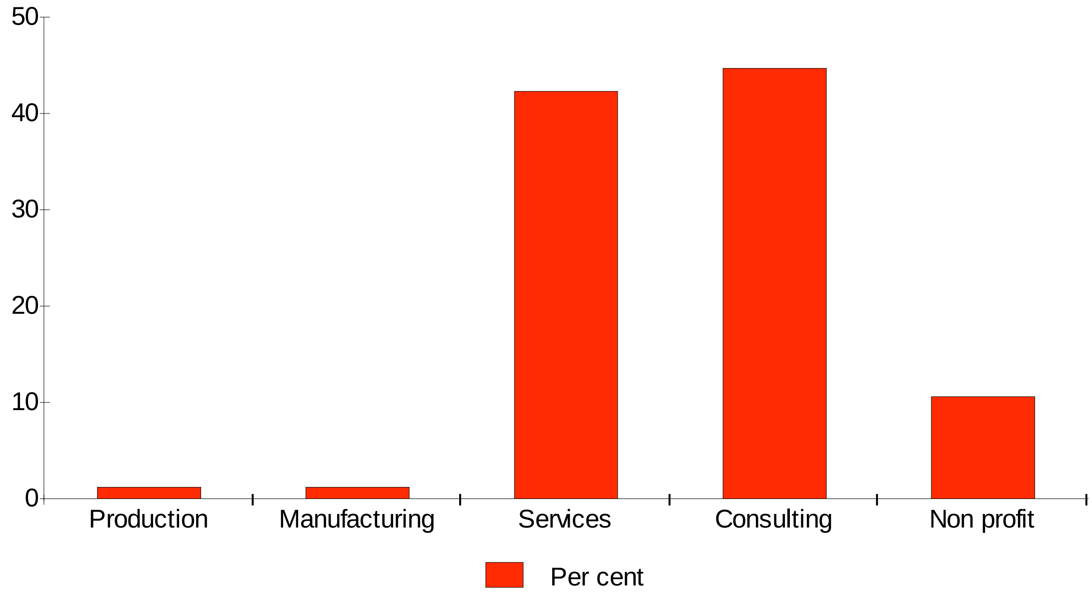
Respondents employment level.



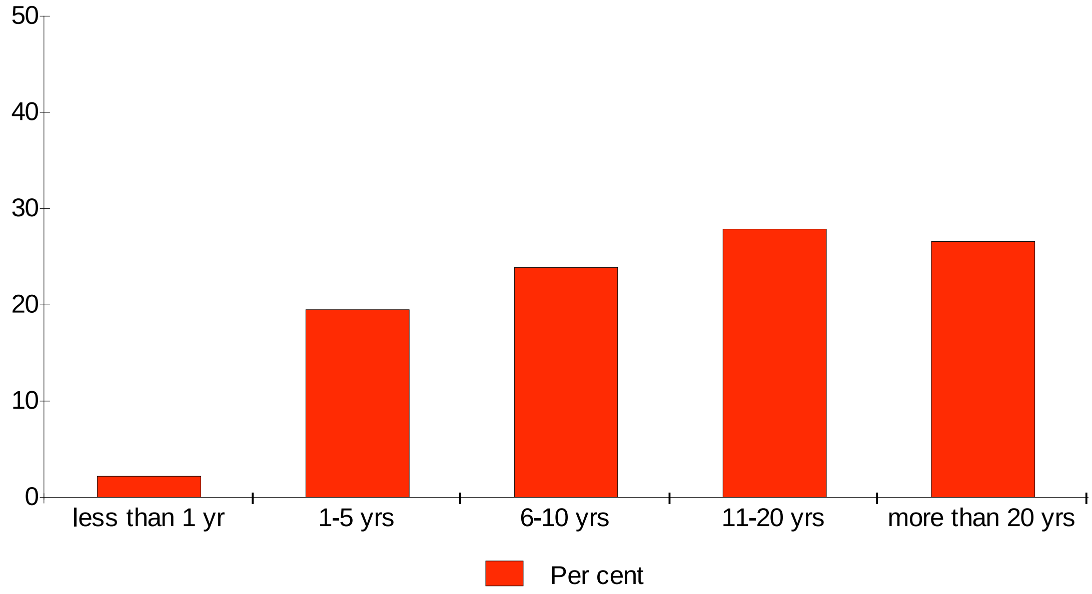
Respondents organization category.



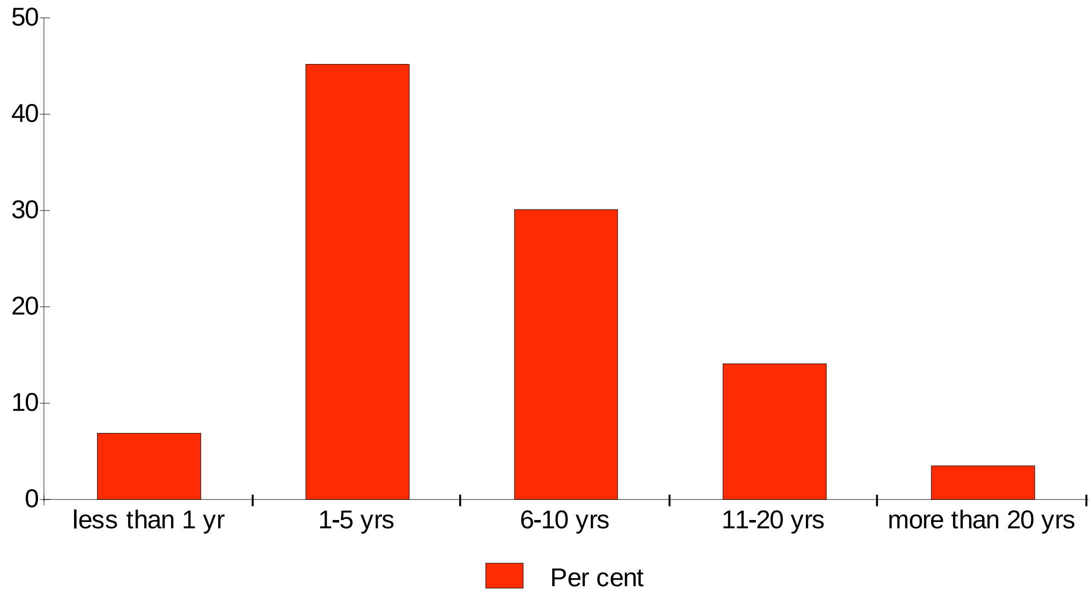
Breakdown of local government responses.



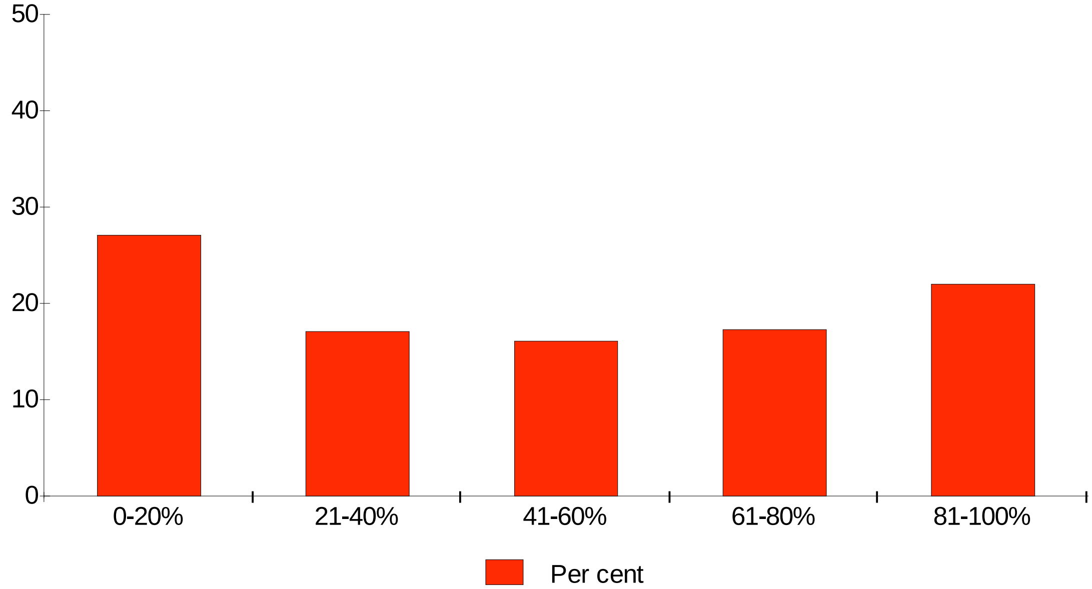
Breakdown of private business responses.



Respondents total years geospatial experience.



Respondents years digital geospatial experience.



Respondents work time using GIS.

APPENDIX G

Respondents Use, Future Use, and

Need for Better Digital Geospatial Data

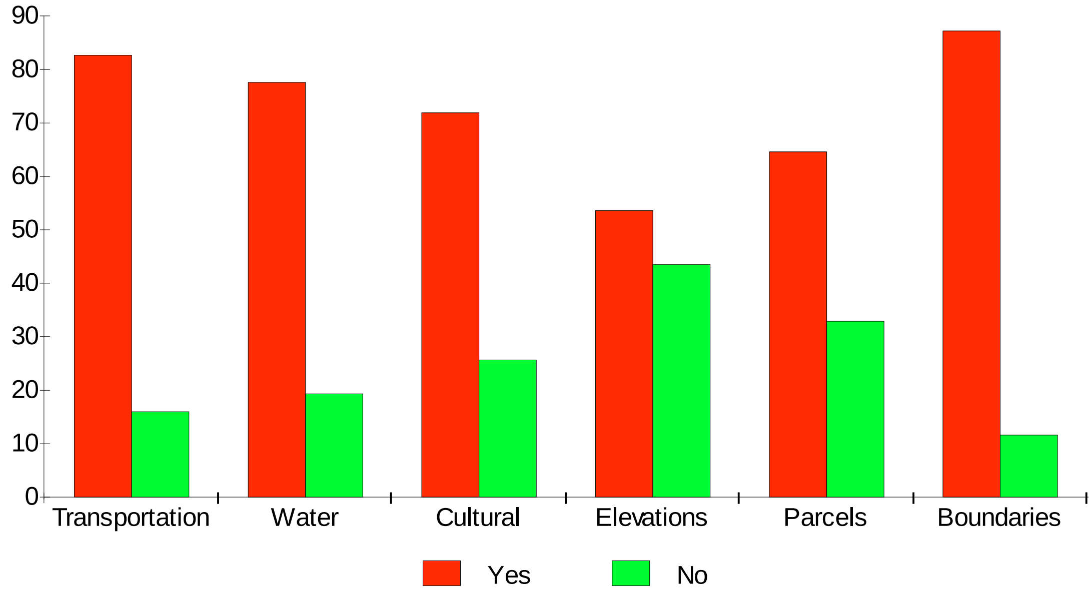


Figure 1. Respondent's Current Use of Digital Geospatial Data

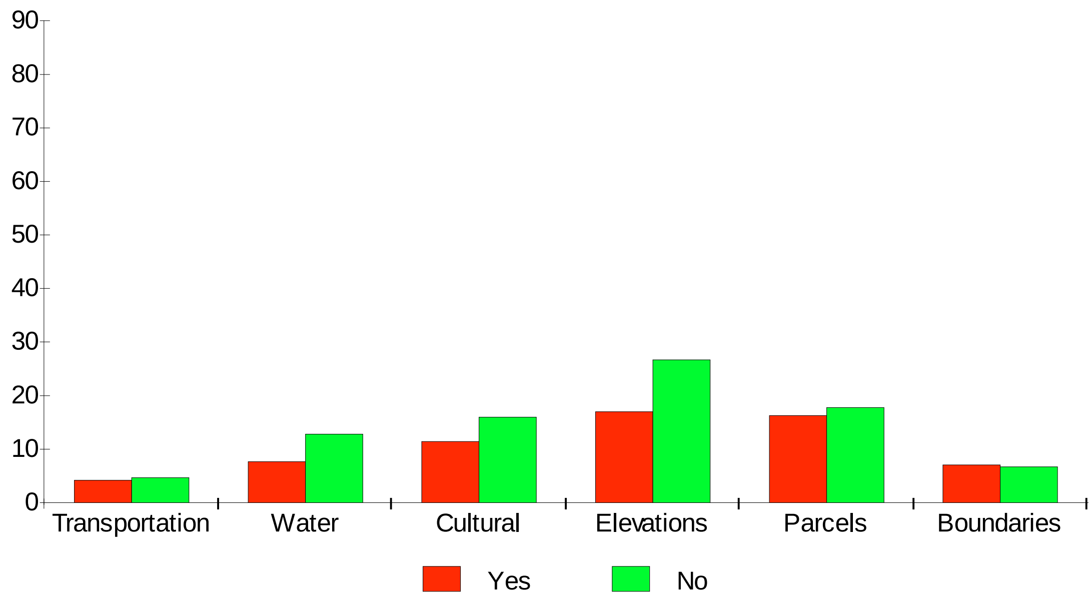


Figure 2. Respondent's Future Need for Digital Geospatial Data
(Only respondents not currently using a given category of data)

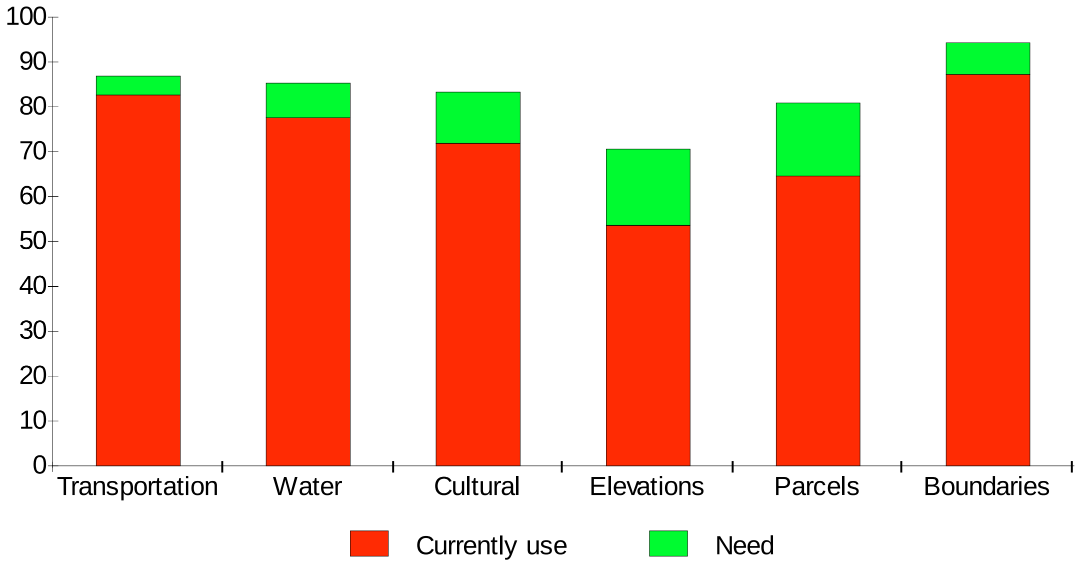


Figure 3. Combined current users and future need users

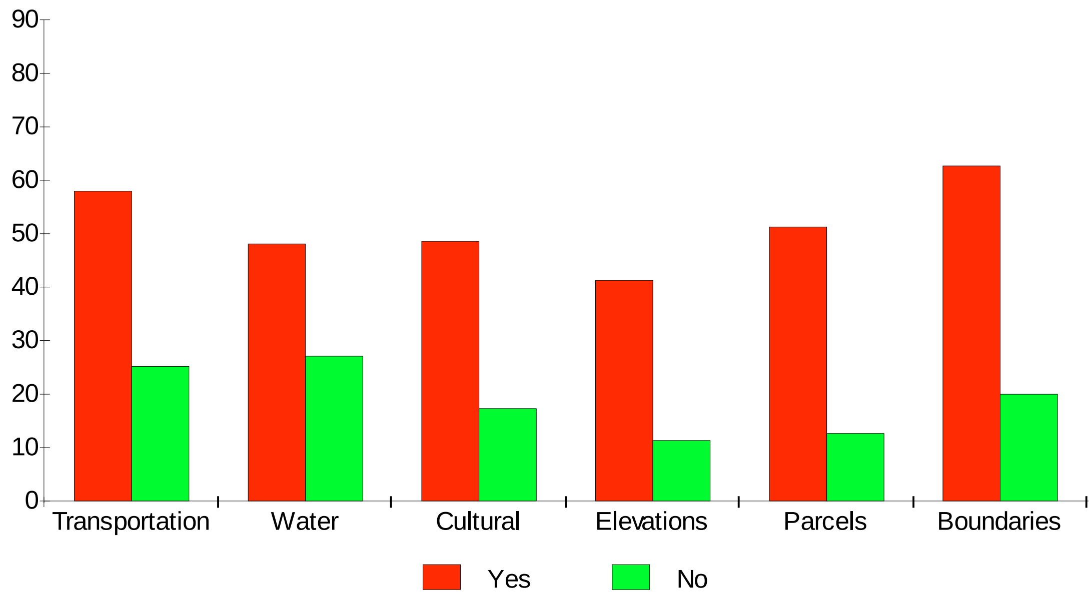


Figure 4. Respondent's Need for Better Digital Geospatial Data

PLEASE NOTE:

Appendix H through P are avaialble vis anonymous ftp: ftp.ncgia.ucsb.edu