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AN ESTIMATE OF COST SAVINGS TO FEDERAL AND STATE GOVERNMENTS RESULTING FROM EXPANDED USGS MAP PRODUCTION

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Executive Summary

This study examines what cost savings would accrue to selected Federal and State Government agencies if the U.S. Geological Survey (USGS) expanded its production of primary maps from a level of 2,500 quadrangles per year to a level of 5,600 quadrangles per year.

The annual cost savings to 18 Federal agencies and the 50 State governments is in the range of $49 to $134 million. This is in comparison to total annual benefits of over $430 million. Cost savings are smaller than benefits because USGS primary maps are multiuse products. A single map can meet the needs of a variety of different applications. Production costs are incurred only once, but benefits are enjoyed as many times as there are separate applications.

The study builds on the results of the USGS's Primary Mapping Economic Analysis (PMEA). The benefit estimates in phase 2 of the PMEA are changed into actual cost savings by deleting the value of multiplicative applications.

The basic methodology of the study is:

1. To determine the appropriate decision unit; that is, over what set of applications a single production cost is spread.

2. To determine the total production requirement within each decision unit; that is, the minimum production that meets the needs of all the user's applications.

3. To multiply the total production requirement times the increase in per quadrangle benefits (resulting from the expanded USGS production) to determine cost savings for a decision unit.

4. To sum the cost savings across all decision units to determine the total cost savings.

The upper and lower bounds of the range of annual cost savings are based on different assumptions as to the appropriate decision units. For the upper bound, each Federal agency and each State government is treated as a separate decision unit. For the lower bound, all Federal and State agencies are combined into a single decision unit. Where along this range the true cost savings lie is determined by the extent to which Federal agencies and State governments effectively coordinate their diverse primary mapping requirements.

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1. Introduction

During fiscal year 1990, the U.S. Geological Survey (USGS) completed the initial primary map coverage of the entire nation. With this milestone, the USGS is facing a new challenge - that of revising and updating these maps to meet the Nation's growing needs for current primary map information.

In response to this challenge, the USGS is conducting a series of studies to better understand the many users and uses of USGS primary maps and to plan ways to meet their needs. One of these studies is the Primary Mapping Economic Analysis (PMEA).

- Phase 1 of the PMEA (September 1987) documents many of the uses of USGS primary map information and the required revision cycle for each application.

- Phase 2 of the PMEA (November 1988) builds on the information collected in phase 1 to estimate benefits and costs associated with different USGS map revision production levels.

The present study builds on the previous PMEA work. The PMEA estimates the benefits of revising primary map information, but does not specifically identify the cost savings to other government agencies from an expanded USGS production level. As early as 1973, an Office of Management and Budget (OMB) report cited significant costs associated with the mapping activities of other Federal agencies. PMEA phase 1 documented that many Federal and State mapping activities are undertaken because the present USGS production level does not provide sufficiently current primary map information.

This study examines the potential for reducing mapping activities (and consequent cost savings) at other government agencies, both Federal and State. It estimates the portion of the benefits of expanded USGS production that can be expected from this source. Although the study cannot pinpoint cost savings at particular agencies, it does estimate the amount of cost savings possible for the government as a whole.

2. Background

The PMEA phase 2 estimated the benefits that are associated with the revision of USGS primary maps if those maps were revised more frequently. Interviews were conducted with a sample of Federal and State agencies. The sample was chosen to represent the most significant users of USGS primary maps. The benefits were measured on the basis of the users' stated "willingness to pay" to make the information on out-of-date maps current enough to meet the requirements of their applications. In the PMEA, users were asked what activities they would perform if current map information were not available. The costs of these activities were estimated from USGS production cost data.

The following example demonstrates how this was done.

User supplied information:
- Map information must be: 5 years old or less
- Willingness to pay: $10,000 per quad
  (implied from activities they would perform)
- Application covers 20 maps per year

If user had to update all maps:
- Cost = $10,000/map x 20 maps = $200,000

If USGS revision cycle = 20 years:
- On average, 5 of the 20 maps will be current enough to meet needs of application
- User will update 15 maps: $10,000 x 15 = $150,000
- Benefit of 20-year revision cycle = $200,000 - $150,000 = $50,000

If USGS revision cycle = 10 years:
- On average, 10 of the 20 maps will be current enough to meet needs of application
- User will update 10 maps: $10,000 x 10 = $100,000
- Benefit of 10-year revision cycle = $200,000 - $100,000 = $100,000

For this application, the benefit of the USGS moving from a revision cycle of 20 years to a revision cycle of 10 years is equal to the increase in benefits.
- 10-year benefit - 20-year benefit
  = Benefit of more frequent revision
- $100,000 - $50,000 = $50,000

As the example shows, the PMEA benefits are actually a measurement of potential cost savings. The benefits are a measure of activities that the users say they would perform, but which they do not need to perform because the USGS provides maps that are current enough to meet the needs of their applications.

These potential cost savings are a measure of the value of more current primary map information. However, they do not reflect the actual cost savings that would accrue to users. The reason for this is that USGS primary maps are multiuse products; that is, a single map can meet the needs of a variety of different applications. Production costs are incurred only once, but benefits are enjoyed as many times as there are separate applications.

To determine how much of the PMEA benefits are actual cost savings to users, the value from these multiplicative applications must be deleted.

3. Method

To determine the value from multiplicative applications, two things must be known:

a. What is the appropriate decision unit.
   - That is, over what set of applications will a single production cost be spread.
   - This question is discussed in section 4.

b. Within a decision unit, what is the total production requirement.
   - This is determined by the degree of similarity in the production requirements for the individual applications.
   - This question is discussed in section 5.

When these two determinations have been made, it is possible to identify those applications (or portions of applications) that are not multiplicative. The PMEA benefits for these applications represent estimates of actual cost savings. That is, the remaining benefits represent primary map revision activities that are presently performed and that would no longer need to be performed if the USGS production level were higher.

4. Selecting the Appropriate Decision Unit

a. What Is a Decision Unit?

The decision unit is the highest level at which the production of map information is coordinated. If two or more applications within a decision unit have the same need for additional map information, they will produce that information only once, and will then share it among the various applications needing it. On the other hand, if two applications in different decision units have the same need for additional map information, they will not coordinate their needs and that information will be produced twice, once by each decision unit.

Benefits were calculated in PMEA phase 2 for 56 separate applications in 18 Federal agencies and for 160 separate applications in 58 State agencies in 5 States. The polar choices for the size of decision units are:

a. To treat each application as a decision unit, resulting in 216 decision units.

b. To treat the entire government as a decision unit, resulting in one decision unit.

There are good reasons for believing that both of these polar cases are inappropriate.

b. Decision Unit for Federal Agencies

Evidence suggests that the appropriate decision unit for Federal agencies is generally no smaller than an individual agency. The PMEA phase 2 questionnaire asked if the agency would attempt to obtain the needed information from other currently existing sources. Agencies with multiple applications typically said that they would attempt to obtain the needed information from within the agency. Another question asked if information that the agency would gather itself would be single purpose or multipurpose. Again, agencies with multiple applications typically said that it would be multipurpose.

Other evidence suggests that the appropriate size is generally also no larger than an individual agency. The PMEA phase 1 interviews describe the separate mapping production units run by several of the agencies and how the output of these units is used within the agency. None mention the provision of information to outside agencies. The phase 2 interviews for single application agencies typically show that any collected data would be single purpose. Several interviews explicitly state that the collected data are for agency use only.

It is reasonable to expect that there should be a large drop in the sharing of data above the agency level. First, map information may be in a format that makes it difficult to share. Many of the "mapping" activities of agencies consist of the collection of information that is penciled on a single file copy. Such information is usually known to only a few persons and not readily reproducible.

Second, even if map information is in a reasonable format, it is more costly to obtain data from outside the agency. Map users are less likely to know of data sources outside their own agency. If they do learn of them, it is likely to be time consuming and costly to obtain the technical information needed to evaluate their usefulness. If they do decide to obtain them, formal procurement procedures between agencies mean additional time and expense.

Third, information from outside a map user's agency is normally more expensive to use. The data are less likely to be in an appropriate format because the agency is less likely to have had any input into decisions on its collection and format. When data are produced within a user's own agency, the offices collecting them are more likely to both solicit and respond to that user's needs. If technical questions are raised about the data, or concerns about their quality, it is harder to resolve this when the source of the data is another agency.

Finally, agencies have much stronger incentives to share data internally than to share them externally. Because agencies are generally independent budgetary units, sharing data internally supports the mission of the agency. Sharing data externally supports the mission of some other agency, which, while it may generate some useful goodwill, is a much weaker incentive than supporting one's own appropriation level.

c. Decision Unit for State Agencies

Evidence suggests that the appropriate decision unit for State agencies is generally no smaller than an individual State government. The PMEA phase 1 interviews generally identify one or two agencies within each State that handle the mapping requirements for all State agencies. Numerous interviews describe how State agencies would rely on a single key State mapping agency for their map revision needs.

The key State mapping agencies are:

- In Connecticut: Department of Environmental Protection
- In Florida: Department of Transportation and Department of Environmental Regulation
- In Illinois: Department of Energy and Natural Resources
- In Oregon: Department of Transportation
- In Utah: Division of Water Resources

Additional evidence that the appropriate decision unit is no smaller than a State government is provided by the State Mapping Advisory Committees that many States maintain. A primary function of these committees is to coordinate mapping requirements for all agencies within a State.

It is unlikely that groups of States coordinate their mapping requirements. The great majority of State applications fall entirely within the boundaries of an individual State. With the minor exception of quadrangles which overlap State boundaries, even adjacent States simply have no common requirements to coordinate.

d. A Range of Decision Units

It is clear that the appropriate decision unit is no smaller than individual Federal agencies and State governments. There is some coordination of mapping requirements above this level. The PMEA interviews do report instances of coordination among agencies and document a general willingness to use revised maps prepared by other agencies. The OMB Circular A-16 process provides information about U.S. Government mapping requirements to the USGS each year to use in setting mapping revision priorities. State Mapping Advisory Committees also foster some coordination of requirements between State and Federal agencies. Nonetheless, it is also clear that coordination of mapping requirements above the level of individual Federal agencies and State governments is imperfect at best.

Rather than attempting to identify a single most appropriate level for the decision units, it is better to specify a range within which the true value lies. The upper bound for this range is individual Federal agencies and State governments. There are 22 decision units in the upper bound.

Federal Agencies
- U.S. Forest Service
- National Agricultural Statistics Service
- Soil Conservation Service
- Bureau of the Census
- National Ocean Service
- and Federal Aviation Administration (see note)
- National Geodetic Survey
- U.S. Army Corps of Engineers
- Defense Mapping Agency
- Department of Housing and Urban Development
- Fish and Wildlife Service
- Bureau of Indian Affairs
- Bureau of Land Management
- National Park Service

Customs Service
Environmental Protection Agency
Federal Emergency Management Administration
Nuclear Regulatory Commission

State Governments
Connecticut
Florida
Illinois
Oregon
Utah

Note: The National Ocean Service and the Federal Aviation Administration are combined in a single decision unit. PMEA phase 1 interviews with the Federal Aviation Administration indicate that the agency routinely contracts with the National Ocean Service for the provision of any needed primary map information. This means that production decisions for these two agencies can be coordinated.

The lower bound for the range treats the entire government (both Federal agencies and State governments) as a single decision unit. The cost savings calculated for these two bounds set the limits within which the true cost savings from expanded USGS production will be found.

5. Determining the Total Production Requirement

The total production requirement for a decision unit is the minimum amount of primary map revision that satisfies the requirements of all applications within the decision unit.

Production requirements for individual applications can be related in four different ways.

a. Requirements are identical

- For example, application A requires that 3 types of map data be updated using aerial photography for a group of 10 quadrangles.
- Application B requires the same 3 types of data for the same 10 quadrangles.
- The requirements are identical: aerial photography is required only once to satisfy both applications.

b. Requirements are independent

- For example, application A requires updating all map data for a group of 10 quadrangles.
- Application B requires the same be done on a group of 10 different quadrangles.
- The requirements are independent: aerial photography for application A is of no use for application B.

c. One requirement is a subset of the other

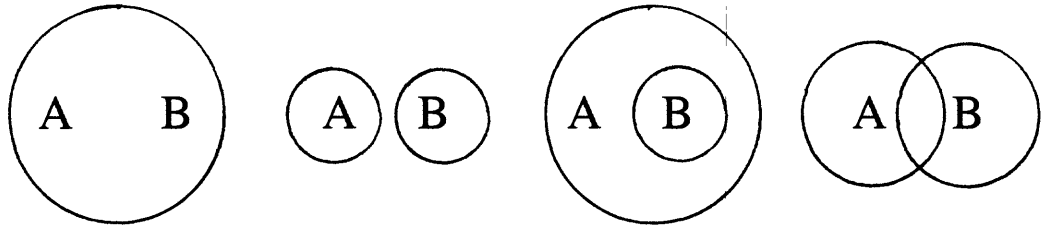
- For example, application A requires photogrammetric work to national map accuracy standards on a particular quadrangle.
- Application B requires work on the same quadrangle, but not necessarily to national map accuracy standards.
- The requirements for application B are a subset of the requirements for application A: the work done for A more than meets the requirements for B.

d. The requirements overlap

- For example, application A requires updating transportation features on quadrangles 1, 2, 3, and 4.
- Application B requires updating transportation features on quadrangles 3, 4, 5, and 6.
- The requirements overlap: the work done to satisfy application A satisfies part (but not all) of the requirements for application B.

The four different relationships can also be illustrated graphically.

Identical Independent Subset Overlap



To convert the PMEA benefits into actual cost savings, it is necessary to determine (for each decision unit) the minimum production necessary to satisfy the requirements of all the applications. This is equivalent to the logical "or."

Appendix A describes how the total production requirement for each decision unit was determined.

6. Cost Savings

a. Explanation of Cost Savings Calculations

The tables presented later in this section show the annual cost savings that would accrue to Federal and State governments if the USGS expanded its production level of revised primary maps from 2,500 quadrangles per year to 5,600 quadrangles per year. The same method could be applied to any other projected USGS production level. A production level of 5,600 quadrangles per year is the maximum capacity of the production equipment the USGS is presently installing.

At a production level of 2,500 quadrangles per year, quadrangles in urban areas are revised on average once every 10 years, and quadrangles in rural areas once every 26 years.

- 6,480 urban quadrangles ÷ 10 years = 648 urban quadrangles/year
- 47,520 rural quadrangles ÷ 26 years = 1,828 rural quadrangles/year

Total = 2,476 quadrangles/year

At a production level of 5,600 quadrangles per year, quadrangles in urban areas are revised on average once every 5 years, and quadrangles in rural areas once every 11 years.

- 6,480 urban quadrangles ÷ 5 years = 1,296 urban quadrangles/year
- 47,520 rural quadrangles ÷ 11 years = 3,960 rural quadrangles/year

Total = 5,616 quadrangles/year

The annual per quadrangle cost savings is determined from the PMEA phase 2 benefit figures. For urban quadrangles, the 10-year benefits are subtracted from the 5-year benefits. For rural quadrangles, the 26-year benefits are subtracted from the 11-year benefits.

The actual benefit figures used in the PMEA phase 2 study are modified in a number of ways for this study.

a. The PMEA benefit figures are derived using a single set of average production costs. For this study the production costs are further broken down into average costs for revising urban quadrangles vs. revising rural quadrangles. Production costs for revising urban quadrangles are generally higher than those used in the PMEA, and production costs for revising rural quadrangles are generally lower than those used in the PMEA.

b. This study uses a more conservative definition of "urban" than was used in the PMEA phase 2, and so only 12 percent of quadrangles nationwide are treated as urban.

c. Each PMEA benefit figure represents the present value of a 7-year stream of benefits. They are converted to annual benefits for this study.

d. Each PMEA benefit figure represents a typical quadrangle within the area of coverage of the application. If only one-half of the quadrangles would actually be revised, then the benefit figure is only one-half of the benefit for those quadrangles that are revised. For this study the benefits are converted to benefits per revised quadrangle. The proportion of quadrangles actually revised is incorporated in the quadrangles-per-year data.

   Appendix B explains how the quadrangles-per-year figures were derived for each application.

e. The PMEA estimated production costs for the use of aerial photography to construct maps either to reconnaissance quality or to national map accuracy standards (NMAS). In this study, an intermediate category (that is, higher than reconnaissance quality but lower than NMAS) was used for three applications of two Federal agencies.

f. The PMEA includes an arbitrary nominal search cost for those applications where the agency would look for other sources of map information. Search costs are ignored in this study.

g. The PMEA explicitly calculates benefits only to 20 years. The benefits for 26 years are calculated by the formula:

   Benefit at agency's optimal cycle x agency's optimal cycle ÷ 26

   For example, assume the agency's optimal cycle is 5 years, and the PMEA benefit figure at 5 years is 12,110. Benefits for 20 years are (12,110 x 5 ÷ 20) = 3,028. Benefits for 26 years are (12,110 x 5 ÷ 26) = 2,329.

b. Estimated Cost Savings

Table 1 presents the estimated cost savings as a range of possible values. The upper bound of the range is determined by assuming that each Federal agency and each State government is a separate decision unit. The lower bound is determined by assuming that Federal and State Governments form a single combined decision unit. Appendix C discusses the assumptions underlying the single decision unit lower bound. Appendix D provides the raw data used in the cost savings calculations.

Table 1. Upper and lower bounds of cost savings
[Totals are different from column figures because of rounding]

Agency	Cost Savings: Urban quads	Cost Savings: Rural quads	Total cost savings
	Upper bound		
Federal agencies			
Forest Service	178,952	8,430,193	8,609,145
Nat. Agr. Stat. Service	0	1,226,585	1,226,585
Soil Conservation Service	104,880	2,377,562	2,482,442
Bureau of the Census	245,592	953,308	1,198,900
Nat. Ocean Service & Fed. Aviation Admin.	10,524,800	2,610,126	13,134,926
Geodetic Survey	648,000	3,059,308	3,707,308
Corps. of Engineers	9,887,453	12,400,361	22,287,814
Defense Mapping Agency	0	11,856,697	11,856,697
Dept. of HUD	0	0	0
Fish & Wildlife Service	52,560	2,870,005	2,922,565
Bureau of Indian Affairs	0	132,535	132,535
Bureau of Land Management	90,896	5,342,675	5,433,571
National Park Service	87,600	516,871	604,471
Customs Service	4,458	21,934	26,392
Envir. Protection Agency	2,313,930	2,431,192	4,745,122
Fed. Emer. Mgmt. Agency	417,690	4,883,538	5,301,228
Nuclear Regulatory Com.	0	0	0
State governments			
Connecticut	219,916	98,457	318,374
Florida	218,210	351,851	570,059
Illinois	376,350	257,778	634,127
Oregon	262,760	1,343,903	1,606,663
Utah	312,707	1,663,415	1,976,122
Total Federal agencies	24,556,810	59,112,887	83,669,698
Total State govt. (x10)	13,899,400	37,154,050	51,053,450
Total	38,456,210	96,266,937	134,723,148
	Lower Bound		
Fed. and State Govts.	12,642,987	36,677,578	49,320,564

c. Interpretation of Cost Savings Figures

Annual cost savings to Federal and State Governments from the expansion of the USGS production level to 5,600 quadrangles per year are somewhere between $49,320,564 and $134,723,148. The position of the actual cost savings within this range depends on the extent to which Federal agencies and State governments effectively coordinate their diverse primary mapping revision requirements. If mapping coordination across decision units is especially thorough, then actual cost savings are near the lower end of the range. If mapping coordination across decision units is the exception rather than the rule, then actual cost savings are near the upper end of the range.

Table 1 lists cost savings by agency. However, it is not possible to extrapolate cost savings for individual agencies toward the lower bound. The difference between the upper and lower bounds is based on the degree of mapping coordination between agencies, but says nothing about the distribution of map revision activities among agencies.

A numerical example should make this point clear.

> Assume that agency A and agency B both have identical mapping requirements valued at $10,000.
>
> If A and B are separate decision units, that is, if they do not coordinate their requirements, then each spends $10,000 on mapping.
>
> If A and B perfectly coordinate, then the $10,000 need be spent only once. However, there are many ways the $10,000 expense could be shared between the agencies.

A = $10,000	A = 0	A = $5,000	or any other
B = 0	B = $10,000	B = $5,000	combination

When the decision unit is expanded beyond the individual agency, there is no longer any way to allocate cost savings to the individual agencies.

The cost savings do not represent line items in the budgets of any one agency or a combination of agencies. The cost savings represent the dollar value of actual mapping activities that would no longer have to be performed. The costs of most mapping activities are not explicitly listed in an organization's budget.

For these reasons, the cost savings figures indicate only the overall effect on Federal and State Governments of an expansion in the USGS production level. They cannot be used to precisely estimate the effect on any one particular agency.

7. Quality Assurance on Results

A variety of quality assurance checks confirm the internal consistency and reasonableness of the cost savings figures.

a. Comparison of Cost Savings With Total Benefits

Table 2 compares the annual cost savings for each of the 22 upper bound decision units with the total annual benefits they would receive from the expansion of the USGS production level.

The percentage of total benefits due to cost savings is remarkably similar for the five State governments studied. A much wider range is seen for the Federal agencies, but fewer applications were included for the Federal agencies than for the State governments. Of the four Federal agencies with seven or more applications, three have percentages in line with the State percentages. In general, for the Federal agencies, the more applications that were counted, the smaller the percentage of total benefits that were due to cost savings. This is consistent with the idea of multiplicative uses.

The PMEA phase 2 study included only a sample of all applications within each agency. If information was collected for additional applications within an agency, it would likely have little effect on the calculated cost savings, but would increase total benefits, thereby reducing the percentage of total benefits due to cost savings.

Table 2. Comparison of cost savings with total benefits

Agency	Benefits	Cost savings	No. of appl.	Pct. cost savings
Federal agencies				
Forest Service	46,142,668	8,609,145	8	19
Nat. Agri. Stat. Service	1,226,585	1,226,585	1	100
Soil Conservation Service	3,694,680	2,482,442	2	67
Bureau of the Census	1,198,900	1,198,900	1	100
Nat. Ocean Service & Fed. Aviation Admin.	27,173,648	13,134,926	3	48
Geodetic Survey	3,707,308	3,707,308	1	100
Corps. of Engineers	51,776,020	22,287,814	7	43
Defense Mapping Agency	11,856,697	11,856,697	1	100
Dept. of HUD	0	0	1	0
Fish & Wildlife Service	4,100,202	2,922,565	7	71
Bureau of Indian Affairs	132,535	132,535	1	100
Bureau of Land Management	33,673,159	5,433,571	10	16
National Park Service	2,405,667	604,471	3	25
Customs Service	26,392	26,392	1	100
Envir. Protection Agency	5,719,147	4,745,122	3	83
Fed. Emer. Mgmt. Agency	25,224,620	5,301,228	2	21
Nuclear Regulatory Com.	50,352	0	1	0
State governments				
Connecticut	1,755,133	318,374	22	18
Florida	2,244,557	570,059	21	25
Illinois	2,276,647	634,127	46	28
Oregon	8,775,145	1,606,663	30	18
Utah	6,358,103	1,976,122	41	31
Total Federal agencies	218,068,224	83,669,698		38
Total State govt. (x10)	214,095,870	51,053,450		24
Total	432,164,094	134,723,148		31

b. Comparison of Cost Savings from Urban and Rural Quadrangles

Table 3 compares the percent of cost savings coming from urban quadrangles with that coming from rural quadrangles for each Federal agency and State government.

Table 3. Percent of cost savings from urban and rural quadrangles

Agency	Pct. from urban quadrangles	Pct. from rural quadrangles
Federal agencies		
Forest Service	2	98
Nat. Agri. Stat. Service	0	100
Soil Conservation Service	4	96
Bureau of the Census	20	80
Nat. Ocean Service & Fed. Aviation Admin.	80	20
Geodetic Survey	17	83
Corps. of Engineers	44	56
Defense Mapping Agency	0	100
Dept. of HUD	-	-
Fish & Wildlife Service	2	98
Bureau of Indian Affairs	0	100
Bureau of Land Management	2	98
National Park Service	14	86
Customs Service	17	83
Envir. Protection Agency	49	51
Fed. Emer. Mgmt. Agency	8	92
Nuclear Regulatory Com.	-	-
State governments		
Connecticut	69	31
Florida	38	62
Illinois	59	41
Oregon	16	84
Utah	16	84

The urban/rural split for the Federal agencies closely matches the areas of concern for those agencies, which is principally rural. The three agencies that have greater than 20 percent of their cost savings from urban quadrangles are also the three agencies with the clearest responsibilities in urban areas.

In the State governments, the percent of cost savings from urban quadrangles is directly related to the degree of urbanization in the State; Connecticut is the most

urbanized, and Oregon and Utah the least urbanized among the five sample States.

c. Cost Savings per Quadrangle in State Governments

Table 4 shows the cost savings per quadrangle for the five sample States.

Table 4. Cost savings in State governments

State	Cost savings	No. of quadrangles	Cost savings per quadrangle	Pct. of average
Connecticut	318,374	97	3,282	348
Florida	570,059	1,021	558	59
Illinois	634,127	995	637	68
Oregon	1,606,663	1,830	878	93
Utah	1,976,122	1,473	1,342	142
Total	5,105,345	5,416	943	

The calculated cost savings per quadrangle is within 50 percent of the average for four of the five sample States. The only State that is not within this average is Connecticut, which is substantially higher than the average. Connecticut also has less than one-tenth as many quadrangles as the next smallest State. The higher cost savings-per-quadrangle figure may simply reflect that Connecticut has fewer quadrangles over which to spread its mapping budget.

Appendixes

The bulk of the basic information used in this study comes from interviews conducted with Federal and State agencies during phases 1 and 2 of the Primary Mapping Economic Analysis (PMRA). In the appendixes that follow, PMEA interviews, agencies, and applications are referenced by the code used in the PMEA.

Agency Codes:

For Federal agencies the agency code is a two-digit number.

- 01 = U.S. Forest Service (USFS)
- 05 = National Agricultural Statistics Service (NASS)
- 06 = Soil Conservation Service (SCS)
- 11 = Bureau of the Census
- 12 = National Ocean Service (NOS)
- 15 = National Geodetic Survey (NGS)
- 16 = U.S. Army Corps. of Engineers (COE)
- 18 = U.S. Army Corps. of Engineers
- 19 = U.S. Army Corps. of Engineers
- 20 = Defense Mapping Agency (DMA)
- 22 = Department of Housing and Urban Development
- 23 = U.S. Fish & Wildlife Service (FWS)
- 29 = Bureau of Indian Affairs (BIA)
- 30 = Bureau of Land Management (BLM)
- 34 = National Park Service (NPS)
- 42 = Federal Aviation Administration (FAA)
- 44 = U.S. Customs Service
- 45 = Environmental Protection Agency (EPA)
- 46 = Federal Emergency Management Agency (FEMA)
- 47 = Nuclear Regulatory Commission

For State agencies the agency code is a 4-digit number. The first two digits are the FIPS State code. The final two digits are a sequence code.

FIPS State codes:

- 09 = Connecticut (8 agencies)
- 12 = Florida (9 agencies)
- 17 = Illinois (23 agencies)
- 41 = Oregon (10 agencies)
- 49 = Utah (16 agencies

PMEA Phase 1 Interview Codes:

For Federal agencies the PMEA phase 1 interview code consists of the prefix "F" attached to the agency code.

For State agencies the PMEA phase 1 interview code consists of the 2-digit Post Office State abbreviation prefixed to the agency code.

Post Office State abbreviations:

CT = Connecticut
FL = Florida
IL = Illinois
OR = Oregon
UT = Utah

Application Codes:

The application code is a six-digit number.

For Federal agencies the first two digits are "85." The third and fourth digits are the agency code. The final two digits are a sequence code.

For State agencies the first four digits are the agency code. The final two digits are a sequence code.

Maps:

Maps created during PMEA phase 2 are referenced by name rather than by code number. All of the maps were created using Spatial Analysis System (SPANS) geographic information system software.

Appendix A

Determining Total Production Requirement

Federal Agencies
- U.S. Forest Service
- National Agricultural Statistics Service
- Soil Conservation Service
- Bureau of the Census
- National Ocean Service
- Federal Aviation Administration
- National Geodetic Survey
- U.S. Army Corps. of Engineers
- Defense Mapping Agency
- Department of Housing and Urban Development
- U.S. Fish & Wildlife Service
- Bureau of Indian Affairs
- Bureau of Land Management
- National Park Service
- U.S. Customs Service
- Environmental Protection Agency
- Federal Emergency Management Agency
- Nuclear Regulatory Commission

State Governments
- Connecticut
- Florida
- Illinois
- Oregon
- Utah

Features Needed Codes

- a = Transportation (roads, railroads, pipelines, power transmission lines, and waterways)
- b = Contours or spot elevations
- c = Hydrography (lakes, streams, springs, and wetlands)
- d = Boundaries (county, city, park, and wildlife areas)
- e = Buildings or other cultural features
- f = Public Land Survey System (PLSS) (section corners, land lines, and other information)
- g = Names (place names and feature names)
- h = Other (control and other geodetic information)

U.S. Forest Service - Agency 01

The PMEA measured benefits for eight applications:

02 = Timber sales
03 = Transportation
04 = Wilderness mapping
05 = Firefighting
50 = Forestry inventory and assessment
51 = Secondary base series mapping
52 = Automated cartography
53 = Primary base coverage

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
02	National forests	a,c,d,e,f	-	7	Field surveys
03	Do.	a,d,f	-	7	Aerial/field (NMAS)
04	Do.	Do.	-	10-15	Field surveys
05	National forests and vicinity	a,b,c,d,e,g	1-3	5-7	Aerial/field (NMAS)
50	National forests	all	1	5	Do.
51	Do.	a,c,d,e,f,g,h	7	7	Do.
52	Do.	Do.	7	7	Do.
53	Do.	Do.	7	7	Do.

Application 05 (firefighting) has the most comprehensive information needs. Collection of data for this application meets most of the needs of all the other applications.

- Application 50 needs slightly more current information.
- Application 05 doesn't collect either PLSS or control information.

Cost savings are calculated from application 05 only, because the information collected for this application adequately fulfills the needs of all their other applications.

National Agricultural Statistics Service - Agency 05

The PMEA measured benefits for one application:

01 = Land use

This application requires more current information than is provided by a 2,500 quadrangles per year production level. Cost savings will be obtained if the USGS expands production to 5,600 quadrangles per year.

Soil Conservation Service - Agency 06

The PMEA measured benefits for two applications:

02 = Soil survey
04 = Watershed planning

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
02	Nationwide (20-30%)	a,c,g	5-10	10-20	Aerial/field
04	Nationwide (60%)	all	5	5	Field survey

Application 02 (soil survey) collects more detailed information, because it uses aerial photographs, but it does not cover all quadrangles. Data collected for this application meet the needs of the other application when the quadrangles overlap.

Cost savings are calculated from application 02 and from 50 percent of application 04.

Bureau of the Census - Agency 11

The PMEA measured benefits for one application:

01 = Decennial census

This application requires more current information than is provided by a 2,500 quadrangles per year production level. Cost savings will be obtained if the USGS expands production to 5,600 quadrangles per year.

National Ocean Service (NOS) - Agency 12
Federal Aviation Administration (FAA) - Agency 42

These two agencies form a single decision unit, since the FAA contracts with NOS for all needed map revision.

The PMEA measured benefits for three applications:

12-01 = Minimum Safe Altitude Program
12-02 = Visual and instrument charts
42-01 = Location determination

Appl. No.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
12-01	Around airports	a,b,e,h	5	5	Aerial (NMAS)
12-02	Airport sites	Do.	5	5	Do.
42-01	Around airports	a,b,c,e,g	5	10	Field survey

Application 12-01 (minimum safe altitude program) has the most comprehensive information needs because it covers a wider geographic area than does application 12-02 and requires more current data in rural areas than does application 42-01. The FAA application does require some information not provided by application 12-01, but not a significant amount.

Cost savings are calculated for application 12-01 only, because the data collected for this application meets nearly all the needs of the other applications.

National Geodetic Survey - Agency 15

The PMEA measured benefits for one application:

01 = Vertical and horizontal controls

This application requires more current information than is provided by a 2,500 quadrangles per year production level. Cost savings will be obtained if the USGS expands production to 5,600 quadrangles per year.

U.S. Army Corps of Engineers (COE) - Agencies 16, 18, 19

The PMEA measured benefits for seven applications:

16-02 = Planning construction projects
18-01 = River and waterways navigation
18-02 = 1:62,500-scale topo maps
19-01 = Geologic studies

19-02 = Coastal studies
19-03 = Environmental impact
19-04 = Hydraulic studies

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
16-02	Nationwide (5-10%)	all	5	10	Aerial/field (NMAS)
18-01	Rivers and coastal	a,c,d,e,g	1	1	Aerial/field
18-02	Lower Miss. Valley	all	5	10	Aerial/field (NMAS)
19-01	Near COE installations	Do.	8	10	Aerial/field
19-02	Coasts	Do.	2-3	2-3	Do.
19-03	Do.	Do.	3	3	Do.
19-04	Do.	Do.	10	10	Do.

The coastal activities of the agency are supported by information collected for applications 18-01 and 18-02. The information needs for applications 19-02, 19-03, and 19-04 are fully met by collections for activity 18-01.

Construction activities of the agency are supported by information collected for application 16-02. Data collected for application 18-02 fully meet these needs when the quadrangles covered overlap.

Geologic activities of the agency are supported by information collected for application 19-01. Data collected for applications 16-02, 18-01, and 18-02 fully meet these needs when the quadrangles covered overlap.

The level of cost savings depends on the degree of overlap of coverage between these applications. Assumed is a 50-percent overlap between construction and coastal, and a 75-percent overlap between these two and geologic. Cost savings are calculated from:

- 100 percent of applications 18-01 and 18-02
- 50 percent of application 16-02
- 25 percent of application 19-01

Defense Mapping Agency - Agency 20

The PMEA measured benefits for one application:

01 = Derivative mapping

This application requires more current information than is provided by a 2,500 quadrangles per year production level. Cost savings will be obtained if the USGS expands production to 5,600 quadrangles per year.

Department of Housing and Urban Development (HUD) - Agency 22

The PMEA measured benefits for one application:

01 = Community development block grant

The HUD uses whatever maps are available, whether the information is current or not. Because the agency incurs no costs at the current USGS production level, there are no cost savings for this agency from an expanded USGS production level.

U.S. Fish and Wildlife Service - Agency 23

The PMEA measured benefits for seven applications:

01 = Wetlands information
02 = Natural resource management
03 = Hazardous wastes
04 = Coastal analysis
05 = Land acquisitions
75 = Pollution containment
76 = River analysis

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
01	National wetlands	all ex. b	-	5	Aerial/field
02	Do.	Do.	-	5	Do.
03	Nationwide	Do.	-	5	Do.
04	Coastal wetlands	Do.	-	5	Do.
05	Nat. wildlife refuges	all	-	5	Do.
75	Nationwide (4%)	all ex. b	-	3	Do.
76	Upper Miss/Ohio Rivers	Do.	3	3	Do.

Approximately the same quality of information is needed for all the applications, but the areas of coverage do not greatly overlap (except that applications 02 and 04 overlap application 01).

Cost savings are calculated for applications 01, 03, 05, 75, and 76, but at 75 percent of each to account for overlapping coverage between them.

Bureau of Indian Affairs - Agency 29

The PMEA measured benefits for one application:

01 = Resource management

This application requires more current information than is provided by a 2,500 quadrangles per year production level. Cost savings will be obtained if the USGS expands production to 5,600 quadrangles per year.

Bureau of Land Management - Agency 30

The PMEA measured benefits for 10 applications:

01 and
91 = Leasing (in Utah and Oregon)
02 and
92 = Grazing allotment (in Utah and Oregon)
03 = Land exchanges
04 = Range improvement
05 and
95 = Recreation (in Utah and Oregon)
06 = Watershed
07 = Wildlife habitat studies
08 = Timber management
09 = Controlling unauthorized use of public lands
50 = Environmental impact studies

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
01	Public Lands	a,d,f	-	10	Aerial/field (NMAS)
91	Do.	all	-	5	Do.
02	Do.	a,d,f,g	-	10	Do.
92	Do.	all	-	10	Aerial (NMAS)
03	Do.	Do.	-	10	Do.
04	Do.	Do.	-	10	Do.
05	Do.	a,c,d,e,f,g	-	7	Aerial/field (NMAS)
95	Do.	all	-	5	Do.
06	Do.	Do.	-	10	Aerial (NMAS)
07	Do.	Do.	-	10	Do.
08	Public timberlands (3%)	Do.	-	5	Aerial/field (NMAS)
09	Public lands	Do.	-	5	Do.
50	Do.	a,b,c,d,e,g	2	5	Aerial/field

Application 09 (controlling unauthorized use) has the most comprehensive information needs. Data collected for this application meet almost all the needs of the other applications.

- Application 50 does need some information in urban areas that is not provided by application 09.

Cost savings are calculated from application 09 and from the urban areas covered by application 50.

National Park Service - Agency 34

The PMEA measured benefits for three applications:

01 = Land use studies
02 = Fire control
03 = Park maintenance

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
01	Nat. park lands and vicinity	all ex. b	5	10	Aerial/field
02	Nat. park lands	a,c,d,e,g	-	10	Do.
03	Do.	a,b,c,d,e,g	2	5	Aerial/field

Application 01 (land use studies) has the most comprehensive information needs. Data collected for this application fully meet the needs of the other 2 applications.

Cost savings are calculated from application 01 only.

U.S. Customs Service - Agency 44

The PMEA measured benefits for one application:

01 = Intercept contraband

This application requires more current information than is provided by a 2,500 quadrangles per year production level. Cost savings will be obtained if the USGS expands production to 5,600 quadrangles per year.

Environmental Protection Agency - Agency 45

The PMEA measured benefits for three applications:

01 = Superfund
50 = Wetlands development
51 = Resource conservation recovery

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
01	Nationwide	a,c,e	5	10	Aerial/field
50	Wetlands	a,c,e,g,h	2	2	Do.
51	Nationwide (3%)	a,c,d,e,g	5	10	Aerial/field (NMAS)

Different information is required for each application. Applications 50 and 51 do

not overlap to any significant extent; both do overlap partly with the needs of application 01.

Cost savings are calculated from applications 50 and 51 and from 75 percent of application 01.

Federal Emergency Management Agency - Agency 46

The PMEA measured benefits from two applications:

01 = Flood insurance study
02 = Coastal flood insurance

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
01	Flood-prone areas	all	1	5	Aerial/field (NMAS)
02	Coastal areas	Do.	1	10	Do.

Application 01 (flood insurance) has the most comprehensive information needs. Data collected for this application fully meet the needs of the other application.

Cost savings are calculated from application 01 only.

Nuclear Regulatory Commission (NRC) - Agency 47

The PMEA measured benefits from one application:

01 = Emergency evacuation maps

The NRC uses whatever maps are available, whether the information is current or not. Because the agency incurs no costs at the current USGS production level, there are no cost savings for this agency from an expanded USGS production level.

Connecticut (09)

The PMEA measured benefits for 22 applications, conducted in 8 agencies:

01-01 and
01-02 = Base for thematic mapping
02-01 = Regional resource inventory
02-02 = GIS positioning
07-01 = Identification of site location and characteristics
07-02 = Water supply impact analysis
07-03 = Geologic and soil characteristics
07-04 = Rate of development index
08-01 = Assessment and purchase planning
08-02 = Farmland inventory
09-01 = Location planning and site feasibility
09-04 = Tract improvement predesign
10-01 = Reconnaissance location
10-02 = Survey inventory
10-03 = Profile development
10-04 = Runoff diversion planning
11-01 = Transportation and boundary inventory
11-02 = Geomorphological study
11-03 = Field identification of landforms
11-50 = Wetlands protection
13-01 = Base overlay for project site environmental characteristics
13-03 = Regional and drainage basin analysis

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
01-01	Statewide and borders	all	5	10	Aerial (NMAS)/field
01-02	Do.	Do.	5	10	Do.
02-01	Statewide	a,b,c,d,e,g	5	10	Do.
02-02	Do.	all	5	10	Do.
07-01	Do.	a,b,d	5	10	Aerial/field (NMAS)
07-02	Do.	a,b,c,e	5	5	Do.
07-03	Do.	a,b,c,e,h	3	5	Do.
07-04	Do.	a,b,e	5	5	Do.
08-01	Do.	all	0	8	Do.
08-02	Do.	a,b,c,d,e	0	8	Aerial (NMAS)/field
09-01	Statewide	all	5	10	Do.
09-04	Do.	Do.	5	10	Aerial/field (NMAS)
10-01	Highways	a,b,c,e	5	7	Do.
10-02	Do.	a,b	10	15	Field (NMAS)
10-03	Do.	Do.	7	15	Aerial/field (NMAS)
10-04	Do.	b,c	7	15	Aerial (NMAS)/field
11-01	Local towns	a,d	5	-	Field
11-02	Statewide	b,c,g	5	10	Aerial/field (NMAS)
11-03	Eastern CT coast	b,c,e	5	5	Do.
11-50	All wetlands	b,c,d,g	5	5	Aerial (NMAS)/field
13-01	Towns in northern Middlesex County	a,c,d,e,g	5	5	Aerial/field
13-03	Do.	all	5	5	Aerial/field (NMAS)

Cost savings are calculated for 100 percent of application 09-04 because this application has the most comprehensive information needs. Application 01-01 requires additional quadrangles along the State border. Application 07-03 requires more current information in both urban and rural areas. Applications 08-01, 11-50, and 13-03 require more current information in rural areas.

Cost savings are calculated from:

- 100 percent of application 09-04
- 5 percent of application 01-01
- 20 percent of application 07-03
- 5 percent of application 08-01
- 10 percent of application 11-50
- 10 percent of application 13-03

Florida (12)

The PMEA measured benefits for 21 applications, conducted in 9 agencies:

01 02 = Land use
01 05 = Display purposes
02 01 = Base for county transportation map
03 01 = Land acquisition
03 02 = Recreation
03 50 and
03 51 = Land management
04 02 = Contract work
04 04 = Land use mapping
05 02 = Wetland inventory
05 03 = Thematic mapping
05 04 = Permit control
06 02 = Ground and water pollution location
06 03 = Digital base
06 04 = Isometric map base
07 01 = Locating retention areas
07 50 = Land management
07 51 = Developmental regional impact statements
09 02 = Transportation planning
25 52 = Surface water use permitting
25 53 = Land use mapping

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
01-02	Statewide	a,b,c,d,f,g	5	5	Aerial (NMAS)
01-05	Do.	-	2	2	-
02-01	Do.	a,c,d,e,f,g,h	-	10	Aerial/field (NMAS)
03-01	Coastal, historic, park, & forest areas	all	-	7	Aerial/field (NMAS)
03-02	Lakes, parks, & rivers	a,b,c,d,g	10	15	Field (NMAS)
03-50	Public, sovereign, & university lands	a,b,c,d,g	-	5	Aerial/field (NMAS)
03-51	Coastline	a,b,c,d,f,h	5	5	Aerial (NMAS)
04-02	Statewide	a,b,d,f,g	5	15	Aerial/Field
04-04	Do.	-	5	5	-
05-02	St. John's Water Mgmt. District	b,c,d,g,h	10	15	Aerial (NMAS)/field
05-03	Do.	a,c,d,f,g,h	4	9	Aerial/field (NMAS)
05-04	Do.	Do.	5	10	Do.
06-02	Suwannee River Water Mgmt. District	all	5	7	Aerial/field
06-03	Do.	Do.	5	7	Field (NMAS)
06-04	Do.	b,c,d,f,g,h	5	7	Do.
07-01	5 central FL co.	a,b,c,d	5	15	Aerial/field
07-50	Do.	a,b,c,d,e,f	5	10	Do.
07-51	Do.	all	3	5	Do.
09-02	11 n. central FL co.	a,b,c,d,f,g	5	20	Do.
25-52	Southwest FL	a,c,d,f,h	-	4	Aerial/field (NMAS)
25-53	Do.	a,c,d	5	5	Do.

Applications 01-02 and 02-01 together meet the majority of revision requirements. Applications 03-01, 03-50, 03-51, 06-03, 25-52, and 25-53 require more frequent updates in rural areas. Applications 05-03 and 07-51 require more current information in both urban and rural areas.

Cost savings are calculated from:

- 50 percent of application 01-02
- 50 percent of application 02-01
- 5 percent of application 03-01
- 10 percent of application 03-50
- 10 percent of application 03-51
- 5 percent of application 05-03

- 5 percent of application 06-03
- 15 percent of application 07-51
- 12 percent of application 25-52
- 10 percent of application 25-53

Illinois (17)

The PMEA measured benefits for 46 applications, conducted in 23 agencies:

01-01 = Planning new airport construction and expansion of existing facilities
01-02 = Regulating and controlling the use of the zoning of land in the vicinity of airports
02-01 = Produce derivative county highway maps
02-02 = Produce street plats
03-01 = Planning highway construction
04-01 = Watershed studies for construction projects
04-02 = Flood studies
05-01 = Evaluating State or Federal projects to convert farmland to other uses
05-02 = Evaluate public service utilities expansion
05-03 = Review reclaimed surface mines
06-01 = Creating slope maps
06-02 = Floodplain studies
06-50 = Determine growth of municipal boundaries to create current boundary map
07-02 = Mapping watersheds
07-04 = Classifying timber coverage dividing the forest for management
08-01 = Basic geologic studies
08-03 = Lands unsuitable for mining studies
09-02 = Environmental studies
10-01 = Delineate watersheds and flood studies
10-02 = Sediment studies and develop slope maps
11-02 = Plotting the location of underground mine shafts
11-04 = General reference and geographic location reference
12-01 = Plan evacuation routes
12-03 = Develop topographic models for radiation dispersion estimates
13-01 = Produce and update tax district maps
14-01 = Plotting known and proposed sanitary landfill sites for evaluation of environmental impact
14-02 = Plotting hazardous waste sites
15-01 = Watershed compilation
15-02 = Plot water treatment facilities
15-03 = Identify and update wetlands
16-01 = Base maps for derivative special purpose maps production
16-04 = Map library and academic uses

17-01 = General academic uses
18-01 = As a base to plot various types of boundaries
18-02 = Delineate open space areas and plot bicycle trails
20-01 = Base to produce county real estate parcel maps
20-02 = Floodplain assessment, drainage subdivisions, water pollution assessment, and derivative maps
20-04 = County road design and general reconnaissance
21-01 = Floodplain analysis
21-02 = Drainage studies and watershed analysis
21-04 = Base map for digitizing
22-02 = Floodplain assessment and drainage design maps
22-05 = Site selection for landfills
23-01 = Plot and plan land developments
23-03 = Sewage and water extension projects
24-03 = General reference material

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
01-01	Statewide	a,c,e	5	5	Aerial
01-02	Airports & vicinity	Do.	5	5	Do.
02-01	Statewide	Do.	8	8	Aerial/field
02-02	Towns of population over 5,000	Do.	8	8	Do.
03-01	Statewide	a,b,e,h	5	15	Aerial/field (NMAS)
04-01	Do.	Do.	2	10	Do.
04-02	Do.	a,b,c,h	2	10	Do.
05-01	Do.	-	5	5	-
05-02	Statewide (rural)	-	-	5	-
05-03	Statewide	-	-	-	-
06-01	Do.	-	5	5	-
06-02	Do.	-	5	5	-
06-50	Statewide (urban)	-	5	-	-
07-02	Statewide	a,b,c,d,e	4	9	Field (NMAS)
07-04	Do.	Do.	4	7	Aerial/field (NMAS)
08-01	Do.	b,c,h	5	10	Field
08-03	Do.	a,b,c,h	5	10	Do.
09-02	Do.	c	5	10	Aerial (NMAS)/field
10-01	Do.	a,b,c,e,h	5	10	Aerial/field (NMAS)
10-02	Do.	Do.	5	10	Do.
11-02	Do.	-	8	8	-
11-04	Do.	-	-	-	-
12-01	Nuclear power stations & vicinity	-	1	1	-
12-03	Do.	-	5	5	-
13-01	Statewide	-	10	10	-
14-01	Do.	a,b,c,d,h	3	3	Field (NMAS)
14-02	Do.	a,b,c,d	4	4	Do.
15-01	Do.	a,b,c,e	8	13	Aerial
15-02	Do.	-	8	8	-
15-03	Do.	b,c	-	10	Aerial/field
16-01	Do.	-	5	5	-
16-04	Do.	-	5	5	-
17-01	Town of Urbana	a,d,e,g	5	13	Aerial
18-01	N.E. Illinois	-	2	2	-
18-02	Do.	-	2	2	-
20-01	Kane County	a,b,c	4	8	Field
20-02	Do.	Do.	5	8	Do.
20-04	Do.	a,e	4	8	Do.

21-01	Lake County	a,b,c	8	13	Aerial/field
21-02	Do.	Do.	5	10	Do.
21-04	Do.	-	5	5	-
22-02	McHenry County	-	3	3	-
22-05	Do.	-	3	3	-
23-01	Will County	a,b,c,d	2	8	Aerial/field
23-03	Do.	Do.	2	8	Do.
24-03	Chicago	-	-	-	-

Application 10-02 meets the most comprehensive information needs. Applications 07-04 and 14-01 require data that are slightly more current. Application 17-01 requires the collection of feature names.

Cost savings are calculated from:

- 100 percent of application 10-02
- 25 percent of application 07-04
- 20 percent of application 14-01
- 5 percent of application 17-01

Oregon (41)

The PMEA measured benefits for 30 applications, conducted in 10 agencies:

01-01 = Locate actual and potential hazards
01-02 = Map base for report data
01-03 = Determining transportation routes for hazardous materials in urban areas
02-01 = Map base for report data
02-02 = Data for GIS studies
02-03 = Map base for rivers study
03-01 = Location of geologic features
03-02 = Hazard analysis
03-03 = Regulatory activities
03-04 = Map base for reports
04-01 = Identify wildlife habitat
04-02 = Base for digital data
04-03 = Depict hunting and fishing areas
05-01 = Aid in fire protection
05-02 = Aid in land management
05-03 = Preliminary road location
06-01 = Inventory of found section corners
06-02 = Control location
06-03 = Access and general location
07-01 = Base for ownership maps
07-02 = Location of section lines and corners
07-03 = Control for other mapping
07-04 = Location of transmitter sites
08-01 = Plan aerial photography
08-02 = Control recovery
08-03 = Reconnaissance for highway surveys
09-01 = Base map
10-01 = Location of emergency shelters
10-02 = Search and rescue operations
10-03 = Forest fire location

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
01-01	Statewide	-	5	5	-
01-02	Do.	a,b,c,d,e,f,g	3	8	Aerial/field (NMAS)
01-03	Statewide (urban)	Do.	3	-	Aerial/field
02-01	Statewide	-	8	8	-
02-02	Do.	all	-	2	Aerial
02-03	Rivers	a,b,c,d,f,g	-	5	Do.
03-01	Statewide	-	15	15	-
03-02	Do.	a,b,c,d,f,g	-	10	Aerial/field
03-03	Do.	Do.	-	10	Field
03-04	Do.	Do.	-	10	Aerial (NMAS)/field
04-01	Do.	Do.	-	10	Field
04-02	Do.	a,c,d,f,g	-	10	Field (NMAS)
04-03	Do.	-	10	10	-
05-01	Forest protection districts	a,b,c,d,f,g	-	8	Aerial/field (NMAS)
05-02	Do.	Do.	-	5	Do.
05-03	Do.	a,b,c,d,f,g,h	-	5	Field (NMAS)
06-01	Statewide	all	5	10	Do.
06-02	Do.	-	10	10	-
06-03	Do.	-	10	10	-
07-01	Do.	all	-	10	Aerial/field (NMAS)
07-02	Do.	a,b,c,d,f,g,h	-	10	Do.
07-03	Do.	-	10	10	-
07-04	Do.	-	10	10	-
08-01	Do.	-	10	10	-
08-02	Do.	all	7	12	Aerial/field (NMAS)
08-03	Do.	Do.	5	8	Do.
09-01	Do.	Do.	2	5	Do.
10-01	Towns & county seats	Do.	5	-	Aerial/field
10-02	Statewide	-	4	4	-
10-03	Do.	-	5	5	-

Application 09-01 has the most comprehensive information requirements. Application 02-02 requires slightly more current information in rural areas.

Cost savings are calculated from:

- 100 percent of application 09-01
- 5 percent of application 02-02

Utah (49)

The PMEA measured benefits for 41 applications, conducted in 16 agencies:

01-01 = Source maps for GIS data base
02-01 = Earthquake preparedness and public awareness
03-01 = Predisaster mitigation
03-50 = Multihazard risk analysis
04-01 = Agricultural development and planning
04-50 = Rangeland and cropland inventory
05-01 = Preparation of mining plans and mineral leases
05-50 = Geophysical and seismic exploration
05-51 = Watershed delineation
06-01 = Land management and acquisitions
06-02 = Proposed park development
06-03 = Natural resource development
06-50 = General management plans
07-01 = Historical and geographic names research
07-50 = Locating and plotting historical trail routes
07-51 = Land use and ownership
07-52 = Archeological site location
08-01 = Timber management
08-02 = Fire control planning
08-50 = Land record automation and royalty verification
08-51 = Land use planning
09-50 = Management and planning of General Trust lands
10-01 = Mapping cities, counties, and highways
10-03 = Roadway design, location, and inventory
10-04 = Geology, drainage, and hydraulics
10-05 = Archeology
10-50 = Information resource and planning tool
11-01 = Detailed engineering design for water projects
11-50 = Base map for planning water projects
11-51 = Land use planning
12-02 = Dam safety (hazard evaluations)
12-50 = Hydrological modeling
13-02 = Range trend studies for big game winter ranges
14-01 = Base map for geologic mapping
14-50 = Base map for hazards assessment
15-01 = Base information for neotectonic studies and geomorphic information
15-02 = Basic educational tool
15-50 = Base maps for plotting environmental and cultural research information
15-51 = Land use classification base map
15-52 = Base information for vertical control extension
16-01 = Surveying and engineering - base map for geodetic control information, location, and plotting

Appl. no.	Area of coverage	Features needed	Age of info. (years) Urban	Rural	Collection method
01-01	Statewide	a,b,d,e,f,g,h	1	5	Aerial
02-01	Pop. centers along the Wasatch Front	a,d,e,g	5	-	-
03-01	Do.	a,c,d,e,f,g	2	5	Aerial/field (NMAS)
03-50	Do.	a,b,c,d,e,f	5	10	Field (NMAS)
04-01	Statewide	a,c,d,e	5	10	Do.
04-50	Do.	Do.	-	10	Aerial/field (NMAS)
05-01	Do.	all	-	5	Aerial/field (NMAS)
05-03	Do.	-	-	-	-
05-51	Do.	a,b,c,d	-	10	Aerial/field (NMAS)
06-01	State parks	all	5	7	Aerial/field (NMAS)
06-02	Do.	Do.	5	7	Do.
06-03	Do.	a,b,c,d,e,f,g	3	7	Do.
06-50	Do.	all	5	7	Aerial/field (NMAS)
07-01	Statewide	a,c,d,e,f,g	1	5	Field
07-50	Do.	-	10	10	-
07-51	Do.	a,c,d,e,f,g	1	5	Field
07-52	Do.	a,c,e,g	5	15	Field (NMAS)
08-01	Do.	a,c,e,f	-	5	Aerial/field
08-02	Do.	a,c,d,e,f,g	5	5	Do.
08-50	Do.	-	-	-	-
08-51	Do.	-	10	10	-
09-50	Do.	a,b,c,d,e,f,g	5	10	Aerial/field (NMAS)
10-01	Do.	a,c,d,f,g,h	1	1	Field (NMAS)
10-03	Do.	a,c,d,e	51	0	Do.
10-04	Do.	all	5	10	Aerial/field (NMAS)
10-05	Do.	a,c,d,e,g	5	10	Field (NMAS)
10-50	Do.	a,b,g,h	3	3	-
11-01	Do.	all	5	5	Aerial/field (NMAS)
11-50	Do.	a,b,c,d	5	20	Do.
11-51	Do.	-	-	-	-
12-02	Do.	-	2	2	-
12-50	Do.	-	5	5	-
13-02	Do.	-	7	7	-
14-01	Do.	-	-	-	-
14-50	Do.	-	5	5	-
15-01	Do.	b,c,h	20	20	Aerial/field (NMAS)
15-02	Do.	a,b,c,d,e,f,g	5	10	Do.
15-50	Do.	a,b,c,d,e,g	5	10	Aerial (NMAS)/field
15-51	Do.	a,c,d,e,f,g	5	10	Do.
15-52	Do.	b,c,h	20	20	Aerial/field (NMAS)
16-01	Salt Lake County	a,b,d,f	2	2	Aerial/field (NMAS)

Application 11-01 has the most comprehensive information needs. Applications 01-01, 03-01, 06-03, and 07-01 require more current information in urban areas. Applications 10-01 and 16-01 require more current information in both urban and rural areas.

Cost savings are calculated from:

- 100 percent of application 11-01
- 20 percent of application 01-01
- 20 percent of application 03-01
- 10 percent of application 06-03
- 20 percent of application 07-01
- 40 percent of application 10-01
- 35 percent of application 16-01

(PAGE 45 FOLLOWS)

Appendix B

Determining Number Of Quadrangles Per Year

Federal Agencies
- U.S. Forest Service
- National Agricultural Statistics Service
- Soil Conservation Service
- Bureau of the Census
- National Ocean Service and
- Federal Aviation Administration
- National Geodetic Survey
- U.S. Army Corps. of Engineers
- Defense Mapping Agency
- U.S. Fish & Wildlife Service
- Bureau of Indian Affairs
- Bureau of Land Management
- National Park Service
- U.S. Customs Service
- Environmental Protection Agency
- Federal Emergency Management Agency

State Governments
- Connecticut
- Florida
- Illinois
- Oregon
- Utah

U.S. Forest Service (application 05 = firefighting)

1. Forest Service lands cover approximately 9,800 quadrangles. This is determined by multiplying the Forest Service's annual production rate of 1,400 times their production cycle of 7 years.
   - 1,400 x 7 = 9,800
   - Source: PMEA phase 1, interview F1, page 5

2. Application 05 also includes areas surrounding National Forests.
   - Source: PMEA phase 2, interview 85-01-05, item 1

   The total quadrangles are rounded up to 10,000. This is probably a conservative estimate.

3. Total annual quadrangles is 10,000 ÷ 7 = 1,428.

4. The urban and rural mix is based on the mix for the Forest Service SPANS maps in Oregon and Utah.
   - Oregon: 517 quads, 0 urban
   - Utah: 237 quads, 11 urban
   - 11 urban quads ÷ 754 total quads = 1 1/2 percent urban

   The Oregon and Utah SPANS maps (ORG1 and UT03) were used in the PMEA phase 2 to calculate benefits for application 05. The corresponding Florida and Illinois SPANS maps were not used in this study because the addition of surrounding areas is concentrated mainly in the West.
   - Source: PMEA phase 2, interview 85-01-05, item 1

5. Annual urban quadrangles = 1,428 x 1 1/2 percent = 21
   Annual rural quadrangles = 1,428 x 98 1/2 percent = 1,407

National Agricultural Statistics Service (NASS) (application 01 = land use)

1. NASS produces 4,000 maps per year.
   - Source: PMEA phase 2, interview 85-05-01, item 6

2. The urban and rural mix is based on the mix for the Nation as a whole because the application covers the entire Nation.
   - 12 percent of all quadrangles are urban
   - Source: PMEA phase 2, analysis of SPANS base map

3. Annual urban quadrangles = 4,000 x 12 percent = 480
   Annual rural quadrangles = 4,000 x 88 percent = 3,520

Soil Conservation Service (SCS)

Application 02 (soil survey)

1. SCS produces maps in 80 counties per year.
   - Source: PMEA phase 1, interview F6, page 4

2. There are about 3,000 counties in the country for an average of about 18 quadrangles per county.
   - 54,000 ÷ 3,000 = 18

   Because quadrangle boundaries do not exactly match county boundaries, it is assumed that an average of 25 quadrangles covers a county.
   - 25 quadrangles per county x 80 counties per year = 2,000 quadrangles per year

3. The urban and rural mix is based on the mix for the Nation as a whole because the application covers the entire Nation.
   - 12 percent of all quadrangles are urban
   - Source: PMEA phase 2, analysis of SPANS base map

4. Annual urban quadrangles = 2,000 x 12 percent = 240
   Annual rural quadrangles = 2,000 x 88 percent = 1,760

Application 04 (watershed planning)

1. This application takes place on non-Federal lands only.
   - Source: PMEA phase 1, interview F6, page 4

2. There are 35,100 non-Federal quadrangles.
   - Source: PMEA phase 2, analysis of SPANS Federal lands map

3. SCS revises 60 percent of the maps covered.
   - Source: PMEA phase 2, interview 85-06-04, item 6

4. Annual number of quadrangles is determined by dividing the total quadrangles revised (35,100 x 60 percent = 21,060) by the SCS production cycle of 5 years.
   - 21,060 ÷ 5 = 4,212

5. These quadrangles are primarily rural.
   - Source: PMEA phase 2, interview 85-06-04, item 10

   To be conservative, it is assumed that all the quadrangles are rural.

Bureau of the Census (application 01 = decennial census)

1. The application requires all quadrangles for the Nation.
   - Source: PMEA phase 1, interview F11, page 1

   This is 54,000 quadrangles.

   Note: Although there are 57,000 total quadrangles, Alaska was not included in the PMEA phase 2 benefit calculations and also is excluded here.

2. Annual number of quadrangles is determined by dividing the total by the Census production cycle of 10 years.
   - 54,000 ÷ 10 = 5,400

3. The urban and rural mix is based on the mix for the Nation as a whole: urban = 12 percent, rural = 88 percent.

4. Annual urban quadrangles = 5,400 x 12 percent = 648
   Annual rural quadrangles = 5,400 x 88 percent = 4,752

National Ocean Service (NOS)
Federal Aviation Administration (FAA) (application 12-01 = Minimum Safe Altitude Program)

1. Total quadrangles is 32,000.
   - 200 airports x 160 quadrangles per airport
   - Source: PMEA phase 1, interview F12, page 2

2. NOS revises 50 percent of the maps covered.
   - Source: PMEA phase 2, interview 85-12-01, item 6

3. Annual number of quadrangles is determined by dividing the total quadrangles revised (32,000 x 50 percent = 16,000) by the NOS production cycle of 5 years.
   - 16,000 ÷ 5 = 3,200

4. The urban and rural mix is based on the mix for the FAA SPANS map of the 5 sample States from the PMEA phase 2.
   - 52 percent urban
   - Source: PMEA phase 2, analysis of FAA1 SPANS map

5. Annual urban quadrangles = 3,200 x 52 percent = 1,664
   Annual rural quadrangles = 3,200 x 48 percent = 1,536

National Geodetic Survey (application 01 = vertical and horizontal controls)

1. The application covers the entire Nation.
   - 54,000 quadrangles
   - Source: PMEA phase 1, interview F15, page 2

2. The Geodetic Survey revises 25 percent of the maps covered.
   - Source: PMEA phase 2, interview 85-15-01, item 6

3. Annual number of quadrangles is determined by dividing the total quadrangles revised (54,000 x 25 percent = 13,500) by the Geodetic Survey production cycle of 5 years.
   - 13,500 ÷ 5 = 2,700

4. The urban and rural mix is based on the mix for the Nation as a whole: urban = 12 percent, rural = 88 percent.

5. Annual urban quadrangles = 2,700 x 12 percent = 324
   Annual rural quadrangles = 2,700 x 88 percent = 2,376

U.S. Army Corps of Engineers (COE)

Application 16-02 (planning construction projects)

1. Annual number of quadrangles covered is between 3,000 and 5,000.
   - Source: PMEA phase 2, interview 85-16-01, item 1

   The average of 4,000 is used in this study.

2. The urban and rural mix is based on the mix for the COE SPANS maps in Illinois.
   - 35 percent urban
   - Source: PMEA phase 2, analysis of ILL6 SPANS map

   The Illinois map was used in PMEA phase 2 to calculate benefits for application 16-02.

3. Annual urban quadrangles = 4,000 x 35 percent = 1,400
   Annual rural quadrangles = 4,000 x 65 percent = 2,600

Application 18-01 (river and waterways navigation)

1. Application covers rivers and coasts.
   - Source: PMEA phase 2, interview 85-18-01, item 1

2. The coastal zone (including Alaska) covers 3,600 quadrangles.
   - Source: Coastal Mapping Handbook, page 14.

   It is assumed that the Alaska coastal zone covers 1,100 quadrangles, and the coverage in the lower 48 States is 2,500 quadrangles.

3. The coastline of the lower 48 States is 11,323 miles, and there are 22,904 miles of navigable rivers.
   - Source: World Data Book

4. Because the ratio of coastline to navigable rivers is approximately 1 to 2, it is assumed that the ratio of map coverage is the same.
   - 2,500 coastal quadrangles + 5,000 navigable river quadrangles = 7,500 quadrangles
   - 54,000 x 15 percent = 8,100

5. Annual number of quadrangles is equal to this total, because the COE's production cycle is 1 year.
   - Source: PMEA phase 2, interview 85-18-01, item 4

6. The urban and rural mix is based on the mix for the COE SPANS maps in Illinois.
   - 35 percent urban

7. Annual urban quadrangles = 7,500 x 35 percent = 2,625
   Annual rural quadrangles = 7,500 x 65 percent = 4,875

Application 18-02 (1:62,500-scale topo maps)

1. The application covers the river basins in the COE's Lower Mississippi Valley Division.
   - Source: PMEA phase 2, interview 85-18-02, item 1

2. The New Orleans District prepares sixty-five 15-minute maps.
   - Source: PMEA phase 1, interview F17, page 1

   Because there are four 7.5-minute maps in each 15-minute map, this is 260 quadrangles. (65 x 4 = 260)

3. Assuming approximately the same coverage in the other three districts in the Lower Mississippi Valley Division, the total number of quadrangles is approximately 1,000.
   - 260 x 4 = 1,040

4. The annual number of quadrangles is determined by dividing the total of 1,040 by the COE production cycle of 15 years.
   - Source: PMEA phase 1, interview F17, page 2
   - 1,040 ÷ 15 = 70

5. The urban and rural mix is based on the mix for the COE SPANS maps in Illinois.
   - 35 percent urban

6. Annual urban quadrangles = 70 x 35 percent = 24
   Annual rural quadrangles = 70 x 65 percent = 46

Application 19-01 (geologic surveys)

1. The COE performs 175 geologic surveys annually, covering an average of 20 quadrangles.
   - Source: PMEA phase 1, interview F19, page 2

   175 x 20 = 3,400 quadrangles annually.

2. The urban and rural mix is based on the mix for COE SPANS maps in Florida, Utah, and Oregon.
   - Florida: 10 quadrangles, 1 urban
   - Utah: 55 quadrangles, 3 urban
   - Oregon: 41 quadrangles, 8 urban
   - 12 urban quadrangles ÷ 106 total quadrangles = 11 percent urban

   The FL10, UT07, and ORG9 SPANS maps for the States were used in the PMEA phase 2 to calculate benefits for application 19-01.

3. Annual urban quadrangles = 3,500 x 11 percent = 385
   Annual rural quadrangles = 3,500 x 89 percent = 3,115

Defense Mapping Agency (DMA) (application 01 = derivative mapping)

1. The application covers the entire Nation.
   - 54,000 x 12 percent urban = 6,480
   - 54,000 x 88 percent rural = 47,520

2. Annual number of quadrangles is determined by dividing the totals of 6,480 and 47,520 by the DMA's production cycle of 20 years.
   - Source: PMEA phase 2, interview 85-20-1, item 6
   - 6,480 ÷ 20 = 324 urban quadrangles
   - 47,520 ÷ 20 = 2,376 rural quadrangles

U.S. Fish and Wildlife Service (FWS)

Application 01 (wetlands information)

1. The application covers wetlands, of which there are 99 million acres in the lower 48 States.
   - Source: PMEA phase 1, interview F23, page 2

   99 million acres equals approximately 2,600 quadrangles.

2. The annual number of quadrangles is determined by dividing the total of 2,600 by the FWS's production cycle of 20 years.
   - 2,600 ÷ 20 = 130
   - Source: PMEA phase 2, interview 85-23-01, item 6

3. The FWS says that all of these quadrangles are rural.
   - Source: PMEA phase 2, interview 85-23-01, item 8

   However, Environmental Protection Agency application 45-50 covers the same area, and they report some urban quadrangles. To be consistent with this, it is assumed that 5 percent of the quadrangles are urban.
   - 130 x 5 percent = 6 urban quadrangles
   - 130 x 95 percent = 124 rural quadrangles

Application 03 (hazardous wastes)

1. The application covers approximately 2,000 hazardous waste sites nationwide.
   - Source: PMEA phase 1, interview F23, page 4

   This is approximately 2,350 quadrangles per year.
   - Source: PMEA phase 2, interview 85-23-75, item 6

2. All of these quadrangles are rural.
   - Source: PMEA phase 2, interview 85-23-03, item 8

Application 05 (land acquisitions)

1. The application covers national wildlife refuges, of which there are 13 million acres in the lower 48 States.
   - Source: PMEA phase 1, interview F34, pages 4 and 5

   13 million acres equals approximately 340 quadrangles.

2. It is assumed that land acquisition activity affects 10 percent of these quadrangles in an average year.
   - 340 x 10 percent = 34

3. All of these quadrangles are rural.
   - Source: PMEA phase 2, interview 85-23-05, item 8

Application 75 (pollution containment)

1. The FWS uses 2,350 maps per year.
   - Source: PMEA phase 2, interview 85-23-75, item 6

2. All of these quadrangles are rural.
   - Source: PMEA phase 2, interview 85-23-75, item 8

Application 76 (river analysis)

1. The application covers 995 quadrangles.
   - Source: PMEA phase 2, analysis of OH10 SPANS map

   The OH10 SPANS map was used in PMEA phase 2 to calculate benefits for application 76.

2. The annual number of quadrangles is determined by dividing the total of 995 by the FWS production cycle of 10 years.
   - 995 ÷ 10 = 100

3. The urban and rural mix is based on the mix from PMEA phase 2 OH10 SPANS map: urban = 30 percent, rural = 70 percent.

4. Annual urban quadrangles = 100 x 30 percent = 30
   Annual rural quadrangles = 100 x 70 percent = 70

Bureau of Indian Affairs (BIA) (application 01 = resource management)

1. Total coverage is 1,400 quadrangles.
   - Source: PMEA phase 1, interview F29, page 2

2. The annual number of quadrangles is determined by dividing the total of 1,400 by the BIA production cycle of 5 years.
   - 1,400 ÷ 5 = 280

3. All of these quadrangles are rural.
   - Source: PMEA phase 2, interview 85-29-01, item 8

Bureau of Land Management (BLM)

Application 09 (controlling unauthorized use of public lands)

1. BLM manages 342 million acres of public land.
   - Source: PMEA phase 1, interview F30, page 2

   342 million acres equals approximately 9,000 quadrangles.

2. The portion of this land that is in Alaska is equivalent to approximately 1,200 quadrangles.
   - Source: Eyeball estimate from BLM map
   - Total coverage = 9,000 - 1,200 = 7,800

3. BLM would make revisions to about two-thirds of these maps.
   - Source: PMEA phase 2, interview 85-30-09, item 6

   The annual number of quadrangles is the total coverage (7,800 x 2/3) divided by the BLM production cycle of 5 years.
   - 7,800 x 2/3 ÷ 5 = 1,030

4. All of these quadrangles are rural.
   - Source: PMEA phase 2, interview 85-30-09, item 8

Application 50 (environmental impact studies)

1. The annual number of quadrangles is approximately the same as for application 09.

2. The urban and rural mix is based on the mix in BLM SPANS maps in Utah: urban = 1 percent.
   - Source: PMEA phase 2, analysis of UT02 SPANS map
   - 1,560 x 1 percent = 16

   The UT02 SPANS map was used in PMEA phase 2 to calculate benefits for application 50.

National Park Service (application 01 = land use studies)

1. Park Service lands total 76 million acres.
   - Source: PMEA phase 1, interview F34, page 2

   76 million acres equals approximately 2,000 quadrangles.

2. The application requires map coverage that extends beyond the boundaries of the 337 units in the National Park System.
   - Source: PMEA phase 1, interview F34, pages 2 and 3

3. It is assumed that there are approximately 1,000 additional quadrangles around the perimeter.
   - 2,000 + 1000 = 3,000 total quadrangles

4. The annual number of quadrangles is determined by dividing the total of 3,000 by the Park Service production cycle of 10 years.
   - Source: PMEA phase 1, interview F34, page 7, and PMEA phase 2, interview 85-34-01, item 11
   - 3,000 ÷ 10 = 300

5. The urban and rural mix is based upon the mix in Park Service SPANS maps in Florida, Utah, and Oregon.
   - Florida: 42 quadrangles, 11 urban
   - Utah: 61 quadrangles, 0 urban
   - Oregon: 6 quadrangles, 0 urban
   - 11 urban quadrangles ÷ 109 total quadrangles = 10 percent urban

   The FL07, UT04, and ORG4 SPANS maps for the States were used in the PMEA phase 2 to calculate benefits for application 01.

6. Annual urban quadrangles = 300 x 10 percent = 30
   Annual rural quadrangles = 300 x 90 percent = 270

U.S. Customs Service (application 01 = intercept contraband)

1. The Customs Service claims that it neither updates primary map information nor contracts with others to do so. Nonetheless, it has contracted with a number of agencies to update mapping along the Mexican and Canadian borders and along the Florida coasts.
   - Source: PMEA phase 1, interview F44, pages 4 and 6

2. It is assumed that the Customs Service has an average revision effort of 20 quadrangles, 15 percent in urban areas.

Environmental Protection Agency (EPA)

Application 01 (superfund)

1. The application covers the entire Nation.
   - 54,000 quadrangles

2. The urban and rural mix is based on the mix for the entire Nation: urban = 12 percent, rural = 88 percent.

3. Total urban quadrangles = 54,000 x 12 percent = 6,480
   Total rural quadrangles = 54,000 x 88 percent = 47,520

4. EPA revises approximately one-half of these maps.
   - Source: PMEA phase 2, interview 85-45-01, item 6
   - Urban = 6,480 x 1/2 = 3,240
   - Rural = 47,520 x 1/2 = 23,760

5. The annual number of quadrangles is determined by dividing the total by the EPA's production cycles of 5 years in urban areas and 10 years in rural areas.

6. Annual urban quadrangles = 3,240 ÷ 5 = 648
   Annual rural quadrangles = 23,760 ÷ 10 = 2,376

Application 50 (wetlands development)

1. The application covers wetlands, of which there are 99 million acres in the lower 48 States.
   - Source: PMEA phase 2, interview 85-45-50, item 1, and PMEA phase 1, interview F23, page 2

2. EPA revises maps for one-half of the wetlands area.
   - Source: PMEA phase 2, interview 85-45-50, item 6
   - 2,600 x 1/2 = 1,300

3. The annual number of quadrangles is determined by dividing the total of 1,300 by the EPA production cycle of 2 years.
   - 1,300 ÷ 2 = 650

4. Wetlands are primarily rural. It is assumed that 95 percent are rural.

5. Annual urban quadrangles = 650 x 5 percent = 33
   Annual rural quadrangles = 650 x 95 percent = 617

Application 51 (resource conservation recovery)

1. The application covers 3 percent of the maps for the entire Nation.
   - Source: PMEA phase 2, interview 85-45-51, item 6
   - 54,000 x 3 percent = approximately 1,600

2. The annual number of quadrangles is determined by dividing the total of 1,600 by the EPA's production cycle of 5 years.
   - 1,600 ÷ 5 = 320

3. The application is mostly in urban areas.
   - Source: PMEA phase 2, interview 85-45-51, item 6

4. It is assumed that 85 percent are urban.

   Annual urban quadrangles = 320 x 85 percent = 272
   Annual rural quadrangles = 320 x 15 percent = 48

Federal Emergency Management Agency (FEMA) (application 01 = flood insurance study)

1. FEMA prepares 6,000 maps per year.
   - Source: PMEA phase 1, interview F46, page 3

2. The average production cost is about $15,000 per quadrangle.

   This figure is based on the type and extent of updating FEMA said they would do.
   - Source: PMEA phase 2, interview 85-46-01

3. FEMA paid contractors from $20 to $24 million for mapping in a recent year.
   - Source: PMEA phase 1, interview F46, page 4

4. This is an average production cost of around $4,000 per quadrangle.
   - $24 million ÷ 6,000 quadrangles = $4,000 per quadrangle

5. FEMA obtains updated map information from localities whenever possible.
   - Source: PMEA phase 2, interview 85-46-01, item 3

6. It is assumed that FEMA obtains updated map information from localities for about 75 percent of the quadrangles.

This is calculated from the ratio of the two average production cost figures.
- $4,000 ÷ $15,000 = about 1/4

7. The urban and rural mix is determined from the mix for the Nation as a whole: urban = 12 percent, rural = 88 percent.

8. Annual urban quadrangles = 6,000 x 12 percent x 25 percent = 180
Annual rural quadrangles = 6,000 x 88 percent x 25 percent = 1,320

Connecticut (09)

Application 01-01 (base for thematic mapping)

1. Application 01-01 has statewide coverage, plus border quadrangles in adjacent States. Total coverage consists of 117 quadrangles.
   - Source: PMEA phase 2, interview 09-01-01, item 1

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 09-01-01, item 6

3. The urban and rural mix of area coverage is 73 urban quadrangles and 44 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 5 and 10 years respectively.

   Annual urban quadrangles = 73 ÷ 5 = 15
   Annual rural quadrangles = 44 ÷ 10 = 4

Application 07-03 (geologic and soil characteristics)

1. Application 07-03 has statewide coverage consisting of 97 quadrangles.
   - Source: PMEA phase 2, analysis of CNST SPANS map

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 09-07-03, item 6

3. The urban and rural mix of area coverage is 61 urban quadrangles and 36 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 3 and 5 years respectively.

   Annual urban quadrangles = 61 ÷ 3 = 20
   Annual rural quadrangles = 36 ÷ 5 = 7

Application 08-01 (assessment and purchase planning)

1. Application 08-01 is conducted in rural areas statewide. This coverage consists of 36 quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

2. 40 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 09-08-01, item 6

3. Annual number of quadrangles is determined by dividing the total number of quadrangles by the rural production cycle of 8 years.

   Annual rural quadrangles = 36 x 0.4 ÷ 8 = 2

Application 09-04 (tract improvement predesign)

1. Application 09-04 has statewide coverage consisting of 97 quadrangles.
   - Source: PMEA phase 2, analysis of CNST SPANS map

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 09-09-04, item 6

3. The urban and rural mix of area coverage is 61 urban quadrangles and 36 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 5 and 10 years respectively.

   Annual urban quadrangles = 61 ÷ 5 = 12
   Annual rural quadrangles = 36 ÷ 10 = 4

Application 11-50 (wetlands protection)

1. Application 11-50 is conducted in all wetland areas, most of which are rural.
   - Source: PMEA phase 2, interview 09-11-50, items 1 and 10

Total coverage is assumed to be approximately 30 quadrangles.

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 09-11-50, item 6

3. It is estimated that approximately 83 percent of the quadrangles in this application are rural and 17 percent are urban. The resulting urban and rural mix of area coverage is 5 urban quadrangles and 25 rural quadrangles.

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the production cycle of 5 years.

   Annual urban quadrangles = 5 ÷ 5 = 1
   Annual rural quadrangles = 25 ÷ 5 = 5

Application 13-03 (regional and drainage basin analysis)

1. Application 13-03 covers 10 quadrangles in northern Middlesex County.
   - Source: PMEA phase 2, interview 09-13-03, item 1

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 09-13-03, item 6

3. The urban and rural mix of quadrangles is seven urban quadrangles and three rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the production cycle of 5 years.

   Annual urban quadrangles = 7 ÷ 5 = 1
   Annual rural quadrangles = 3 ÷ 5 = 1

Florida (12)

Application 01-02 (land use)

1. Application 01-02 has statewide coverage consisting of 1,022 quadrangles.
   - Source: PMEA phase 2, analysis of FLST SPANS map

2. 70 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 12-01-02, item 6

3. The urban and rural mix of area coverage is 352 urban quadrangles and 670 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the production cycle of 5 years.

   Annual urban quadrangles = 352 x 0.7 ÷ 5 = 49
   Annual rural quadrangles = 670 x 0.7 ÷ 5 = 94

Application 02-01 (base for county transportation map)

1. Application 02-01 requires statewide coverage in all rural areas. This coverage consists of 670 quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

2. 70 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 12-02-01, item 6

3. Annual number of quadrangles is determined by dividing the total number of rural quadrangles by the production cycle of 10 years.

   Annual rural quadrangles = 670 x 0.7 ÷ 10 = 47

Application 03-01 (land acquisition)

1. Application 03-01 covers coastal, historic, park, and forest areas throughout rural Florida. This coverage consists of approximately 127 quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP and FL14 SPANS maps

2. 80 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 12-03-01, item 6

3. Annual number of quadrangles is determined by dividing the total number of rural quadrangles by the production cycle of 7 years.

   Annual rural quadrangles = 127 x 0.8 ÷ 7 = 15

Application 03-50 (land management)

1. Application 03-50 is conducted on public, sovereign, and university lands. This coverage consists of 15 quadrangles, all of which are rural.
   - Source: PMEA phase 2, analysis of NURBCLIP and FL03 SPANS maps

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 12-03-50, item 6

3. Annual number of quadrangles is determined by dividing the total number of rural quadrangles by the production cycle of 5 years.

   Annual rural quadrangles = 15 ÷ 5 = 3

Application 03-51 (land management)

1. Application 03-51 is conducted in all coastal quadrangles. This coverage consists of 447 quadrangles.
   - Source: PMEA phase 2, analysis of FL15 SPANS map

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 12-03-51, item 6

3. The urban and rural mix of area coverage is 207 urban quadrangles and 240 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the production cycle of 5 years.

   Annual urban quadrangles = 207 ÷ 5 = 41
   Annual rural quadrangles = 240 ÷ 5 = 48

Application 05-03 (thematic mapping)

1. Application 05-03 is conducted in the St. John's Water Management District. This coverage consists of 278 quadrangles.
   - Source: PMEA phase 2, analysis of FL02 SPANS map

2. 50 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 12-05-03, item 6

3. The urban and rural mix of area coverage is 139 urban quadrangles and 139 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 4 and 9 years respectively.

   Annual urban quadrangles = 139 x 0.5 ÷ 4 = 17
   Annual rural quadrangles = 139 x 0.5 ÷ 9 = 8

Application 06-03 (digital base)

1. Application 06-03 is conducted in the Suwannee River Water Management District. This coverage consists of 123 quadrangles.
   - Source: PMEA phase 2, analysis of FL12 SPANS map

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 12-06-03, item 6

3. The urban and rural mix of area coverage is 4 urban quadrangles and 119 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 5 and 7 years respectively.

   Annual urban quadrangles = 4 ÷ 5 = 1
   Annual rural quadrangles = 119 ÷ 7 = 17

Application 07-51 (developmental regional impact statements)

1. Application 07-51 is conducted in five counties in central Florida. This coverage consists of 79 quadrangles.
   - Source: PMEA phase 2, analysis of FL01 SPANS map

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 12-07-51, item 6

3. The urban and rural mix of area coverage is 16 urban quadrangles and 63 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 3 and 5 years respectively.

   Annual urban quadrangles = 16 ÷ 3 = 5
   Annual rural quadrangles = 63 ÷ 5 = 13

Application 25-52 (surface water use permitting)

1. Application 25-52 is conducted in the rural areas of the Southwest Florida Water Management District. This coverage consists of 67 quadrangles.
   - Source: PMEA phase 2, analysis of FL05 and NURBCLIP SPANS maps

2. 60 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 12-25-52, item 6

3. Annual number of quadrangles is determined by dividing the total number of rural quadrangles by the production cycle of 4 years.

   Annual rural quadrangles = 67 x 0.6 ÷ 4 = 10

Application 25-53 (land use mapping)

1. Application 25-53 is conducted in the Southwest Florida Water Management District. This coverage consists of 132 quadrangles.
   - Source: PMEA phase 2, analysis of FL05 SPANS map

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 12-25-53, item 6

3. The urban and rural mix of area coverage is 65 urban quadrangles and 67 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the production cycle of 5 years.

   Annual urban quadrangles = 65 ÷ 5 = 13
   Annual rural quadrangles = 67 ÷ 5 = 13

Illinois (17)

Application 07-04 (classifying timber coverage dividing the forest for management)

1. Application 07-04 has statewide coverage consisting of 995 quadrangles.
   - Source: PMEA phase 2, analysis of ILST SPANS map

2. 20 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 17-07-04, item 6

3. The urban and rural mix of area coverage is 297 urban quadrangles and 698 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 4 and 7 years respectively.

   Annual urban quadrangles = 297 x 0.2 ÷ 4 = 15
   Annual rural quadrangles = 698 x 0.2 ÷ 7 = 20

Application 10-02 (sediment studies and develop slope maps)

1. Application 10-02 has statewide coverage consisting of 995 quadrangles.
   - Source: PMEA phase 2, analysis of ILST SPANS map

2. 50 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 17-10-12, item 6

3. The urban and rural mix of area coverage is 297 urban quadrangles and 698 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 5 and 10 years respectively.

   Annual urban quadrangles = 297 x 0.5 ÷ 5 = 30
   Annual rural quadrangles = 698 x 0.5 ÷ 10 = 35

Application 14-01 (plotting known and proposed sanitary landfill sites for evaluation of environmental impact)

1. Application 14-01 has statewide coverage consisting of 995 quadrangles.
   - Source: PMEA phase 2, analysis of ILST SPANS map

2. 25 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 17-14-01, item 6

3. The urban and rural mix of area coverage is 297 urban quadrangles and 698 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the production cycle of 3 years.

   Annual urban quadrangles = 297 x 0.25 ÷ 3 = 25
   Annual rural quadrangles = 698 x 0.25 ÷ 3 = 58

Application 17-01 (general academic uses)

1. Application 17-01 is conducted in the town of Urbana, which consists of one quadrangle.
   - Source: PMEA phase 2, interview 17-17-01, item 1; analysis of ILL8 SPANS map

2. 15 percent of the map is revised for this application.
   - Source: PMEA phase 2, interview 17-17-01, item 6

3. It is assumed that this quadrangle will be revised once every year.

Oregon (41)

Application 02-02 (data for GIS studies)

1. Application 02-02 is conducted in rural areas statewide. This coverage consists of 1,723 quadrangles.
   - Source: PMEA phase 2, analysis of ORST and NURBCLIP SPANS maps

2. 75 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 41-02-02, item 6

3. Annual number of quadrangles is determined by dividing the total number of rural quadrangles by the production cycle of 2 years.

   Annual rural quadrangles = 1723 x 0.75 ÷ 2 = 646

Application 09-01 (base map)

1. Application 09-01 has statewide coverage consisting of 1,830 quadrangles.
   - Source: PMEA phase 2, analysis of ORST SPANS map

2. 75 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 41-09-01, item 6

3. The urban and rural mix of area coverage is 107 urban quadrangles and 1,723 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 2 and 5 years respectively.

   Annual urban quadrangles = 107 x 75 percent ÷ 2 = 40
   Annual rural quadrangles = 1,723 x 75 percent ÷ 5 = 258

Utah (49)

Application 01-01 (source maps for GIS data base)

1. Application 01-01 has statewide coverage consisting of 1,472 quadrangles.
   - Source: PMEA phase 2, analysis of UTST SPANS map

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 49-01-01, item 6

3. The urban and rural mix of area coverage is 79 urban quadrangles and 1,393 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 1 and 5 years respectively.

   Annual urban quadrangles = 79 ÷ 1 = 79
   Annual rural quadrangles = 1,393 ÷ 5 = 279

Application 03-01 (predisaster mitigation)

1. Application 03-01 covers 18 quadrangles containing population centers along the Wasatch Front.
   - Source: PMEA phase 2, interview 49-03-01, analysis of UT08 SPANS map

2. 90 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 49-03-01, item 6

3. The urban and rural mix of area coverage is 17 urban quadrangles and 1 rural quadrangle.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 1 and 5 years respectively.

   Annual urban quadrangles = 17 x 0.9 ÷ 1 = 8
   Annual rural quadrangles : It is assumed that the one rural quadrangle in this application would be revised once per year

Application 06-03 (natural resource development)

1. Application 06-03 has statewide coverage consisting of 188 quadrangles.
   - Source: PMEA phase 2, analysis of UT12 SPANS map

2. 65 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 49-06-03, item 6

3. The urban and rural mix of area coverage is 37 urban quadrangles and 151 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 3 and 7 years respectively.

   Annual urban quadrangles = 37 x 65 percent ÷ 3 = 8
   Annual rural quadrangles = 151 x 65 percent ÷ 7 = 14

Application 07-01 (historical and geographic names research)

1. Application 07-01 has statewide coverage consisting of 1,472 quadrangles.
   - Source: PMEA phase 2, analysis of UTST SPANS map

2. 75 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 49-07-01, item 6

3. The urban and rural mix of area coverage is 79 urban quadrangles and 1,393 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the urban and rural production cycles of 1 and 5 years respectively.

   Annual urban quadrangles = 79 x 75 percent ÷ 1 = 59
   Annual rural quadrangles = 1,393 x 75 percent ÷ 5 = 209

Application 10-01 (mapping cities, counties, and highways)

1. Application 10-01 has statewide coverage consisting of 1,472 quadrangles.
   - Source: PMEA phase 2, analysis of UTST SPANS map

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 49-10-01, item 6

3. The urban and rural mix of area coverage is 79 urban quadrangles and 1,393 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the production cycle of 1 year.

   Annual urban quadrangles = 79 ÷ 1 = 79
   Annual rural quadrangles = 1,393 ÷ 1 = 1,393

Application 11-01 (detailed engineering design for water projects)

1. Application 11-01 has statewide coverage consisting of 1,472 quadrangles.
   - Source: PMEA phase 2, analysis of UTST SPANS map

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 49-11-01, item 6

3. The urban and rural mix of area coverage is 79 urban quadrangles and 1,393 rural quadrangles.
   - Source: PMEA phase 2, analysis of NURBCLIP SPANS map

4. Annual number of quadrangles is determined by dividing the total number of urban and rural quadrangles by the production cycle of 5 years.

   Annual urban quadrangles = 79 ÷ 5 = 16
   Annual rural quadrangles = 1,393 ÷ 5 = 279

Application 16-01 (surveying and engineering base map for geodetic control information, location, and plotting)

1. Application 16-01 covers Salt Lake County, which consists of 14 quadrangles, all of which are urban.
   - Source: PMEA phase 2, interview 49-16-01, UT11 SPANS map

2. 100 percent of the maps are revised for this application.
   - Source: PMEA phase 2, interview 49-16-01, item 6

3. Annual number of quadrangles is determined by dividing the total number of urban quadrangles by the production cycle of 2 years.

   Annual urban quadrangles = 14 ÷ 2 = 7

Appendix C

Single Decision Unit Case

Total Production Requirement for Federal and State Governments as a Single Decision Unit

1. Overview Of Approach

The total production requirement when the entire Federal and State Government system is treated as a single decision unit is developed in a three-step process.

a. First determine the potential for coordination of mapping requirements among the 50 State governments.

b. Then determine the potential for coordination among the 18 Federal agencies.

c. Finally, determine the potential for coordination between the States and the Federal Government.

2. Coordination Among State Governments

There is little likelihood that significant coordination of mapping requirements can take place among the 50 States. The great majority of State applications fall entirely within the boundaries of an individual State. With the minor exception of quadrangles that overlap State boundaries, even adjacent States simply have no common requirements to coordinate. None of the PMEA interviews with State agencies make any mention of interstate coordination of mapping.

If there are no overlapping requirements among the 50 States, then the total production requirement is the same whether the States are considered a single decision unit or 50 separate decision units. As a conservative estimate, it is assumed that there is 10-percent overlap in requirements. This means that cost savings for the States are 10 percent smaller when the States are a single decision unit.

3. Coordination Among Federal Agencies

The tables below lists relevant information about the urban and rural applications used to calculate cost savings when each Federal agency is treated as a separate decision unit.

Urban Applications

Agency	Appl. no.	Area of coverage	Features needed	Age of info. (years)	Collection method
USFS	01-05	Nat. forests and vicinity	a,b,c,d,e,g	1-3	Aerial/field (NMAS)
NASS	05-01	Nationwide	a,c,e,f,g,h	10	Aerial
SCS	06-02	Nationwide (20-30%)	a,c,g	5-10	Aerial/field
Census	11-01	Nationwide	a,c,d,g	2	Field survey
NOS/FAA	12-01	Around airports	a,b,e,h	5	Aerial (NMAS)
NGS	15-01	Nationwide	a,b,h	4	Field survey (NMAS)
COE	16-02	Nationwide	all	5	Aerial/field (NMAS)
	18-01	Rivers and coastal	a,c,d,e,g	1	Aerial/field
	18-02	Lower Miss. valley	all	5	Aerial/field (NMAS)
	19-01	Near COE installations	all	8	Aerial/field
DMA	20-01	Nationwide	all	10	Aerial (NMAS)
FWS	23-76	Upper Miss/Ohio R.	all ex. b	3	Aerial/field
BLM	30-50	Public lands	a,b,c,d,e,g	2	Do.
NPS	34-01	Nat. park lands and vicinity	all ex. b	5	Do.
Customs	44-01	Borders and airports	a,b,c,d,e,g	6	Do.
EPA	45-01	Nationwide	a,c,e	5	Do.
	45-50	Wetlands	a,c,e,g,h	2	Do.
	45-51	Nationwide	a,c,d,e,g	5	Aerial/field (NMAS*)
FEMA	46-01	Flood-prone areas	all	1	Do.

* = Less than national map accuracy standards, more than casual quality

Rural Applications

Agency	Appl. no.	Area of coverage	Features needed	Age of info. (years)	Collection method
USFS	01-05	Nat. forests and vicinity	a,b,c,d,e,g	5-7	Aerial/field (NMAS)
NASS	05-01	Nationwide	a,c,e,f,g,h	20	Aerial
SCS	06-02	Nationwide (20-30%)	a,c,g	10-20	Aerial/field
	06-04	Nationwide (60%)	all	5	Field survey
Census	11-01	Nationwide	a,c,d,g	3	Do.
NOS/FAA	12-01	Around airports	a,b,e,h	5	Aerial (NMAS)
NGS	15-01	Nationwide	a,b,h	10	Field survey (NMAS)
COE	16-02	Nationwide	all	10	Aerial/field (NMAS)
	18-01	Rivers and coastal	a,c,d,e,g	1	Aerial/field
	18-02	Lower Miss. valley	all	10	Aerial/field (NMAS)
	19-01	Near COE installations	all	10	Aerial/field
DMA	20-01	Nationwide	all	15	Aerial (NMAS)
FWS	23-01	National wetlands	all ex. b	5	Aerial/field
	23-03	Nationwide	all ex. b	5	Do.
	23-05	Nat. wildlife refuges	all	5	Do.
	23-75	Nationwide	all ex. b	3	Do.
	23-76	Upper Miss/Ohio R.	all ex. b	3	Do.
BIA	29-01	Indian reservations	all	5	Aerial
BLM	30-09	Public lands	all	5	Aerial/field (NMAS)
NPS	34-01	Nat. park lands and vicinity	all ex. b	10	Aerial/field
Customs	44-01	Borders and airports	a,b,c,d,e,g	10	Do.
EPA	45-01	Nationwide	a,c,e	10	Do.
	45-50	Wetlands	a,c,e,g,h	2	Do.
	45-51	Nationwide	a,c,d,e,g	10	Aerial/field (NMAS*)
FEMA	46-01	Flood-prone areas	all	5	Do.

* = Less than national map accuracy standards, more than casual quality

For urban applications:

a. FEMA has the most comprehensive need for information at national map accuracy standards.

b. The needs of COE (application 16-02) and NOS are partly met by the FEMA data.

c. The need of EPA (application 45-51) is mostly met by the FEMA, COE, and NOS data.

d. Needs for information at national map accuracy standards for all other applications are fully met by the FEMA, COE, NOS, and EPA data.

e. Needs for lower quality information for BLM, Census, NPS, EPA (application 45-01), and SCS are mostly met by the FEMA, COE, NOS, and EPA data.

f. Needs for lower quality information for all other applications are fully met by the previously counted applications.

Cost savings for urban applications are calculated from:

FEMA	=	100 percent
COE 16-02	=	50 percent
NOS/FAA	=	50 percent
EPA 45-51	=	10 percent
Census	=	25 percent
BLM	=	10 percent
NPS	=	10 percent
EPA 45-01	=	10 percent
SCS	=	10 percent

For rural applications:

a. FEMA has the most comprehensive need for informational national map accuracy standards.

b. The needs of BLM, USFS, COE (application 16-02), EPA (application 45-51), NOS, and NGS are partly met by the FEMA data.

c. Needs for information at national map accuracy standards for all other applications are fully met by the previously counted applications.

d. Needs for lower quality information for COE (application 18-01), EPA (application 45-50), Census, FWS (application 23-75), SCS (application 06-04), and BIA are partly met by the previously counted applications.

e. Needs for lower quality information for all other applications are fully met by the previously counted applications.

Cost savings for rural applications are calculated from:

FEMA	=	100 percent
BLM 30-09	=	30 percent
USFS	=	40 percent
NGS	=	30 percent
COE 16-02	=	15 percent
EPA 45-51	=	15 percent
NOS/FAA	=	15 percent
COE 18-01	=	20 percent
EPA 45-50	=	20 percent
Census	=	20 percent
FWS 23-75	=	20 percent
SCS 06-04	=	10 percent
BIA	=	10 percent

4. Coordination Between State And Federal Governments

The table below summarizes the extent of map revision requirements of the five sample States.

State	Age of Info (years)	
	Urban	Rural
Connecticut	5	10
Florida	5	10
Illinois	5	10
Oregon	2	5
Utah	5	5

All requirements are statewide, are for most features, and are at or near national map accuracy standards.

There are significant overlapping requirements between the States and the Federal agencies as a single decision unit.

For urban applications:

a. The needs of COE, NOS/FAA, EPA, NPS, and SCS are fully met by the State data.

b. The needs of FEMA, Census, and BLM are partly met by the State data.

In addition to the State applications, cost savings for urban applications are calculated from:

FEMA	=	25 percent
Census	=	10 percent
BLM	=	5 percent

For rural applications:

a. The needs of NGS, COE (application 16-02), and EPA (application 45-51) are fully met by the State data.

b. The needs of all other Federal applications are partly met by the State data.

In addition to the State applications, cost savings for rural applications are calculated from:

FEMA	=	25 percent
BLM 30-09	=	10 percent
USFS	=	10 percent
NOS/FAA	=	5 percent
COE 18-01	=	15 percent
EPA 45-50	=	15 percent
Census	=	10 percent
FWS	=	10 percent
SCS 06-04	=	5 percent
BIA	=	5 percent

5. Quality Assurance On Results

To verify the reasonableness of this estimate, the total production requirement was also generated using an alternate method. The primary method attempts to identify the particular applications with the most comprehensive information needs. The alternate method attempts to identify the minimum production level that satisfies all

applications. This level does not exactly match any one particular application. Benefit figures are generated for this fictional production level and are used to estimate cost savings.

The two different methods yield very similar estimates of total cost savings.

a. For Federal agencies as a single decision unit

The alternate method assumes the following production level:

To meet urban applications:

(1) Basic program is a 10-year cycle using aerial photographs and field surveys to produce information at national map accuracy standards.

(2) More current information at national map accuracy standards is provided by aerial photographs on a 5-year cycle.

(3) More current lower quality information for some features (transportation, hydrography, boundaries, buildings, and names) is provided on a 2-year cycle.

To meet rural applications:

(1) Basic program is a 10-year cycle using aerial photographs and field surveys to produce information at national map accuracy standards.

(2) More current lower quality information is provided on a 5-year cycle.

(3) Only one-half of the rural quadrangles are revised during a cycle.

Federal agencies	Cost savings		Total
	Urban quads	Rural quads	cost savings
Primary method	14,184,724	14,972,356	29,157,079
Alternate method	7,692,408	27,054,000	4,746,408

b. For Federal and State Governments as a single decision unit

The alternate method assumes the following production level:

To meet urban applications:

(1) Basic program is a 5-year cycle using aerial photographs and field surveys

to produce information at national map accuracy standards.

(2) More current lower quality information for some features (transportation, hydrography, boundaries, buildings, and names) is provided on a 2-year cycle.

To meet rural applications:

(1) Basic program is a 10-year cycle using aerial photographs and field surveys to produce information at national map accuracy standards.

(2) More current information at national map accuracy standards is provided by aerial photographs on a 5-year cycle.

(3) Only one-half of the rural quadrangles are revised during a cycle.

Federal agencies	Cost savings		Total
	Urban quads	Rural quads	cost savings
Primary method	12,642,987	36,677,578	49,320,564
Alternate method	22,583,448	31,717,730	54,301,178

Appendix D

Cost Savings Calculations

How to read the calculations:

1. "Production costs" and "Needed cycle" are determined from the PMEA phase 2 questionnaires.

2. "Benefits of USGS Cycle" are determined from the production cost (PC) and needed cycle (NC) according to the following formulas:

   5-year benefit = (PC x NC) ÷ 5

   10-year benefit = (PC x NC) ÷ 10

   11-year benefit = (PC x NC) ÷ 11

   26-year benefit = (PC x NC) ÷ 26

   With the condition that the benefit not exceed the production cost.

3. "Pct. factor" is the percent of the application that is included in the total production requirement for the decision unit. Appendix A documents how the percent factors were determined.

4. "Quads per year" is the number of quadrangles that need to be revised each year to satisfy the requirements of the application. Appendix B documents how the quadrangles per year were determined.

5. For urban quadrangles, cost savings are calculated by the following formula:

   Cost savings = (5-year benefit - 10-year benefit)
   x pct. factor x quads per year

   For rural quadrangles, cost savings are calculated by the following formula:

   Cost savings = (11-year benefit - 26-year benefit)
   x pct. factor x quads per year

Federal Agencies - Urban Quadrangles

Appl. no.	Prod. cost	Needed cycle	Benefits of: 5-year	Benefits of: 10-year	Pct. factor	Quads per year	Cost savings
01-05	28,405	3	17,043	8,522	1	21	178,952
05-01	2,445	10	2,445	2,445	1	480	0
06-02	2,185	8	2,185	1,748	1	240	104,880
11-01	1,895	2	758	379	1	648	245,592
12-01	12,650	5	12,650	6,325	1	1,664	10,524,800
15-01	5,000	4	4,000	2,000	1	324	648,000
16-02	23,310	5	23,310	11,655	.5	1,400	8,158,500
18-01	5,085	1	1,017	509	1	2,625	1,334,813
18-02	32,845	5	32,845	16,423	1	24	394,140
19-01	6,275	10	6,275	6,275	.25	385	0
23-01	5,840	5	5,840	2,920	.75	6	13,140
23-76	5,840	3	3,504	1,752	.75	30	39,420
30-50	28,405	2	11,362	5,681	1	16	90,896
34-01	5,840	5	5,840	2,920	1	30	87,600
44-01	3,715	6	3,715	2,229	1	3	4,458
45-01	3,525	5	3,525	1,763	.75	648	856,575
45-50	5,375	2	2,150	1,075	1	33	35,475
45-51	10,455	5	10,455	5,228	1	272	1,421,880
46-01	23,205	1	4,641	2,321	1	180	417,690
						Total	124,556,810

Federal Agencies - Rural Quadrangles

Appl. no.	Prod. cost	Needed cycle	Benefits of: 11-year	Benefits of: 26-year	Pct. factor	Quads per year	Cost savings
01-05	16,320	7	10,385	4,394	1	1,407	8,430,193
05-01	1,510	20	1,510	1,162	1	3,520	1,226,585
06-02	1,565	15	1,565	903	1	1,760	1,165,323
06-04	2,195	5	998	422	.5	4,212	1,212,239
11-01	1,275	3	348	147	1	4,752	953,308
12-01	6,480	5	2,945	1,246	1	1,536	2,610,126
15-01	2,455	10	2,232	944	1	2,376	3,059,308
16-02	13,990	10	12,718	5,381	.5	2,600	9,538,636
18-01	3,160	1	287	122	1	4,875	807,955
18-02	19,780	10	17,982	7,608	1	46	477,210
19-01	3,860	10	3,509	1,485	.25	3,115	1,576,560
20-01	11,795	15	11,795	6,805	1	2,376	11,856,697
23-01	3,650	5	1,659	702	.75	124	89,017
23-03	3,650	5	1,659	702	.75	2,350	1,687,008
23-05	7,720	5	3,509	1,485	.75	34	51,624
23-75	3,650	3	995	421	.75	2,350	1,012,205
23-76	3,650	3	995	421	.75	70	30,151
29-01	1,805	5	820	347	1	280	132,535
30-09	19,780	5	8,991	3,804	1	1,030	5,342,675
34-01	3,650	10	3,318	1,404	1	270	516,871
44-01	2,460	10	2,236	946	1	17	21,934
45-01	2,210	10	2,009	850	.75	2,376	2,065,500
45-50	3,185	2	579	245	1	617	206,134
45-51	6,338	10	5,762	2,438	1	48	159,558
46-01	14,108	5	6,413	2,713	1	1,320	4,883,538
						Total	59,112,887

State Governments - Urban Quadrangles

Appl. no.	Prod. cost	Needed cycle	Benefits of: 5-year	Benefits of: 10-year	Pct. factor	Quads per year	Cost savings
09-01-01	22,050	5	22,050	11,025	0.05	15	8,269
09-07-03	23,300	3	13,980	6,990	.2	20	27,960
09-08-01	21,910	0	0	0	.05	0	0
09-09-04	30,345	5	30,345	15,173	1	12	182,070
09-11-50	10,425	5	10,425	5,213	.1	1	521
09-13-03	21,910	5	21,910	10,955	.1	1	1,096
12-01-02	14,475	5	14,475	7,238	.5	49	177,319
12-02-01	27,510	0	0	0	.5	0	0
12-03-01	15,810	0	0	0	.05	0	0
12-03-50	8,530	0	0	0	.1	0	0
12-03-51	12,275	5	12,275	6,138	.1	41	25,164
12-05-03	20,005	4	16,004	8,002	.05	17	6,802
12-06-03	13,705	5	13,705	6,853	.05	1	343
12-07-51	4,170	3	2,502	1,251	.15	5	938
12-25-52	15,000	0	0	0	.12	0	0
12-25-53	10,560	5	10,560	4,680	.1	13	7,644
17-07-04	9,115	4	7,292	3,646	.25	15	13,673
17-10-02	23,440	5	23,440	11,720	1	30	351,600
17-14-01	7,350	3	4,410	2,205	.2	25	11,025
17-17-01	2,075	5	2,075	1,038	.05	1	52
41-02-02	2,695	0	0	0	.05	0	0
41-09-01	32,845	2	13,138	6,569	1	40	262,760
49-01-01	2,555	1	511	256	.2	79	4,037
49-03-01	10,240	2	4,096	2,048	.2	8	3,277
49-06-03	31,045	3	18,627	9,314	.1	8	7,451
49-07-01	3,070	1	614	307	.2	59	3,623
49-10-01	7,530	1	1,506	753	.4	79	23,795
49-11-01	32,845	5	32,845	16,423	1	16	262,760
49-16-01	15,845	2	6,338	3,169	.35	7	7,764
						Total	1,389,940

State Governments - Rural Quadrangles

Appl. no.	Prod. cost	Needed cycle	Benefits of: 11-year	Benefits of: 26-year	Pct. factor	Quads per year	Cost savings
09-01-01	12,730	10	11,573	4,896	0.05	4	1,335
09-07-03	12,855	5	5,843	2,472	.2	7	4,719
09-08-01	12,590	8	9,156	3,874	.05	2	528
09-09-04	17,280	10	15,709	6,646	1	10	90,629
09-11-50	6,985	5	3,175	1,343	.1	5	916
09-13-03	12,590	5	5,723	2,421	.1	1	330
12-10-02	9,300	5	4,227	1,788	.5	94	114,624
12-02-01	17,175	10	15,614	6,606	.5	47	211,685
12-03-01	9,650	7	6,141	2,598	.05	15	2,657
12-03-50	6,085	5	2,766	1,170	.1	3	479
12-03-51	8,215	5	3,734	1,580	.1	48	10,341
12-05-03	13,510	9	11,054	4,677	.05	8	2,551
12-06-03	8,575	7	5,457	2,309	.05	17	2,676
12-07-51	2,785	5	1,266	536	.15	13	1,424
12-25-52	11,125	4	4,045	1,712	.12	10	2,801
12-25-53	7,665	5	3,484	1,474	.1	13	2,613
17-07-04	5,700	7	3,627	1,535	.25	20	10,463
17-10-02	12,995	10	11,814	4,998	1	35	238,545
17-14-01	4,805	3	1,310	554	.2	58	8,770
17-17-01	1,275	13	1,275	638	.05	0	0
41-02-02	1,665	2	303	128	.05	646	5,641
41-09-01	19,780	5	8,991	3,804	1	258	1,338,262
49-01-01	1,525	5	693	293	.2	279	22,315
49-03-01	6,870	5	3,123	1,321	.2	1	360
49-06-03	18,960	7	12,065	5,105	.1	14	9,745
49-07-01	1,945	5	884	374	.2	209	21,320
49-10-01	5,560	1	505	214	.4	1,393	162,484
49-11-01	19,780	5	8,991	3,804	1	279	1,447,191
49-16-01	10,220	2	1,858	786	.35	0	0
						Total	3,715,405

Single Decision Unit Case - Urban Quadrangles

Appl. no.	Prod. cost	Needed cycle	Benefits of: 5-year	Benefits of: 10-year	Pct. factor	Quads per year	Cost savings
11-01	1,895	2	758	379	0.1	648	24,559
30-50	28,405	2	11,362	5,681	.05	16	4,545
46-01	23,205	1	4,641	2,321	.25	180	104,423
States							12,509,460
						Total	12,642,987

Single Decision Unit Case - Rural Quadrangles

Appl. no.	Prod. cost	Needed cycle	Benefits of: 11-year	Benefits of: 26-year	Pct. factor	Quads per year	Cost savings
01-05	16,320	7	10,385	4,394	0.1	1,407	843,019
06-04	2,195	5	998	422	.05	4,212	121,224
11-01	1,275	3	348	147	.1	4,752	95,331
12-01	6,480	5	2,945	1,246	.05	1,536	130,506
18-01	3,160	1	287	122	.15	4,875	121,193
23-75	3,650	3	995	421	.1	2,350	134,961
29-01	1,805	5	820	347	.05	280	6,627
30-09	19,780	5	8,991	3,804	.1	1,030	534,267
45-50	3,185	2	579	245	.15	617	30,920
46-01	14,108	5	6,413	2,713	.25	1,320	1,220,885
States							33,438,645
						Total	36,677,578