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The Role of NOAA in a Multipurpose Cadastre

Michael J. Kevany

National Geodetic Survey

Rockville, Md.

June 1984

U. S. DEPARTMENT OF COMMERCE

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EXECUTIVE SUMMARY

Although the concept of a multipurpose cadastre was developed years ago, it has only recently gained popularity and momentum as computer systems and space-age technologies now make implementation practical. Escalating costs of locating land data and archiving land-related information within a multiplicity of antiquated files have generated pressure to adopt a modern, unified, land information system. Many local governments still rely on poorly constructed maps, while others use inconsistently related maps. In some areas, maps are nonexistent. The concept of a multipurpose cadastre is proposed as a solution to this problem. One of the basic requirements for such a cadastre is compatibility, achievable through the mechanism of a geodetic reference system. It is this need for nationwide geodetic control, already established and maintained by the National Oceanic and Atmospheric Administration (NOAA) through the National Geodetic Reference System (NGRS), that uniquely qualifies NOAA to play a major role in this program.

The National Academy of Sciences (NAS) evaluated the concepts, techniques, and value of the multipurpose cadastre, and in resulting reports recommended several activities for which NOAA has responsibility. Persons involved in the preparation of those reports briefed the NOAA Administrator on the multipurpose cadastre and the NAS recommendations, and encouraged NOAA activity in this area. The Administrator requested a review and recommendations for NOAA's roles. This report furnishes the requested information. Based on a study of potential NOAA roles, it begins with a review of the multipurpose cadastre requirements. The review identifies five requirement areas including: products, standards and procedures, technical assistance and guidance, funding, and coordination and enforcement. The sources of these requirements are identified as local governments, State governments, utilities, and professional organizations.

The report summarizes NOAA resources and current programs that relate to the multipurpose cadastre. The legislative and administrative basis for NOAA operations, the infrastructural reference systems, and the data bases currently maintained by NOAA are also discussed.

Since the development of a multipurpose cadastre will be a joint effort among many public and private organizations, the study identifies the organizations involved, and reviews the potential roles and relationships among them. These relationships are important in defining NOAA's roles and maximizing the mutual benefit from these efforts.

Based on the analyses and evaluations of the study, the report lists recommendations for a NOAA objective regarding the multipurpose cadastre and assigns roles. The recommended objective is to support the multipurpose cadastre concept and development of a national Survey Information Network (SIN). This objective is translated into a series of functional roles which are, in turn, subdivided into further specific roles. The functional roles include performing activities to accomplish the NOAA objectives, coordination with other organizations, development of multipurpose cadastre activities, and training. In addition, the report recommends establishment of a NOAA

Multipurpose Cadastre Program through which various activities would be executed, coordinated, and controlled.

The roles include development of SIN, development of plane and geodetic survey standards and specifications, and support for the conduct of geodetic surveys. The proposed information system would be built around the NGRS, but would be expanded to incorporate all survey data required for the multipurpose cadastre. SIN would be based on a distributed network of data bases maintained by the National Geodetic Survey (NGS), States, local governments, and others. Individual data bases would be designed to incorporate standards for compatibility and linked through a communications network. Each would be operated and supported by the responsible organization.

The full implementation of the identified NOAA multipurpose cadastre roles will require extensive resources and will take many years to accomplish. The proposed approach to implementation of a NOAA multipurpose cadastre program begins with existing resources, adds limited resources quickly, and includes a new initiative for significant funding to carry out the bulk of the program in future years.

In the first phase, existing NOAA resources will be focused on multipurpose cadastre development. In this phase NOAA's intention to participate in the multipurpose cadastre will be stated, initial resources will be committed to the venture, initial prototype activities will be accomplished, and the multipurpose cadastre will be publicized. Funding for this phase will be identified within the Office of Charting and Geodetic Services from among existing activities. The level of funding will be approximately \$100,000, and the phase will last about 3 to 6 months.

In the second phase, which will follow as soon as practical, Phase I activities will be augmented with interim NOAA discretionary funding of about \$300,000. These funds will be allocated to support a multipurpose cadastre coordinator and other staff time, travel for technical assistance and promotion of multipurpose cadastre activities, and execution of a project to serve as an initial prototype. Phase II will last 1 year or until funding for the new initiative becomes available.

The third phase will be supported by funding from a new initiative, and will be the first substantial effort directed at the multipurpose cadastre. It will include multiple activities extending the NOAA role into a full program. In the initiative technical assistance, training, data base development, and full prototype projects will be performed. As initial activities are completed, this phase will continue with ongoing support for the multipurpose cadastre including completion and maintenance of the data base, continued training and technical assistance, distribution of products, and research and development on important issues.

Funding for this full NOAA multipurpose cadastre program should be \$7-8 million annually. NAS has recommended that the Federal Government budget \$90 million annually, or 40 percent of the funding required to accomplish the objectives of the multipurpose cadastre. Conservatively, NOAA's portion of this responsibility is at least 8-10 percent of the Federal total, or \$7-8 million.

The need for a multipurpose cadastre has become irrefutable. So, too, has the requirement for a common, nationwide, spatial reference system for the unambiguous positioning and linking of all components. It is also universally agreed that the existing NGRS, which can be selectively extended to adequate control-point densities, is ideally suited for this purpose. Some of the major questions remaining are how to effect the required network densification, who should assume the leadership and coordination role, and how should NOAA participate. This study attempts to answer these questions. Without answers to these questions, the vitally needed multipurpose cadastre may never become a reality or, perhaps even worse, may become merely a computerized perpetuation of the patchwork of land records existing today.

ABSTRACT

This study contains a proposal for a Federal multipurpose cadastre, with the National Oceanic and Atmospheric Administration (NOAA) as the lead agency responsible for its development. Chapter I provides background information on the proposed cadastre. Chapter II describes and categories the requirements of NOAA and other Federal organizations, including products, services, and resources needed to develop and maintain the cadastre that may be provided by Federal organizations. Chapter III recommends specific roles for NOAA in developing and maintaining the cadastre, based on an analysis of the requirements, NOAA's resources and responsibilities, and potential roles of related organizations. The NOAA roles are divided into: horizontal and vertical control; technical assistance; standards, specifications, and procedures; guidance and training; publications; research and development; technology transfer; funding; coordination and enforcement; and internal administration. Chapter IV identifies non-NOAA organizations with a relationship, or a potential role, in the multipurpose cadastre. Chapter V contains an implementation plan for establishing and executing the recommended NOAA roles.

I. INTRODUCTION

A. The Multipurpose Cadastre

Over the past two decades a growing interest has emerged in improving land records and land information systems in the United States. Throughout the country there is a recognition that current land information records are in disarray. The methods of collecting, storing, and disseminating data are antiquated and extremely inefficient. As land values have skyrocketed, the availability of accurate land information on a timely basis has become increasingly important. The costs of storing and maintaining data with current methods have also dramatically increased. Governments can no longer afford to carry the burden of redundant and inefficient operations. A solution to the dilemma rests in improving land records and mapping systems and making multiple use of the data which is acquired. This solution is imbedded in the concept of the multipurpose cadastre.

The definition of the term "cadastre" is "an official register of the quantity, value, and ownership of real estate used in apportioning taxes." A multipurpose cadastre is an extension of this definition to encompass both additional contents and a wider variety of usage which includes juridical, fiscal, environmental (physical), and statistical cadastres, each with geographic locations and parcel identifiers. A multipurpose cadastre has four major components. The first is a homogeneous, nationwide reference system comprised of horizontal and vertical geodetic control points. The second involves a series of large scale topographic base maps controlled by the geodetic reference networks. The third is a series of land information and cadastral overlays, keyed to the base maps, delineating individual land parcels. And the fourth includes a series of registers or land data files that are linked to the map overlays and the geodetic reference system by means of unique geocoded parcel identifiers.

Most proposals for establishing multipurpose cadastres advocate incorporating of existing land data systems whenever possible to minimize expense and disruption inherent in the creation of entirely new systems. In many cases, this can be accomplished by such steps as adding parcel geocodes to existing files to provide a common linkage between files; tying local land survey systems to the national geodetic reference system; and either recasting existing map sheets to a common reference system or performing new mapping using uniform standards and specifications.

There is such a wide disparity in the quality and adequacy of existing land data systems. Requirements for land data in urban, suburban, and rural areas differ so greatly, that determinations of how best to upgrade these systems and integrate them into a modern multipurpose system must be made on a case-by-case basis. Whatever methods are selected, however, multipurpose usefulness requires adherence to a uniform set of standards and specifications in geopositioning, mapping, and parcel identification. This does not mean, for instance, that all coordinate systems, map formats, and geocodes must be identical. It simply means that the surveying and mapping methods used should meet minimum standards of accuracy to ensure that land parcels are unambiguously related to the uniform reference system. The choice of coordinate

types (Cartesian, ellipsoidal, local, national, etc.) is then of no great concern because each can be transformed into any other system.

Although there is widespread agreement among creators and users of land data on the desirability of multipurpose cadastres, overall progress has been slow. There are many reasons for this lack of progress. One is the cost of modernizing land data systems. Every jurisdiction is pressed for funds, with some, especially the less populated, more in need than others. The fact that the cost of modern systems can be amortized over time by the savings accrued from eliminating waste and inefficiency is not sufficient reason for communities which cannot raise the needed capital to avoid creating a cadastre. Other sources of funds will probably be required.

Another reason for the inertia is that the roles of the various creators and users have either been poorly defined, or that proposed rules have not been universally accepted. We know what the land data needs are at each level of government and the private sector. We also know the present roles of the participants and what products are being produced. But how to integrate these efforts into an acceptable hierarchy, with each party making its proper contribution, and how to achieve public acceptance and legislative support, have thus far eluded us.

Perhaps the most important reason for slow progress is the lack of a single national coordinating effort. In recognition of this need, the U.S. Congress introduced legislation in both the House and the Senate, in the form of a rider on a Public Lands Survey Bill, calling for the Departments of Commerce, Agriculture and Interior to conduct a feasibility study for a national multipurpose cadastre. The bill failed to get out of committee on the first attempt, but has recently been reintroduced.

B. Background

Considerable research, discussion, and planning have transpired over the past several years regarding the multipurpose cadastre. Several major conferences have been held on this topic, or its specific components, and publications have been produced based on these meetings and their findings. Some of the key meetings which have resulted in important documents include the following:

- Comprehensive Unified Land Data System (CULDATA), December 1966
- Compatible Land Identifiers--the Problems, Prospects, and Payoffs (CLIPP), 1972
- North American Conference on Modernization of Land Data Systems (A Multipurpose Approach) (MOLDS), 1975
- Land Records Symposia of the University of Maine, 1976 and 1982
- Joint ASP/ACSM Symposium on Modern Land Data Systems, 1977
- Second MOLDS Conference, 1978
- Specialty Conference on Planning and Engineering Interface with a Modernized Land Data System, 1980.

During this time MOLDS was organized into a formal organization, holding meetings and disseminating information on a periodic basis. The National

Academy of Sciences' (NAS) Committee on Geodesy formed a Panel on a Multipurpose Cadastre. This panel conducted extensive investigations into the subject of a multipurpose cadastre and published two comprehensive reports; Need for a Multipurpose Cadastre (NAS 1980) and the Procedures and Standards for a Multipurpose Cadastre (NAS 1983). These reports enumerate technical and administrative issues related to the multipurpose cadastre. It is on the basis of these recommendations that the present study was conducted.

The National Geodetic Survey (NGS) a division within the National Oceanic and Atmospheric Administration (NOAA), will assume major responsibility for the development of multipurpose cadastral files. NOAA is mandated by law to establish and maintain national networks of horizontal and vertical geodetic control that form the primary reference system for all surveying, mapping, and multipurpose cadastral activities in the United States. In addition to creating and maintaining the primary control networks, NGS works with other Federal, State, and local agencies through cooperative agreements and reimbursable projects to create secondary control densification networks, which are fundamental to the creation of cadastral files. As the Nation's primary geodetic agency, NGS also conducts research, provides guidance, and conducts special-purpose, ultraprecise surveys. NGS also coordinates activities of the Federal Geodetic Control Committee (FGCC), which is responsible for the promulgation of geodetic surveying specifications and standards, research and development, information dissemination, and Federal coordination of geodetic surveying and related activities conducted in whole or in part with Federal funds.

NOAA's responsibility relative to the multipurpose cadastre clearly extends beyond simply providing the primary reference system of geodetic control. For more than a decade, in recognition of this need and responsibility, three consecutive directors and a number of other NGS employees have actively participated in the continuing dialogue on multipurpose cadastral files at symposia and conferences. NGS was one of the founders of the North American Institute for Modernization of Land Data Systems, with a former NGS director serving as the first MOLDS president. Consistent with OMB Circular A-16 direction, NGS policy provides for the transformation of local coordinate systems to National Geodetic Reference System (NGRS) coordinates so that multipurpose usage can be effected by any user, public or private.

C. Purpose and Scope of the Study

This study was undertaken to define NOAA's role in developing a nationwide multipurpose cadastre, authorized in response to the recommendations of the National Academy of Sciences (1980, 1983) regarding the key role of the NGS in providing the necessary geodetic reference framework for the multipurpose cadastre. NOAA and its representatives have been active in prior considerations of the multipurpose cadastre, but to date no specific role has been established for NOAA in this field. This study undertook an analysis of the requirements for products, services, and support that the multipurpose cadastre will generate, and compared those requirements with NOAA's current operations, products, and resources and its overall mission and responsibilities. Since the multipurpose cadastre will realistically be developed through the joint effort of many organizations, the study also identified related organizations, and evaluated their current and potential roles relative to NOAA.

This study draws heavily on the documented efforts of the NAS Committee on Geodesy (NAS 1980, 1982). In addition, the study utilized other materials from meetings and conferences of interested organizations and contacts with individuals in various organizations who have special knowledge or may be potential developers and users of the cadastre.

D. Overview

Chapter I provides background material. Chapter II describes and categorizes requirements of a multipurpose cadastre for various roles by NOAA and other Federal organizations. These are not the same requirements for a multipurpose cadastre that are adequately described in the NAS reports, but rather requirements for products, services, and resources needed to develop and maintain a multipurpose cadastre, which may be provided by Federal organizations.

Chapter III recommends specific roles for NOAA in the development and maintenance of a multipurpose cadastre, based on the analysis of requirements, NOAA's resources and responsibilities and the potential roles of related organizations. These areas are divided into horizontal and vertical control; technical assistance; standards, specifications, and procedures; guidance and training; publications; research and development; technology transfer; funding; coordination and enforcement; and internal administration.

Chapter IV provides an implementation plan for establishing and executing the recommended roles for NOAA. The plan includes an identification of necessary tasks, a schedule, resource estimates, and responsibilities.

Appendix A outlines the required tasks. Appendix B describes NOAA's resources, products, programs, and plans that would potentially support a multipurpose cadastre. At this stage of the analysis all potential NOAA elements are described, although some may not actually be finally recommended for the NOAA role.

Appendix C identifies other (non-NOAA) organizations with a relationship to, or a potential role, in the multipurpose cadastre, and evaluates their association with the cadastre and with NOAA. The organizations considered include Federal agencies, State governments, professional societies, organizations with a special interest in the multipurpose cadastre and universities with related programs.

II. REQUIREMENTS FOR FEDERAL SUPPORT OF A MULTIPURPOSE CADASTRE

A. Requirements

Defining the role of the National Oceanic and Atmospheric Administration in a multipurpose cadastre will be based on requirements for Federal support that have been identified. NOAA's purpose is not to create an artificial market for its products, but rather to identify legitimate requirements among State and local governments and private individuals and organizations for products and services for which the Federal Government is the most appropriate provider. There are many such legitimate requirements identified in the prior studies and reports of the National Academy of Sciences (NAS), and those of other groups including meetings on topics related to multipurpose cadastres. In addition, State and local organizations have requested support in various forms. The first task in this study is to identify cadastral requirements which may be relevant to potential NOAA roles and use these as a base line to define those roles.

Tables 1 through 5 identify requirements according to the type of support required: products, technical assistance and guidance, standards and procedures, funding, and coordination and enforcement.

Table 1.--Products required for a multipurpose cadastre

-
1. Geodetic reference framework. Monumented and described points whose locations have been accurately determined with respect to a reference coordinate system placed in sufficient density to support a cadastre.
 2. Aerial photography. Rectified aerial photographs and orthophotographs to support large scale base mapping.
 3. Base Map. 1:4800 or larger scale planimetric base maps tied to survey control and plotted within national map accuracy standards.
 4. Federal ownership boundary data. Legal descriptions and cadastre maps of boundaries between Federal and non-Federally owned lands.
 5. Federal ownership data. Attribute data regarding ownership of Federal land (identifiers, status, etc.)
 6. Coastal/marine boundaries. Data and maps describing the State and private boundaries in coastal/marine areas.
 7. Flood plain and environmental data. Maps, photography/imagery and descriptions of flood plain boundaries, topography, geologic and soil classifications, vegetation and cover, and other physical and environmental characteristics of the land.
 8. Documentation. Documents describing geodetic products and services of the Federal Government and sources of availability.
 9. Software, system designs, and algorithms. Computer programs, system design documentation, and specifications for algorithms useful in developing a multipurpose cadastre (e.g., programs to perform coordinate transformations from one system to another or converting data from the NGRS data base format to other computer systems).
-

Table 2.--Standards and procedures for a multipurpose cadastre

-
1. Surveys. Classification, standards of accuracy, and supporting specifications for geodetic control and cadastral surveys.
 2. Photogrammetry. Standards and specifications for producing and interpreting photogrammetry and photogrammetric products.
 3. Map accuracy. Standards and specifications for producing large scale planimetric base and cadastral maps.
 4. Ownership boundary accuracy. Standards and specifications for determining and describing ownership boundaries.
 5. Base map compilation. Procedures for compiling and producing accurate planimetric base maps.
 6. Cadastral mapping. Procedures for producing accurate cadastral map overlays to base maps.
 7. Coding schemes. Standard coding schemes and procedures for assignment for various attributes (e.g., parcel identification, land-use, industrial classification, geographic location identification).
 8. Data structures. Descriptions of alternative data structures for digital storage of coordinate, map, land identification, land records, and other cadastre data sets.
-

Table 3.--Technical assistance and guidance

-
1. Inventory of Federal products and services. Assistance in identifying products and services available and their sources, and guidance in acquisition and use.
 2. Multipurpose cadastre concepts. Training and information dissemination on the concepts, use, and value of multipurpose cadastres.
 3. Multipurpose cadastre development and implementation techniques. Guidance and technical assistance on developing, implementing, and using a multipurpose cadastre and its component parts.
 4. Checklist. Checklists of tasks, steps, decision, standards, and other guidance for developing and operating a multipurpose cadastre.
 5. Contracting for surveys. Guidance and technical assistance to State and local governments for contracting with private firms to conduct surveys that meet multipurpose cadastre standards and specifications.
 6. Contracting for aerial photography. Guidance and technical assistance to State and local governments for contracting with private firms to perform aerial photography and photogrammetry and to produce photographic and photogrammetric products that meet multipurpose cadastre standards and specifications.
 7. Contracting for mapping. Guidance and technical assistance to State and local governments for contracting with private firms to produce planimetric base, cadastral, and other maps that meet multipurpose cadastre standards and specifications.
 8. Establishing platting requirements. Technical assistance and guidance to state and local governments for establishing requirements and controls for subdivision and parcel plats that satisfy multipurpose cadastre requirements.
 9. Training in multipurpose cadastre development. Training programs to support technical assistance and guidance in each of the aspects of the multipurpose cadastre.
 10. National/global perspective. Guidance on national perspective of multipurpose cadastre issues relating local activities to each other and to national programs.
 11. Research and development. Technical studies and tests of new development in multipurpose cadastre elements, techniques, uses, and other aspects. Publicize findings to appropriate organizations.
 12. Centers of Excellence. Support development, operation, and publication of activities of Centers of Excellence in the fields of multipurpose cadastre, surveying, and land records.
-

Table 4.--Funding categories for multipurpose cadastre

-
1. Demonstration projects. Funds to develop, test, or demonstrate techniques, products, or other aspects of multipurpose cadastre.
 2. Documentation. Funds for documentation of exemplary systems, procedures, or experiences and for distribution of documentation to appropriate locations.
 3. Control densification. Funds for high priority survey control densification to support development of cadastre.
 4. Meetings. Funding or sponsorship of organizations, conducting meetings, workshops, or conferences for furtherance of multipurpose cadastres.
 5. Research and development. See table 3, item 11.
 6. Centers of Excellence. See table 3, item 12.
-

Table 5.--Coordination and enforcement of multipurpose cadastre activities

-
1. Coordinate activities of various organizations involved in promoting, supporting, and participating in development of multipurpose cadastres.
 2. Enforce standards for Federal and federally supported projects.
-

B. Source of Requirements

Which organizations and professions generate a demand for a multipurpose cadastre? They are, of course, the organizations and professions that develop and use the multipurpose cadastre. Identifying them specifically will help us understand the requirements for support more fully and focus the roles more clearly. The organizations involved include State, county, and city governments and their various departments and divisions; public and private utilities; and private firms and individuals who generate and or use cadastre information and components. The primary organization involved in development and use of a multipurpose cadastre will be the county government. In most states the county has the most extensive responsibility for land records management. It is usually the repository for juridical land records, the source of base and cadastral maps as well as the producer and user of operational land data. The departments or individuals responsible for land records in a county typically include the following:

1. County Recorder, Register of Deeds, etc. Responsible for maintaining the legal repository of all land ownership records. Also maintains indexes for accessing and retrieving data from these records.
2. County surveyor or engineer. Responsible for establishing and maintaining survey control, establishing and enforcing surveying standards, conducting control and project surveys, maintaining a repository of subdivision survey data, and approving or certifying land surveys. However, individuals often do not carry out all these responsibilities.
3. Tax assessor. Responsible for establishing values on all land and improvements for tax purposes. Generally develops and maintains an extensive set of parcel-related information to support this function including: large scale tax parcel or cadastral maps, parcel attribute data file(s), and a parcel identification and indexing system.
4. Public Works. Responsible for constructing and maintaining public facilities, generally including roads, flood control storm sewers, parks and public buildings, and often water supply and sanitary sewers. Generally responsible for maintenance of county base map. Performs project surveys, searches title, establishes right-of-way ownership data, maintains base maps, and facility maps or overlays, produces design drawings for facilities, and stores data related to public facilities.
5. Planning. Responsible for land-use planning, subdivision regulation, and zoning. Generates and uses a large amount of land-related data and maps. Generally does not require high-precision data. Often serves as organizer or catalyst in multipurpose land records projects.
6. Data processing. Responsible for development and operation of computers, data processing and information systems, including land records system. Now playing increasingly important role as designer of automated land records system, often as manager and operator of automated mapping systems.

City governments are also important users and keepers of land information. They usually operate within the county information structure maintaining, separate maps and data for incorporated areas. Cities often provide municipal services beyond those offered by the county. The cities generally do not perform tax assessing functions and, therefore, may not maintain a complete parcel inventory. Cities often utilize county base and cadastral maps in their operations. (See appendix C for details.)

Utilities, whether publicly or privately owned, are major generators and users of land information. In constructing, installing, and maintaining water, electric, gas, telephone, and sewer systems the utilities acquire or produce large scale maps of relatively high precision. They conduct surveys of right-of-way, construction, and facility locations. They often rely on geodetic control to achieve necessary precision beyond a large service area. Utilities are also interested in ownership records and may maintain data on land use and physical conditions. Some utilities participate in map- and data-sharing programs with local governments, although many, including municipally owned utilities, operate independently.

State governments play multiple roles in regard to land information. They are generally the source of many laws relating to surveying, mapping, land titles, recording procedures, and zoning practices. Some states operate geodetic control programs independently or through cooperative agreements with the National Geodetic Survey (NGS). Others have little or no formal survey control activity. Most perform project surveying for roads and other facilities; some provide technical assistance to local governments.

States generally maintain large scale maps only for state owned lands. Some have programs for establishing state-wide maps providing assistance to local jurisdictions ranging from technical expertise to funding of aerial photography full mapping projects. States maintain information on coastal and marine boundaries and are often a major repository of physical and environmental and coastal zone management data.

Private organizations may be users and/or suppliers of land information. Land development and resource extraction companies use and generate large amounts of information on land ownership and physical and environmental conditions. They may enter into formal or information-sharing agreements with State and local governments.

The legal profession and title insurance industry use land record data extensively in searching and verifying ownership titles. In particular, they are concerned with data indexing schemes.

Surveying and engineering firms also perform surveying and map production for the private sector and contract with State and local governments for these services. Many mapping systems of local governments are produced initially through contract with private firms. Virtually all aerial photography for State and local governments is performed through contract. In this role the contractor often provides the technical expertise for decisions made by local governments in the areas of surveying, photogrammetry, and mapping.

Several professions and professional organizations have a strong interest in multipurpose cadastres and the Federal role in their development. Most have an interest in supporting such systems, although some have personal interests which are incompatible. A few have serious concerns about some aspects such as the title and legal professions' concern about land registration and title systems that would adversely affect their business. The key professional organizations include the American Bar Association, American Congress on Surveying and Mapping, American Land Title Association, American Planning Association, American Public Works Association, American Society of Civil Engineers, American Society of Photogrammetry, International Association of Assessing Officers, National Association of Counties, National Association of County Recorders and Clerks, and the Urban and Regional Information Systems Association.

Some of these professional organizations have internal programs related to the multipurpose cadastre. All have participated in prior national activities and meetings on the subject.

III. RECOMMENDATIONS FOR NOAA ROLES

A. Background

The National Academy of Sciences' (NAS) prior work and reports on the multipurpose cadastre identified numerous elements of the cadastre that must be developed. The reports also indicated that the development of the elements would be a joint effort among the various local, State, and Federal government organizations, the private sector, and interested professional organizations. Among the elements identified to be included in a multipurpose cadastre are eight for which NOAA has at least some responsibility:

1. "A geodetic framework for the multipurpose cadastre." (NAS 1983:20)
2. "Densification of the Geodetic Reference Frame - Monuments that are precisely located by geodetic surveys are needed at more closely spaced intervals in most parts of the United States so that positions of land-related data may be determined." (NAS 1983:8)

"Extension of the network of first- and second-order geodetic control points, to provide this basic framework in every county of the United States." (NAS 1983:4)

"Completion of the geodetic framework for the cadastre along the boundaries of federal lands..." (NAS 1983:4)
3. Federal Guidelines - Guidelines are needed for federally supported programs that may have an impact on cadastral development. (NAS 1983:19)
4. "We urge that the Federal offices with the technical skills required required for defining standards for geodetic surveying, base mapping, cadastral mapping, and land-attribute data be invited by NACO [National Association of Counties] to contribute to these processes [the identification of areas in which more specific standards and procedures are needed] at the appropriate points." (NAS 1983:127)
5. "There remains an urgent need for designation of a single lead agency in the federal government in the field of surveying and mapping to provide a structure for the formal recognition of procedures and standards for a multipurpose cadastre...and to oversee compliance with them by the federal establishment. The need for designation of such an agency was stated in the report to the Office of Management and Budget by the Federal Mapping Task Force (1973), was endorsed in the concluding chapter of the Committee on Geodesy (1980) report, and was reiterated in the Committee on Geodesy (1981) report." (NAS 1983:127-128)
6. "We recommend the use of the State Plane Coordinate Systems as the basis for the recording of positions in local land-data systems in the United States. Selection of any other projection should be done reluctantly and only after most careful consideration." (NAS 1983:24)

"We recommend the State Plane Coordinate Systems be used as the basis of the multipurpose cadastres in each state. Monumented points of known location on this system should be distributed throughout the area served, at intervals no greater than 0.2 to 0.5 mile in urban areas and 1 to 2 miles in rural areas." (NAS 1983:2)

7. "We recommend that a program of federal grants to counties (or their equivalents) be established to provide between 30 to 50 percent of the cost of developing multipurpose cadastres that meet or exceed federal requirements, subject to participation of the state government in the design and partial funding of the program." (NAS 1983:4)
8. "One of the first items on any federal agenda for a multipurpose purpose cadastre should be to resolve a clear statement of the objectives of federal initiative..." (NAS 1983:126)

NGS is specifically identified as having responsibility to establish and maintain the NGRS adequate for present and future needs (NAS 1983:20) and for having provided practical projections for use in local surveying and large-scale mapping operations through the State Plane Coordinate System (NAS 1983:23).

Although the recommendations are few, they levy a wide range of requirements for actual implementation. These requirements have been identified in more detail in Chapter 2 of this report. The wide range of requirements also stimulates a wide range of potential roles for NOAA. As recommended by the National Academy of Sciences, the first role is the resolution of a clear statement on the objectives of its initiative.

The objective for NOAA's initiative in the multipurpose cadastre should be to support the multipurpose cadastre concept and the development of the National Survey Information Network (SIN). This reference system would include data on the descriptions and observations for a network of monumented locations that is of sufficient density to support the multiple purposes of the cadastre. The data should also be of adequate accuracy and precision to meet various requirements. Development of this system will include two major components:

- o the establishment or expansion and maintenance of a data base of relevant information.
- o the conduct and documentation of surveys in accordance with standards and procedures covering method, accuracy, precision, ties, and other requirements.

The objectives of an adequate data base and use of appropriate survey methods throughout the country are ambitious and will take many years to accomplish. These are basic requirements of the multipurpose cadastre that should be undertaken. The long-term objectives can provide the structure for numerous roles that NOAA can perform beginning with existing products, services, and resources. Based on these objectives, NOAA can build a multipurpose cadastre support program which includes its data base, geodetic survey

activities, technical assistance, standards and specifications, training, demonstration projects, and research and development.

The method of operation should be a cooperative approach among NOAA, other Federal organizations, State and local governments, the private sector, and professional societies and organizations specifically interested in the multipurpose cadastre. NOAA cannot perform or fund all, or even most, of the necessary activities. It can, however, develop the structure and standards for accomplishing the objectives and, through its own activities and the support, guidance, and assistance it provides to others, direct the development of the SIN.

Conceptually SIN will be an aggregation of data bases of survey information supported by procedures and standards for the conduct of surveys and for the maintenance of the data bases. The system data base is conceived as a network of distributed data bases established and maintained by NOAA, state governments, local governments, and regional organizations (fig. 1). The content, structure, and quality of the data bases would be established by NOAA as well as the techniques for linking the individual entities. The surveys would be performed by personnel from each of the above organizations and the private sector in accordance with standards and procedures furnished by NOAA. Methods and formats for recording the survey data would also be provided by NOAA.

B. The NOAA Roles

The overall objectives of the NOAA support for the multipurpose cadastre can be achieved by establishing a program consisting of five functional roles. These roles are the following:

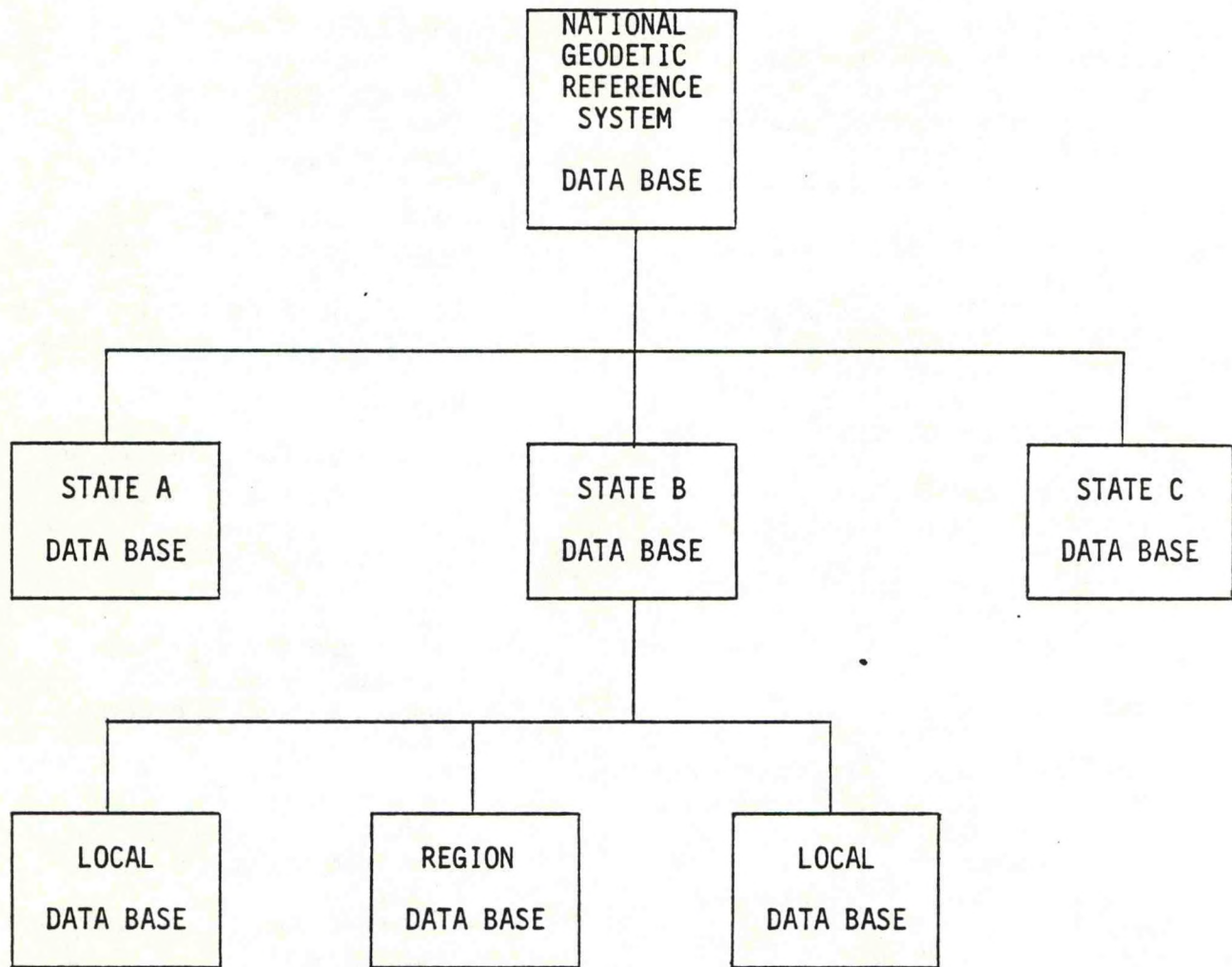
1. Primary role - Activities performed to directly accomplish the objectives.
2. Support role - Activities within NOAA that will support the conduct of the primary roles.
3. Coordination role - Activities which NOAA will perform to coordinate the efforts of related organizations in accomplishing multipurpose cadastre objectives.
4. Development role - Activities for the development of techniques or understanding necessary to implement a multipurpose cadastre.
5. Training role - Activities to educate and train all related personnel in the concepts and techniques of the multipurpose cadastre.

These five functional roles are composed of 12 individual roles, each intended to accomplish a specific aspect of the multipurpose cadastre. The activities performed under each of the individual roles should be coordinated and integrated through an overall NOAA multipurpose cadastre program.

Each of the roles in the NOAA Multipurpose Cadastre Program can be implemented through a series of integrated activities or tasks identified in

Table 6. The first activity within NOAA, relevant to establishing its multi-purpose cadastre roles, should be the development of a comprehensive program covering all the roles and integrating them with each other and with other NOAA programs.

CONCEPT



1. -- Concept of the Survey Information Network (SIN).

Table 6.--Potential NOAA roles for multipurpose cadastre

Primary Roles:

1. Build Survey Information Network
Design data base structure
Design network structure
Incorporate National Geodetic Reference System
Maintain and extend NGRS
2. Develop Survey Standards and Specifications
Distribute existing standards
Plan extended standards
Develop extended standards
Publicize availability and importance of standards
3. Conduct Geodetic Surveys
Conduct horizontal and vertical network surveys
Execute cooperative agreements for surveys
Conduct tidal surveys/measurements

Support Roles:

4. Develop Technical Assistance Program
Plan technical assistance program
Establish technical assistance procedures
Establish technical assistance procedures
Develop guide books
5. Develop Product Distribution Program
Plan distribution system
Establish distribution system
Identify related products
Incorporate in distribution system
Develop/Standardize computer systems
Publicize distribution program
6. Support State Plane Coordinate Systems
Provide location coordinates
Provide transformation algorithms and programs
Provide information on the systems and their use

Coordination Roles:

7. Coordinate Federal Multipurpose Cadastre Activities
Develop coordination role
Obtain recognition of role
Execute role
8. Develop State/Local Multipurpose Cadastre Program
Plan State/local program
Establish State/local program
Conduct State/local program

Development Roles

9. Conduct Prototype Project(s)
Plan prototype program
Identify exemplary and prototype sites/candidates
Document exemplary sites and distribute
Select prototype project site(s)
Conduct/support prototype project
10. Conduct Multipurpose Cadastre Research and Development
Plan research and development program
Conduct/support research and development
Document and distribute research and development

Training Roles:

11. Develop Multipurpose Cadastre Training Program
Plan training program
Develop training materials
Establish training program
Conduct training program
12. Recognize Centers of Excellence
Establish criteria and program
Select centers
Support centers

Table 7.--Synopsis of Multipurpose Cadastre Program

Develop Overall NOAA Multipurpose Cadastre Program:

- o Establish multipurpose cadastre objectives and policy
 - o Define the multipurpose cadastre program
 - o Establish program priorities
 - o Assign responsibilities
 - o Allocate funds
 - o Publicize NOAA activities
 - o Establish multipurpose cadastre liaison office
-

C. Program Development

Develop Overall NOAA Multipurpose Cadastre Program

All activity carried out by NOAA in support of the Multipurpose Cadastre Program should be coordinated as defined in table 7. As recommended by NAS the program should begin with a clear statement of the NOAA objectives regarding the cadastre. Based on the objectives a clear policy should be formulated on the cadastre and upon the role of NOAA.

A plan for incorporating the various current and future activities into a comprehensive and integrated program should then be developed. Many of the multipurpose cadastre activities are currently performed by NOAA but not under a multipurpose cadastre umbrella. To maximize the benefits of the program, the relationships among these and any future activities should be identified. It should also be recognized that certain activities included in the cadastre program will continue to support other objectives as well. Within the program, priorities should be established based on the needs for activities, NOAA resources, and the relationships among activities. The program should also include assignment of responsibilities to appropriate NOAA units and the allocation of funds, or budget recommendations, for identified multipurpose cadastre activities.

To maximize the effectiveness of the NOAA program it should be publicized to the other participants in the multipurpose cadastre--state and local governments, other Federal agencies, professional organizations, and the private sector. A multipurpose cadastre reference library should also be established for NOAA personnel and others.

One of the key assignments to be made early in the program should be the establishment of a multipurpose cadastre coordinator or coordination office. The role should be to coordinate the multipurpose cadastre activities among the various NOAA units involved and with other Federal agencies, State and local governments, and professional organizations.

Initial Increment NOAA can initiate its multipurpose cadastre program by having appropriate management and personnel review the policies and programs proposed in this report, modifying them to suit their requirements, and adopting the resulting policies and programs as the NOAA program. Staff should also be assigned to refine the proposed implementation plan to reflect modifications made by management and to provide a greater level of detail for program management. Initial work on the high-priority items should then proceed immediately.

D. Specific Roles

Role 1. Build Survey Information Network (SIN)

One of the major objectives of NOAA is to develop a nationwide SIN, which will be composed of compatible data bases, and a set of procedures to support updating, retrieval, and quality control. NOAA, with the assistance of other participating organizations, must design the data base structure and the network structure for the system. These structures will be used in the design

and development of the individual data bases and will ensure compatibility among the data and with the rest of the data bases. The network will be composed of numerous individual local, regional, State and Federal data bases developed by separate organizations and tied into the network through telecommunications or magnetic tape procedures. The NGRS will serve as the basic building block of the network; the design resulting from its current restructuring will provide the basis for the new data base structure. As part of SIN, NOAA will continue to operate, maintain and expand the NGRS data base.

NOAA must also provide stimulus and guidance to potential participants urging them to participate in the reference system and undertake compatible data base development.

Initial Increment. NOAA should continue its current NGRS activities including completion of the restructuring of the data base, maintenance and updating the data base, and retrieval and dissemination of data. It should also work to increase the amount of data to be incorporated into the data base and publicize the NGRS. It should form a team to perform preliminary planning and integration into the broader SIN.

Role 2. Develop Survey Standards and Specifications

NOAA has developed standards and specifications for geodetic surveying (e.g., horizontal, vertical, and astronomic), hydrographic survey, tidal data determination, and distance measurement calibration. These standards, particularly those for horizontal and vertical geodetic surveying, should be distributed to the multipurpose cadastre community through an appropriate mechanism. Since the SIN will incorporate more than geodetic surveys including, for example, land surveys, cadastral surveys, project surveys, standards and specifications covering other areas of surveying should be developed. These standards and specifications should cover ties to the geodetic network, accuracy, precision and documentation procedures. The standards should be related to existing geodetic survey standards and to the data base standards. They should be developed through a coordinated effort possibly through the Federal Geodetic Control Committee, and would also include NOAA and other Federal, State, local, and private representatives. The preparation of the standards should begin with preparation of a plan covering the identification of participants, responsibilities of the participants and the range of standards and specifications to be produced. Based on the plan, the various participants will produce and approve appropriate standards and specifications under the leadership of NOAA.

The resulting standards, their importance, and use should be publicized and distributed by NOAA. The participating organizations and appropriate professional organizations should support NOAA in the publicity and distribution activities.

Initial Increment. NOAA should publicize and distribute documents defining current standards and specifications to the multipurpose cadastre community. It should develop a program to promote their use through professional organizations. A team should begin planning for the expansion of the standards beyond geodetic surveys, covering other aspects of the reference network.

Mechanisms should be explored for developing and distributing more comprehensive standards including participation with other organizations.

Role 3 Coordinate Geodetic Surveys.

NOAA has ongoing programs to complete the horizontal control network, to update the vertical control network, and to establish additional tidal stations. These activities, and the resulting data, will contribute to the quality of the multipurpose cadastre. The level of detail of the multipurpose cadastre is such that these networks must be extended to a significantly greater level of density than now exists. The implementation of the Global Positioning System (GPS) Technology will improve productivity greatly and facilitate network improvement. NOAA should continue, and if possible, increase GPS activities by State and local agencies to satisfy the requirements of the multipurpose cadastre in each county. Consideration should be given to modify resource allocation prioritization and scheduling to recognize the needs of the multipurpose cadastre. NOAA should establish a procedure to recognize qualifying counties as priority multipurpose areas. NOAA should continue and expand its cooperative agreement program to support additional geodetic surveying in association with States and local governments, while encouraging and supporting geodetic surveying by other organizations.

Initial Increment. NOAA should continue to coordinate and promote extension of the horizontal and vertical networks. It should pursue full implementation of GPS to increase productivity. It should establish a priority system which includes multipurpose cadastre requirements as an important consideration. It should solicit more support and participation by state and local governments in surveying and monument maintenance and should expand its cooperative agreement activities.

Role 4 Develop a Technical Assistance Program.

Successful development and implementation a multipurpose cadastre will involve numerous organizations and persons, many of whom will require assistance in dealing with the specific techniques of the multipurpose cadastre, especially those in highly technical field of geodetic referencing and surveying. NOAA should develop a program of technical assistance to support development and use of a multipurpose cadastre. The assistance should cover concepts and techniques of a multipurpose cadastre, surveying, establishment and use of survey control, availability and use of geodetic reference data, and other issues that will be of interest to those establishing a multipurpose cadastre.

The technical assistance program should begin with the development of a program plan which describing assistance to be provided, staff responsibilities, methods of operation, supporting materials and services, training of advisory personnel, funding arrangements, and budget.

Next a team of personnel who will provide technical assistance should be formed. The team may initially include the State geodetic advisors and selected headquarters personnel. (NGS now employs 9 advisors in specific States. Their salaries are paid jointly by the State and NGS.) In the longer

term more State geodetic advisors and regional advisors may be added to the team. All personnel assigned to the team should receive training in the concepts and techniques of the multipurpose cadastre and in procedures of the NOAA technical assistance program procedures. The procedures should cover the method of operation, reporting, financial arrangements, and other issues.

Training of the advisory personnel should begin with an initial intensive class and continue over a period of time with specialized sessions and distribution of relevant materials. The advisory program should then be initiated, with advisors assigned areas of responsibility.

A series of guidebooks should be prepared to assist the technical advisory team. The guidebooks should provide practical information on development, implementation, and use of the various components of the multipurpose cadastre. Topics covered should include geodetic surveying, other classes of surveying, use of control in mapping and land description, establishing platting requirements, techniques for implementation, sources of data, and others. The guidebooks should be published for distribution through the technical advisory service. They should be developed in cooperation with other organizations and should be integrated into a series covering the full spectrum of topics affecting the multipurpose cadastre.

Initial Increment. The initial task is to develop the technical assistance program plan and adopt it for implementation. Current State geodetic advisors and selected headquarters staff should also receive multipurpose cadastre orientation and offer assistance. NOAA can also publicize the availability of technical assistance to state and local governments.

Role 5 Develop Product Distribution Program.

NOAA currently produces and distributes a variety of products that will become a part of the multipurpose cadastre including NGRS data, standards and specifications documents, and others. To support distribution, it has published documents describing products and services and has established distribution centers through which the products may be obtained. The distribution system and the various products should be reviewed in the context of the multipurpose cadastre. Improvements which might facilitate use in the multipurpose cadastre should be planned. The inclusion of additional multipurpose cadastre products produced by NOAA or other organizations should also be considered in the planning.

In addition to its standard geodetic survey data and products, NOAA produces and distributes various other products related to the multipurpose cadastre. These include such items as computer programs for processing geodetic data and for performing coordinate transformations, marine charts, aerial photography and, others. These products may not be incorporated in the cadastre distribution system but should be made easily available to the multipurpose cadastre community. NOAA should review all of its products and produce an inventory and catalog of their availability.

Even though the multipurpose cadastre may not be a primary mission of NOAA, related products should be reviewed to determine if minor modifications would make them more readily available or useful to the client community. If minor

modifications would broaden their use, their production would be more cost effective for NOAA. An example is the potential for standardization and packaging of computer programs to operate on available computer systems.

The distribution system should include methods and procedures to publicize the availability of products, to assist customers in locating products to retrieve and distribute products, to account for items distributed and funds received, and to monitor inventories. Methods of electronic distribution of digital data should be developed in the plan.

If possible all products should be made available through a single, central source. At a minimum, a central index of all products should be established and should be accessible through a toll-free telephone number. The planned distribution system should be established and implemented, probably in a phased approach beginning with the current NOAA products and distribution centers. The availability of the distribution system and its products should be widely publicized throughout the multipurpose cadastre community.

Initial Increment. The present National Geodetic Information Center and its services and products should be publicized to State and local governments. The staff of the center should also be briefed on multipurpose cadastre issues and on potential inquiries which may be received. Planning for enhanced or revised distribution procedure should also be undertaken soon. Planning for the distribution of related products should also be performed and a decision made on whether this distribution should be incorporated in an overall system or continue to operate separately.

Role 6 Support State Plane Coordinate System (SPCS).

NOAA is responsible for providing coordinate data from which State plane coordinates are derived. It also provides algorithms and computer programs to compute State plane coordinate values for location data and assists in developing legislation that addresses SPCS applications. Since NAS has recommended that the State Plane Coordinate System be employed as the standard coordinate system for the multipurpose cadastre, NOAA should support this effort. It should develop information on the SPCS and disseminate it through technical assistance and a products distribution system.

Initial Increment. NOAA should continue current activities related to the SPCS. It should also prepare and disseminate information on issues related to the new adjustment of the North American Datum of 1983 (NAD 83) and its impact on State plane coordinates.

Role 7 Coordinate Federal Multipurpose Cadastre Activities.

The National Academy of Sciences strongly recommends that some Federal agency take the lead in coordinating activities of the individual agencies in relation to the multipurpose cadastre. While several Federal agencies have potential roles, or are performing functions related to the multipurpose cadastre, none is clearly dominant. NOAA's role of responsibility for the basic underlying structure of the cadastre, the geodetic reference framework, gives it a key position. The geodetic reference framework is not only the basic linking element of the cadastre but was the first to be developed. With

responsibility for this initial and basic activity NOAA should assume the lead role of coordination.

NOAA should review activities and coordination requirements of the Federal participants, and should develop an appropriate coordinating role. The role should define the level of recognition and authority to be obtained, the method of coordination, the objectives to be achieved, and the areas of activity to be coordinated.

The coordination role will cover activities such as standards and procedures to be adopted, preparation of integrated or related documentation and guide-books, joint participation in technical advisory and technology transfer activities, and joint funding of prototype projects and research.

NOAA should establish itself as the Federal coordinator in three phases. First it should establish its internal policy, objectives, and program for multipurpose cadastre activities. Next it should establish relationships with concerned non-Federal organizations, including State and local governments, professional societies, and private organizations. These relationships should include the implementation of NOAA programs and the exploration of coordination activities and roles. NOAA should then initiate a Federal coordination role by one of two strategies. It should either establish itself as the Federal coordinator by calling a meeting of appropriate Federal agencies to review and coordinate Federal activities or it should seek formal authorization as the lead agency from the Office of Management and Budget (OMB) either as an adjunct to its leadership in the Federal Geodetic Control Committee (FGCC) or specifically as the leader of the multipurpose cadastre. The former, ad-hoc approach may be more appropriate since OMB may not see the multipurpose cadastre as an area warranting formal recognition.

NOAA should continue its role in FGCC and should continue to enforce geodetic survey standards.

Initial Increment. Initially, NOAA should establish its multipurpose cadastre program and adopt related policies. It should also evaluate the strategies described above and adopt a policy regarding its lead agency role.

Role 8 · Develop State and Local Multipurpose Cadastre Program.

Implementation of the multipurpose cadastre will be accomplished primarily by local and State governments. They will play an important role in developing the national Survey Information Network. If they are to perform these functions effectively it will be necessary for Federal and other interested organizations to stimulate interest, provide guidance, and support these governments. While they generally appreciate the value of the multipurpose cadastre, many lack the understanding and technical skills to accomplish its development. NOAA, therefore, should establish a program to encourage participation by State and local governments in the development of the multipurpose cadastre, particularly in the conduct and use of surveys and survey data. The program should encourage and assist these governments in performing geodetic and other surveys in accordance with FGCC standards, to enter appropriate data in the NGRS, to develop survey reference data bases and to perform survey monument maintenance, and to develop multipurpose cadastrals for their areas.

The program should integrate other programs of training, technical assistance, and product distribution to facilitate their effectiveness in dealing with State and local governments. It should include presentations at appropriate meetings, preparation and publication of articles, personal contacts and visits to interested organizations, distribution of selected materials, and linkage to other NOAA supported programs.

NOAA should plan the program, assign responsibilities, allocate appropriate funds, and conduct the activities.

Initial Increment. NOAA should develop the overall State and local program, and assign a coordinator to publicize its roles to the State and local governments.

Role 9. Conduct Prototype Projects.

As a part of the development of the multipurpose cadastre it will be necessary to test methodology and procedures and demonstrate capabilities to potential multipurpose cadastre organizations. The land record applications of SIN will particularly require testing and demonstration. NOAA should support the conduct of one or more prototype projects. In these projects specific procedures will be employed, documented, and evaluated. Results will be published and disseminated to the multipurpose cadastre community. The sites selected may be locations where NOAA is already planning to conduct a project. State and local governments should also play an active part and contribute to the project. Prototype projects may be conducted in cooperation with other organizations as a part of a demonstration of additional aspects of the multipurpose cadastre. NOAA would provide funding, technical assistance, personnel participation, and other support to the projects.

In addition to the conduct of prototype projects, NOAA should identify, document, and publicize the experiences, techniques, and procedures gained from a selected set of exemplary sites. These sites would have already developed or implemented an important component of the multipurpose cadastre or accomplished an important objective. The experiences gained and information generated are of interest to other organizations that might employ the same or similar techniques. They would also be useful for organizations to undertaking similar efforts.

NOAA should fund the review, documentation, publication, and distribution of information from the exemplary sites.

Initial Increment. NOAA should review candidate projects that are in the planning stage to determine if any might serve as a prototype. If projects are appropriate, they should be designated as multipurpose cadastre prototypes. It should also produce a document describing exemplary sites and distribute it to appropriate organizations.

Role 10. Conduct Multipurpose Cadastre Research and Development

There are several aspects of the multipurpose cadastre requiring further research and development before they can be implemented or used effectively.

There is need for additional information about the multipurpose cadastre, availability of source materials, value of geodetic referencing, and other issues. NOAA should, continue and augment its research and development activities in related issues. Some research may be conducted internally by NOAA staff, some through the multipurpose cadastre centers of excellence, some through joint projects with other organizations, and some by contractors. Some research and development (R&D) may be conducted as a part of the prototype activity described in Role 9.

Initial Increment. NOAA should review the multipurpose cadastre, identify issues requiring R&D identify approaches (funding, staff etc.) to conducting the research, and prepare an R&D plan for the multipurpose cadastre. The plan should address funding and distribution of results along with identification of projects and definition of priorities. NOAA should conduct or support the identified R&D and should publish and disseminate the findings.

Role 11 Develop Multipurpose Cadastre Training Program.

NOAA employees who will provide technical assistance and participate in multipurpose cadastre activities will require training in overall concepts and techniques and in technical issues beyond the scope of geodetic surveying. Persons in State and local governments, and the private sector who will be involved with the multipurpose cadastre also will need training in issues and techniques. NOAA should plan, develop, and conduct a multipurpose cadastre training program to which will address concepts, overall components, organizational issues, and details of geodetic and other surveying. The training program should be developed initially for NOAA staff and later modified and expanded for others. The modification should include descriptions of NOAA products, their availability and use.

Training of non-NOAA personnel should be conducted with NOAA materials and guides but in cooperation with professional societies or other interested organizations to expand resources and minimize NOAA costs.

Initial Increment. Personnel who will be involved in NOAA's multipurpose cadastre activities should be identified. An initial multipurpose cadastre training program for these persons should be developed and conducted as soon as possible. Plans for further training should also be developed.

Role 12. Recognize Centers of Excellence.

A valuable resource in the development of the multipurpose cadastre may be the establishment and recognition of Centers of Excellence. The National Academy of Sciences has recommended support by the Federal Government for the establishment of a Center or Centers of Excellence in land-information science, for the purpose of providing a program that develops scholars and professionals. The centers are forming in universities at this time to conduct educational activities and research. The Institute for Modernization of Land Data Systems (MOLDS) has recently designated three institutions as Centers of Excellence.

NOAA should establish a program of support for these centers and criteria for evaluating and recognizing them. The program should include priority for R&D and other funding, development of a center for NOAA training, establishment as a center for distribution of NOAA information, participation in prototype projects, and direct funding for establishing the center.

Using established criteria NOAA should review and evaluate the three institutions designated by MOLDS and any other candidates proposed, certifying recognition of those meeting or exceeding NOAA standards. It should then work with these institutions to develop their participation in distributing published information, training, technology transfer, R&D, and other programs.

Initial Increment. NOAA should review the MOLDS designation criteria and institutions recognized and, if acceptable, should adopt the criteria and extend its own recognition to the three institutions.

IV. OTHER ORGANIZATIONS PARTICIPATING IN CADASTRE

Numerous Federal, State, and local governments, and private organizations will participate in the development and use of the multipurpose cadastre. The relationships among these organizations will be important to the effective implementation of the program. Some organizations will provide source data, funding, or standards and specifications; others will perform developmental functions; and most will become users of the information. Tables 8 and 9 list the organizations involved and their relationship to the cadastre.

Table 8.--Relationships of Federal organizations to multipurpose cadastre

Organization	Interest area	Coverage	Completeness geog. subject	Status	Role
		S=Spotty N=National L=Local	1=Complete 2=Substantial 3=Spotty	1=Current 2=Planned 3=Within Mission	1=Maintain Data 2=Support 3=Education
<u>Agriculture</u>					
ESC	Parcel record	N	2	3	2
Soil Conservation	Cadastral overlay	N	2	1	1
	Environment				
Forest Service	Cadastral overlay	L	3	1	1
	Environment				
<u>Commerce</u>					
Census	Administrator	N	2	2	1
NOAA	Geodetic control	N	2	1	1
	Cadastral survey				
NTIS	General	N	N/A	1	2
NBS	Geocodes	N	1	1	2
<u>Defense</u>					
COE	Base map	S	3	2	1
	Base map	L	3	2	1
	Cadastral overlay				
	Environment				
<u>EPA</u>					
EPA	Environment	N	3	3	2
<u>FEMA</u>					
FEMA	Environment	N	1	3	1
	Base map	N	2	3	2
<u>HUD</u>					
HUD	Cadastral Overlay	L	3	3	2
<u>Interior</u>					
BLM	Cadastral overlay	N	2	2	1
USGS	Base map	N	1	2	1

Table 8.--Continued

<u>NASA</u>	Environment	N	1	2	1	1
<u>OMB</u>	General	N	2	2	1	1
<u>Transportation</u>	Geodetic control	L	3	3	1	1
<u>FHWA</u>	Cadastral overlay	L	2	2	1	1
<u>TVA</u>	Base map	L	2	2	1	1
	Cadastral overlay					
	Environment					

Legend

Organizational abbreviations:
 BLM Bureau of Land Management
 COE Corps of Engineers
 DMA Defense Mapping Agency
 EPA Environmental Protection Agency
 ESC Economic Statistical, Cooperative Service
 FEMA Federal Emergency Management Agency
 FHWA Federal Highway Administration
 HUD Housing and Urban Development
 NASA National Aeronautics and Space Administration
 NOAA National Oceanic and Atmospheric Administration
 NTIS National Technical Information Service
 OMB Office of Management and Budget
 TVA Tennessee Valley Authority
 USGS U.S. Geological Survey

Table 9.--Relationships of non-Federal organizations to multipurpose cadastre

Organization	Interest area	Coverage	Completeness geog. subject	Status	Role	
<u>National Academy of Sciences</u>	General	N	1	2	1	3
<u>Modernization of Land Land Data Systems</u>	General	N	1	2	1	3
<u>National Association of Counties</u>	General	N	2	2	3	3
<u>Council of State Govt's</u>	General	N	1	2	3	3
<u>American Congress on Surveying and Mapping</u>	Geodetic control Base map Cadastral overlay	N	2	2	1	3
<u>American Society of Photogrammetry</u>	Geodetic control Base map	N	2	2	1	3
<u>American Public Works Association</u>	Base map Cadastral overlay	N	2	2	1	3
<u>American Association of State Surveyors</u>	Geodetic control Base map Cadastral overlay	N	2	2	1	3
<u>International Association of Assessment Officers</u>	Parcel records	N	2	2	1	3

Table 9.--Continued

<u>American Bar Association</u>	Cadastral overlay Land records	N	2	2	1	3
<u>American Land Title Association</u>	Cadastral overlay Land records	N	2	2	1	3
<u>National Association of County Recorders and Clerks</u>	Land parcels	N	2	2	1	3
<u>Urban and Regional Information Systems Association</u>	General	N	2	2	1	3
<u>University of Wisconsin</u>	General	L/N	2	2	1	3
<u>University of Maine</u>	General	N	3	2	1	3
<u>States</u>	General	L	1	2	3	4

V. PROPOSED IMPLEMENTATION APPROACH

The full implementation of the identified cadastre roles will require extensive resources and will take many years to accomplish. The proposed approach begins with existing resources, adds limited resources quickly, and includes a new initiative for significant funding to carry out the bulk of the program in future years. The approach is described in terms of phases, although it is anticipated that it actually will be a continuum without discrete breaks, building to an operation level.

In the first phase, existing NOAA resources will be focused on multipurpose cadastre development. In this phase NOAA's intention to participate in the multipurpose cadastre will be stated, initial resources will be committed, initial prototype activities will be accomplished, and the multipurpose cadastre will be publicized. Funding for this phase will be reidentified within C&GS from among existing activities. The level of funding will be approximately \$100,000 and the phase will last approximately 3 to 6 months.

In the second phase, which will follow as soon as practical, the Phase 1 activities will be augmented with interim NOAA discretionary funds of about \$300,000. These funds will be allocated to support a multipurpose cadastre coordinator and other staff time, travel for technical assistance, and promotion of multipurpose cadastre activities and execution of a project to serve as an initial prototype. Phase 2 will last 1 year, or until funding for the new initiative becomes available.

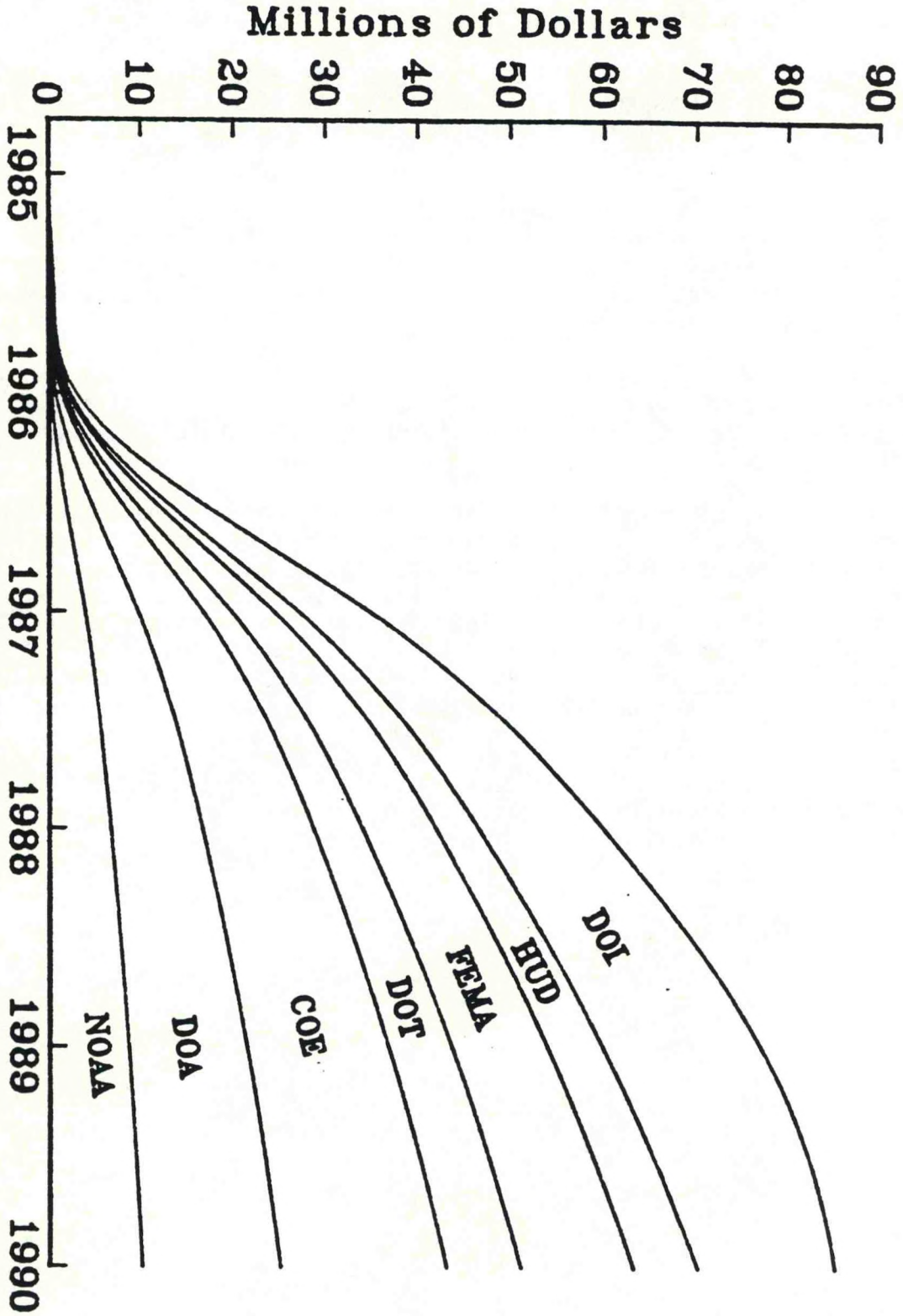
The third phase will be supported by funding from a new initiative and will be the first substantial effort directed at the multipurpose cadastre. It will include multiple activities which will extend the NOAA activities into a full program. In the initiative technical assistance, training, data base development, and full prototype projects will be performed. As initial activities are completed this phase will continue with ongoing support for the multipurpose cadastre, including completion and maintenance of the data base, continued training, technical assistance, distribution of products, and research and development on important issues.

Funding for the full NOAA multipurpose cadastre program should be \$4.5-10 million annually. The National Academy of Sciences has recommended that the Federal Government should budget \$90 million annually, or 40 percent of the funding required to accomplish the objectives of the multipurpose cadastre. Conservatively NOAA's portion of this responsibility is at least 5-10 percent of the Federal total, or \$4.5 to 10 million.

Figure 1 is an illustration of the NAS recommendation on funding. The amounts for other agencies are estimates of possible levels of expenditures.

The activities for each of the phases are listed in tables 10 through 12. A detailed listing of implementation tasks follows in appendix A.

Possible Contributions to Federal Multipurpose Cadastre Budget



Phase 1

Phase 1 will involve immediate actions, which can be taken within NGS, to establish a NOAA presence in the multipurpose cadastre, begin development of the full program, and achieve some solid accomplishments to verify the importance of NOAA to this endeavor.

Phase 2 covers the issuance of a statement on the establishment of the NOAA Multipurpose Cadastre Program and plans for the cadastre. This statement will be publicized to the multipurpose cadastre community who will be asked to join NOAA in this endeavor.

In Phase 1 NGS will carry out organizational activities by assigning a multipurpose cadastre coordinator responsible for guiding initial efforts of the program. It will also prepare the detailed multipurpose cadastre program, organize a technical assistance capability, and assign multipurpose cadastre responsibilities to selected persons.

NOAA will identify current activities related to the multipurpose cadastre and refocus assignments to support that objective. These activities include ongoing geodetic surveying, data base maintenance, and distribution of standards and products.

In the area of specific accomplishment, NGS will identify one or more projects (or sites) which are currently carrying out, or will be carrying out, prototype multipurpose cadastre functions during the first 6 months of the cadastre program. A project will be selected, redefined, if necessary, and executed as an initial prototype multipurpose cadastre example. The findings of the project will be documented and publicized to the community. The prototype will be used to test and verify some aspect of the use and value of geodetic control in a multipurpose cadastre.

During Phase 1 NGS will initiate publicity and begin training personnel for technical assistance to State and local governments. The staff will be selected from among State geodetic advisors and headquarters personnel. Table 10 lists specific tasks.

Table 10.--Phase 1: Initial activities for multipurpose cadastre

-
1. Issue statement that NOAA(NGS) has established a multipurpose cadastre program which will support development of the multipurpose cadastre throughout the United States. Assign coordinator in NGS and publicize activity.
 2. Assign NGS personnel to develop detailed program.
 3. Include issues relating to multipurpose cadastre and Survey Information Network (SIN) in restructuring of the National Geodetic Reference System data base.
 4. Assign employees to review and analyze potential scope of SIN.
 5. Enhance distribution of standards and specifications for the Multipurpose Cadastre Program.
 6. Conduct geodetic surveys, tidal measurements, and other surveys in support of multipurpose cadastre. Incorporate requirements for the multipurpose cadastre in establishing priorities. Perform and publicize a Global Positioning System project as a multipurpose cadastre activity.
 7. Train State geodetic advisors and selected headquarters personnel in multipurpose cadastre issues and assign them to provide technical assistance.
 8. Develop initial multipurpose cadastre technical assistance plan and program.
 9. Review NOAA products for inclusion in multipurpose cadastre distribution program.
 10. Distribute NOAA products to the multipurpose cadastre community, adding, where practical, an indication of the multipurpose cadastre program (e.g. a cover letter stating these products are part of the program). Add distribution of copies of multipurpose cadastre articles and publications.
 11. Publicize availability of NOAA products and services through the professional organizations, publications and other media used by multipurpose cadastre community. Publicity should describe the program and indicate that items in 11 are part of the multipurpose cadastre program.
 12. Review proposed coordination role. Make contacts with related organizations. Raise visibility of NOAA(NGS) in preparation for coordination role.
 13. Publicize NOAA's multipurpose cadastre role and interests to State and local governments. Encourage them to form projects and activities and to communicate with NOAA on their efforts. Produce articles and presentations by NGS staff for this purpose. Target specific organizations for publicity.
 14. Review recently completed, active, and planned projects. Identify any projects which might be incorporated and publicized in whole or in part as a multipurpose cadastre activity. Encourage/direct project managers to recognize the multipurpose cadastre aspect in planning, performing, and reporting on the project.
 15. Develop a demonstration/exemplary project publicity program. Identify projects and locations of interest and produce articles about them. Encourage the local cadastre users to publicize their activities and

to include geodetic referencing, NOAA, and multipurpose cadastre in their publications.

16. Support research and development of multipurpose cadastre . Publicize results of recent findings [e.g., publication on the Use and Value of Geodetic Information (Epstein and Duchesneau 1984)].
 17. Review recognition of Centers of Excellence by Institute for Modernization of Land Data Systems. If acceptable, issue similar recognition from NOAA. Publicize NOAA's recognition of centers.
-

Phase 2

Phase 2 will involve allocation of additional discretionary funds to augment and build on the multipurpose cadastre activities. These funds will be used to increase the level of communication and technical assistance with the multipurpose cadastre community. The multipurpose cadastre coordinator assignment will be expanded to full or near full time.

Prototype activity will be increased with funding to add specific multipurpose cadastre functions and to document, publish, and disseminate information on the findings of the prototype.

Since one of the most important early activities of the multipurpose cadastre is communication with and guidance for State, local, and private participants, Phase 2 will include travel funds to attend and participate in meetings of professional organizations and others who are interested in the multipurpose cadastre. Participation will include presentation of information on the NOAA role and on the use and value of geodetic control. In addition to formal meetings the travel will include visits to specific sites to provide technical assistance and to nurture multipurpose cadastre efforts.

Phase 2 will include allocation of personnel time to prepare for and participate in the meetings, to provide the technical assistance, and to prepare articles for publication. It will also include time to perform internal planning and preparation for the full NOAA multipurpose cadastre program.

To begin developing capabilities among State and local governments and focus the attention of the private sector, Phase 2 will include preparation and initial conduct of a workshop/seminar on the concepts, value and techniques, including especially geodetic control, of the multipurpose cadastre. NOAA will make arrangements with one or more professional organizations and/or universities to continue conduct of the workshop throughout the country. Articles and documents will also be prepared and published for distribution to the community. These will provide technical information and guidance and conceptual and value information on the multipurpose cadastre for use by state and local officials and professionals in the private sector. Table 11 summarizes Phase 2 activities.

Table 11.--Phase 2: Cadastre activities performed
with NOAA Discretionary Funds

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1. Extend all Phase 1 activities.
 2. Assign full- or substantial-time multipurpose cadastre coordinator in NGS.
 3. Allocate funds to support prototype activities.
 4. Allocate travel funds for coordinator and NGS staff to attend appropriate meetings to make presentations on NOAA's multipurpose cadastre program, and visits to key locations to encourage and support multipurpose cadastre activities and to locations requiring technical assistance.
 5. Allocate time of selected NGS personnel to perform multipurpose cadastre activities including presentations, preparation of articles, program planning and technical assistance.
 6. Allocate funds to publish and distribute selected articles and documents concerning multipurpose cadastre issues.
 7. Allocate funds to prepare and conduct an initial multipurpose cadastre workshop/seminar for State and local officials and the private sector. Work with a professional association in preparing and conducting the workshop.
-

Phase 3

Phase 3 will implement the full NOAA multipurpose cadastre program supported by major funding from the proposed new initiative. It will involve all of the roles described in Chapter III. In some areas it will augment existing and ongoing activities to focus them on multipurpose cadastre requirements and achieve maximum benefit for that purpose. In others it will initiate new activities which must be performed to develop multipurpose cadastre capabilities or support cadastre functions. It is anticipated that this program will be NOAA's part of an overall nationwide movement modeled after the recommendations of the National Academy of Sciences and involving other Federal agencies, State and local governments, professional organizations, and the private sector.

The NOAA multipurpose cadastre program will begin with augmentation of ongoing surveying and data base activities and with infrastructure development within NOAA and capacity building among State and local governments. These activities will include training, technical assistance, SIN design and development, standards and specifications development, and prototype development. As the program matures and the capabilities for development of the multipurpose cadastre are in place, emphasis will shift to ongoing support for geodetic control surveying, data base operation, product distribution, and technical assistance.

The conduct of the multipurpose cadastre program will also involve several organizational and administrative activities. The coordinator's role will be expanded to an organizational unit within NGS with responsibility for all aspects of the program. The responsibility will cover internal development and production activities, liaison with and coordination of multipurpose cadastre functions performed by other NOAA units, liaison with State and local governments and professional organizations, management of state and local government prototype and support projects, and management of other NOAA multipurpose cadastre activities including recognition of Centers of Excellence, preparation of publications and guidance, technical assistance, development of standards and specifications, and training.

An important aspect of this function is coordination with other organizations involved in the multipurpose cadastre. Since the overall cadastre is to be developed and operated by organizations at all levels it will be necessary to develop effective coordinating mechanisms to promote effectiveness. The first level of coordination will be within NOAA where separate units will continue to be responsible for field operations, distribution, system development, data base operation, and so forth. The multipurpose cadastre elements of these functions must be coordinated through this program. Next, the activities of several Federal agencies must be coordinated to minimize redundancy and conflict and maximize effectiveness. This will require establishment of a lead agency as recommended by the National Academy of Sciences. NOAA should seek that position.

Numerous State and local governments will also be performing the bulk of the multipurpose cadastre functions. It will be necessary for NOAA to coordinate efforts with these organizations individually as they participate in a joint project with NOAA and collectively through the National Association of

Counties, as recommended by the National Academy of Sciences, or with another coordinating body.

Finally, several organizations (e.g., MOLDS) will be involved with the multipurpose cadastre playing important roles in information dissemination, capacity building and technology transfer, NOAA must establish a coordination mechanism with these organizations.

The main focus of the program will, be on the development and maintenance of the Survey Information Network and on the availability of geodetic control data. NGS will take multipurpose cadastre requirements into consideration in its overall survey operational planning and scheduling. NOAA will also support the development of prototype components and participate in joint efforts for development of individual components. NOAA will operate and maintain its components while state and local governments will be responsible for ongoing operation of their own components and data bases.

NOAA will take the lead in the development and dissemination of standards and specifications for surveys and related elements of the multipurpose cadastre. It will involve others, through the participation of professional organizations, in the development and dissemination activities. Table 12 summarizes Phase 3 activities.

In addition to these primary functions, the NOAA multipurpose cadastre program will include many additional support, coordination, and development activities. Appendix A lists tasks required for implementation of full program.

Table 12.--Phase 3: First Year's implementation of full cadastre program

Continue completion of restructuring National Geodetic Reference System data base
Design Survey Information Network (SIN)
Estimate SIN costs
Distribute existing standards and specifications
Plan for extension of standards and specifications
Continue horizontal and vertical geodetic control activities
Continue and expand cooperative agreements
Continue implementation of Global Positioning System
Continue tidal activities
Establish program of multipurpose cadastre recognition for cities and counties
Plan technical assistance
Train NOAA personnel for technical assistance
Develop technical assistance procedures
Provide technical assistance
Review and plan product distribution
Continue distribution procedures
Publicize availability of products
Continue support of State Plane Coordinate System
Review Federal Government's coordination role
Establish appropriate relationships with other organizations
Determine NOAA's coordination role
Develop State-local program
Conduct briefings, presentations, meetings
Plan prototype program
Fund initial prototype project
Select and document exemplary sites
Publish and publicize prototype experiences

APPENDIX A. TWELVE IMPLEMENTATION TASKS FOR FULL CADASTRE PROGRAM

1. Build Survey Information Network (SIN)

Tasks

1. Analyze survey requirements and survey data
2. Analyze operational environment at each level (local, region, State, national)
3. Analyze relationships among levels and organizations
4. Review National Geodetic Reference System (NGRS) experiences
5. Complete NGRS data base redefinition
6. Produce conceptual design for Survey Information Network (SIN)
7. Produce SIN generic data base network design
8. Produce SIN data base network design
9. Document SIN design document for local, regional, state use
10. Produce SIN design document for local regional, state use
11. Promote SIN design
12. Establish SIN operation
13. Incorporate new NGRS data base into SIN
14. Establish SIN committee (or incorporate into Federal Geodetic Control Committee)
15. Provide technical assistance on SIN implementation and use
16. Establish procedures for updating SIN
17. Maintain SIN

2. Develop Standards and Specifications

1. Continue distribution of existing standards and specifications
2. Promote availability and use of standards and specifications
3. Analyze SIN requirements for standards and specifications
4. Identify additional standards and specifications required
5. Review requirements with appropriate organizations
6. Identify participants in standards development
7. Establish coordination mechanism with Federal, State, and local governments, and private sector.
8. Determine responsibilities for development of standards and specifications
9. Produce draft standards and specifications
10. Review and approve standards and specifications
11. Publish documents describing standards and specifications
12. Publicize availability, value and use of standards and specifications
13. Disseminate documents and information on standards and specifications

3. Coordinate Geodetic Surveys

1. Continue to coordinate horizontal and vertical surveys and tidal measurements
2. Complete operational implementation of Global Positioning System
3. Continue to execute cooperative agreements
4. Review current density of geodetic control
5. Determine multipurpose cadastre control network requirements by States
6. Review plans for surveying requirements estimate status by yearly increments of 5 years and 5-year increments thereafter
7. Establish multipurpose cadastre related priority system

8. Determine rate of increased activity
 9. Promote conduct of geodetic surveys by others
 10. Provide technical assistance on geodetic surveying to others
 11. Solicit State and local mark maintenance support
4. Technical Assistance Program
 1. Analyze technical assistance requirements
 2. Inventory and analyze NOAA technical assistance resources
 3. Produce technical assistance plan
 4. Allocate funds/resources to technical assistance program
 5. Assign technical assistance responsibilities
 6. Produce technical assistance procedures
 7. Produce or acquire technical assistance supporting materials
 8. Train technical assistance personnel
 9. Publicize technical assistance program
 10. Produce guidance material on multipurpose cadastre
 11. Operate, manage, and monitor the technical assistance program
5. Product Distribution Program
 1. Review and inventory available products and distribution operations
 2. Inventory and review related products
 3. Estimate multipurpose cadastre distribution requirements
 4. Determine relationships with prime distribution system
 5. Redesign product distribution and assistance system
 6. Produce related products distribution plan
 7. Establish related products distribution system
 8. Publicize NOAA geodetic products, availability, and acquisition procedures
 9. Establish cost recovery procedures
 10. Continue current operations of National Geodetic Information Center
 11. Modify NGIC operations to accommodate distribution plan
 12. Develop electronic data distribution capabilities
 13. Operate, manage and monitor product distribution
6. Support State Plane Coordinate System (SPCS)
 1. Review SPCS support requirements
 2. Continue to compute SPCS coordinates for geodetic positions for points in NGRS
 3. Continue to distribute computer programs for coordinate transformations
 4. Develop and distribute information on SPCS
7. Coordinate Federal Cadastre Activities
 1. Establish NOAA multipurpose cadastre role
 2. Review coordination requirements
 3. Identify related Federal and non-Federal organizations
 4. Establish relationships with appropriate organizations
 5. Determine level of coordination responsibility to be established
 6. Establish coordination role
 7. Carry out coordination role

8. Develop State and Local Program
 1. Assign State/local coordination
 2. Review NOAA/State and local relationships
 3. Produce program plan

 4. Prepare program materials
 5. Conduct internal briefings
 6. Publicize the NOAA/State and local program
 7. Produce inventory of State and local contacts
 8. Conduct briefings, and presentations, and maintain individual contacts
 9. Conduct State and local program

 9. Conduct Prototype Projects
 1. Review potential prototype and exemplary issues
 2. Review candidate prototype and exemplary sites
 3. Produce prototype project plan
 4. Identify potential cooperating organizations
 5. Select exemplary sites
 6. Review, document, and publish information on exemplary sites
 7. Identify prototypes site(s)
 8. Negotiate with cooperating organizations
 9. Conduct prototype project
 10. Document, publish, and disseminate information on prototype experiences

 10. Conduct Research and Development (R&D)
 1. Review potential R&D requirements
 2. Review available funding and resources
 3. Produce R&D plan and priorities
 4. Select R&D topics
 5. Select personnel/organization to perform R&D
 6. Conduct R&D
 7. Manage R&D program
 8. Document, publish, and distribute R&D results

 11. Develop Training Program
 1. Review internal and external training requirements
 2. Produce training plan
 3. Prepare training and training materials
 4. Select candidates for training
 5. Conduct internal NOAA training
 6. Conduct outside training
 7. Monitor and report training activities

 12. Recognize Centers of Excellence
 1. Review Institute for Modernization of Land Data Systems criteria for selecting Centers of Excellence
 2. Establish recognition criteria
 3. Review candidate centers
 4. Extend recognition to candidates
 5. Support and utilize Centers of Excellence for Cadastre
-

APPENDIX B. NOAA's RESOURCES AND POTENTIAL ACTIVITIES

Legislative and Administrative Responsibilities

1. Public Law 373 authorized activities
Establish and maintain geodetic networks
Measure, analyze and predict tides and currents
Measure Polar Motion
Process and publish data
Perform research and development to increase engineering and scientific knowledge and the geophysical sciences and develop methods, instruments and conduct investigations.
Provide basic data for engineering and scientific purposes and for other commercial and industrial needs.
2. OMB Circular A-16: Coordinate geodetic and related surveying activities of Federal agencies including those funded in whole or in part by Federal funds.
3. Borax Decision - 1935: The Supreme Court Decision in Borax Consolidated Ltd. vs. Los Angeles in 1935 established the mean high-water line along a coast as the base line in bounding riparian right.
4. Submerged Lands Act of 1953 (P.L. 31): The Submerged Lands Act of 1953, in effect, established the mean low water line along a shore as the base line for the determination of the State-Federal boundary.
5. Geneva Convention of 1958 on the Law of the Sea: The convention cites the mean low water line for international boundary determinations.

National Geodetic Reference System:

Infrastructural Reference Systems and Data Bases

1. Horizontal Network Component - North American Datum of 1927/North American Datum of 1983: Geographic Coordinates and State Plane Coordinates for 250,000 points.
2. Vertical Network Component: National Geodetic Vertical Datum 1929/North American Vertical Datum of 1988. Elevations for 500,000 bench marks.
3. Gravity Network Component: Gravity values for 2 million points and 5,000 marked gravity base line points.
4. Tidal and Water Level Datums: More than 5,000 tidal and water level datum points have been established along the shores of the coastal zone states. Mean high water, mean low water and mean sea level elevations have been determined points and lake level elevations at lake level datum points.
5. Nautical Charts: One or more of the marine boundary lines is depicted on every nautical chart although the plate-Federal and the international lines are indicated on a select group.
6. Marine Maps: These are select series of marine maps which incorporate certain base line reference features. The maps include select charts with offshore mineral lease Block attices overlaid, bathymetric maps along the shore, coastal zone maps, and marine boundary maps.
7. Technical Specifications and Standards of Accuracy
 - Geodetic Surveys (Horizontal and Vertical)
 - Geodetic Astronomy
 - Hydrographic Surveys
 - Tidal Datum Determinations
 - Distance Measurement Calibrations
8. Technical Information:
 - Availability List of Geodetic Information (attached)
 - NOAA Catalog of Products and Services
9. Archival Records
 - Geodetic observations
 - Horizontal angles and distances
 - Zenith distances
 - Leveling observations
 - Gravity observations
 - Astronomic observations
 - Tidal observations
 - Shoreline surveys
 - Topographic surveys along the coast
 - Aerial photography
 - Hydrographic survey sheets

APPENDIX C. RELATIONSHIPS OF OTHER ORGANIZATIONS TO CADASTRE

The following discusses organizations with an interest in the multipurpose cadastre and summarizes their current or potential relationship. Information highlights issues that will be important in determining NOAA's roles. In some cases the activities of individuals, beyond the official role of the organization, are discussed to indicate potential directions which the organization may take. The organizations are divided into Federal, professional, and others.

Federal Organizations

U.S. Department of Agriculture (USDA).

The USDA has a broad interest in land related information. It collects and/or maps some data and has a wide interest in using local government data. Three units within USDA have a special interest in the multipurpose cadastre.

Economic, Statistical, Cooperative Service. This organization is interested in access to land data on a nationwide basis. In particular, it was responsible for a study of foreign ownership of United States agricultural lands. A few individuals in the organization have a long-term interest in the multipurpose cadastre and have become recognized personally as leaders in the field. At present, their role is more as interested individuals than in an official capacity.

Area of Interest: Parcel records.

Role: Guidance

Soil Conservation Service. This organization is involved in performing and supporting mapping of soils and other features in counties throughout the country. It has extensive, special purpose, mapping capabilities, and employs a large network of people with land record interest in counties throughout the Country.

Areas of Interest: Environmental (soils) data, cadastral boundaries, survey control

Roles: Map producer, guidance

Forest Service. The Forest Service is responsible for surveying and maintaining maps and data for the lands which it owns and manages. It also has an extensive program of acquisition and processing of physical, environmental, and natural resource data. It does not have a direct interest in the multipurpose cadastre, but its surveys, maps, and data are of interest to the counties where the forests are located.

Areas of Interest: Cadastral Survey, Cadastral Overlay, Environmental Maps and Data

Role: Cadastral Surveyor, Map Producer, Environmental Data Source

U.S. Department of Commerce (DOC).

The DOC has several responsibilities which are closely related to the multipurpose cadastre. The most important of these is the National Oceanic and Atmospheric Administration's (NOAA) responsibility for the Nation's horizontal and vertical control networks included in the National Geodetic Reference System (NGRS). Four other units of Commerce have programs related to the multipurpose cadastre.

Bureau of Census. Census produces and maintains maps of all areas of the country. It is currently embarking on a program to develop a U.S. digital map at a scale of 1:100,000 which will be related to local address and geocode data. It conducts a periodic survey of taxable property values using local land record data. The individuals involved in this effort have analyzed local land data systems and have published information about them. In doing so, they have become recognized experts in the field. Because of its major data collection efforts, the Census has established a network of personnel in local offices and local government contacts with interests in mapping and geographic locations.

Areas of Interest: Mapping, geographic identification, local land records

Role: Information source, contacts with local governments

National Oceanic and Atmospheric Administration (NOAA). NOAA's relationship to cadastre is described in detail in Appendix B. In general, NOAA is responsible for establishing and maintaining the horizontal and vertical geodetic network, which is the recommended geodetic reference framework for the multipurpose cadastre. As a part of this responsibility, NOAA maintains the NGRS, a data base of geodetic information. It also chairs the Federal Geodetic Control Committee which coordinates all Federal geodetic control survey activities and data. At present NOAA is involved in the readjustment of the National horizontal and vertical geodetic networks, an activity which has great significance to multipurpose cadastre activities in the near future. The adjustment will also affect the State Plane Coordinate System which has been recommended for the multipurpose cadastre by the National Academy of Sciences (NAS). NOAA also has responsibility for definition of coastal/marine boundaries and administers the coastal zone management program.

Areas of Interest: Geodetic control, tidal datum

Roles: Expansion and maintenance of horizontal and vertical control networks', maintenance of NGRS and dissemination of data, technical assistance and training, and standards and specifications.

NAS Recommendation: Maintain and densify the geodetic control framework. Publish specifications and standards related to geodetic control surveys.

National Technical Information Service (NTIS). NTIS receives, stores, and distributes technical publications and computer programs produced by Federal agencies or with Federal funding. Included in its holdings are reports on land records, mapping, and computer systems, and land record related computer programs which can be obtained by interested parties. NTIS also operates a

computer system and data base, which assist users in locating items by topic, title, and author.

Area of Interest: Information support

Role: Information dissemination

National Bureau of Standards (NBS). NBS establishes and maintains standards for various entities, a few of which are related to the multipurpose cadastre. Among these area standards for computer systems, graphic data exchange, and Federal Information Processing Standards (FIPS) such as standard place names and identifiers. It also calibrates instruments for geodetic surveying.

Area of Interest: Standards

Role: Publish standards

Department of Defense (DOD).

DOD has some involvement in civilian land records activities. The Corps of Engineers performs surveys, acquires land, and uses local land records in its flood control, navigation, and other projects. The Defense Mapping Agency also performs some domestic surveying and mapping work.

Corps of Engineers (COE). COE performs project related surveys and mapping in limited areas around the country. COE acquires land for some of its projects and in doing so generates and uses cadastral maps and surveys and property data records. In most projects it acquires and processes environmental data for the specific area. It surveys, maps, and analyzes flood potential in selected flood hazard areas. Some of the maps and data from these activities are of value to a multipurpose cadastre.

Areas of Interest: Cadastral survey, large scale mapping, environmental data and maps, land records

Role: Provide maps and data to a cadastre, utilize the cadastre.

Defense Mapping Agency (DMA). DMA performs limited surveying and mapping of domestic lands generally in relation to a defense installation. The products of these activities may be made available for multipurpose cadastre use when not restricted because of national security. The agency also conducts research and development in cartographic and surveying techniques and technology.

Areas of Interest: Control survey, research and development

Role: Provide data on domestic surveys performed. Provide findings of research and development.

Department of Transportation (DOT).

The DOT and particularly its Federal Highway Administration (FHWA) funds the conduct of surveys of roads and rights-of-way throughout the country. It operates predominantly through individual State highway and transportation departments. The focus of its activity is generally project related. FHWA has some limited standards and specifications for its projects. It could potentially provide additional guidance or standards to make surveys and other products more generally useful to the cadastre.

Areas of Interest: Standards

Role: Require grant recipients to follow survey and mapping standards and specifications.

Environmental Protection Agency (EPA).

EPA produces, stores, and disseminates data on environmental and physical characteristics. In general its spatial information is not of high precision. EPA enforces numerous information requirements and has a network of contacts with State and local governments. It also funds local projects for which surveying and mapping are performed.

Area of Interest: Environmental data

Role: Provide environmental data.

Federal Emergency Management Agency (FEMA). FEMA has a nationwide program for production and distribution of flood hazard maps. It also provides information on flood hazard locations to local governments and individuals. A key factor in its mapping program is the ability of local governments and individual property owners to relate accurately flood hazard boundaries to property ownership boundaries. FEMA also has an interest and uses many State and local maps and land records systems for its emergency planning and operation activities. It operates and funds an extensive network of State and local emergency centers.

Areas of Interest: Flood hazard mapping, local maps, and land-use data

Role: Provide flood hazard maps, provide guidance and encouragement to local governments.

Department of Housing and Urban Development (HUD).

HUD administered the Real Estate Settlement Practices Act which conducted research and developed prototype land records systems in several locations. HUD owns an extensive number of land parcels around the country which it acquired through foreclosure of guaranteed mortgages. It continues to guarantee large numbers of mortgages and enforces numerous regulations, some which are related to cadastre records. HUD also regulates interstate land sales and through this process utilizes surveys and land records. Because of these activities it has an interest in improved land records. HUD funds some local land records and mapping activities through its community development and urban action grant programs.

Area of Interest: Juridical cadastre

Role: Require that grant and guarantee recipients meet standards and specifications in surveys, mapping, and land descriptions.

Department of the Interior (DOI).

DOI has major activities and responsibilities in the area of the multipurpose cadastre. It operates the Federal Government's nationwide mapping program through the U.S. Geological Survey (USGS); it manages, surveys, maps, and maintains records on Government-owned land through the Bureau of Land Management (BLM).

USGS. USGS is responsible for the production of standard maps on a nationwide basis at a scale of 1:25,000. This is the most commonly used single map set in the country and is recommended in the NAS study as the base map in rural areas. USGS performs some geodetic control surveying, produces aerial photography, and provides some source materials for a multipurpose cadastre. It conducts pilot projects in large scale mapping and provides advice and guidance on mapping to local, state, Federal, and private organizations. USGS is also involved in major projects to convert operations to automation and serves as the chair of the Federal Interagency Coordinating Committee on Digital Cartography.

Areas of Interest: Large-scale mapping, surveying, standards

Role: Provide standard large scale maps, conduct surveys in accordance with standards and specifications, produce and support standards and specifications for large scale mapping, provide technical assistance.

Bureau of Land Management (BLM). BLM is responsible for federally owned lands. It conducts cadastral surveys, maps Federal ownership, and maintains ownership, status, and other data on Federally owned lands. The BLM maintains the Public Lands Survey System (PLSS) of section corner locations on Federal lands, an activity recognized as part of the multipurpose cadastre by NAS. Individuals of the organization are active in multipurpose cadastre

activities. BLM provides advice to local governments on cadastral surveying and mapping standards and procedures. BLM also publishes the Manual of Instructions for the Survey of the Public Land of the United States.

Areas of Interest: Cadastral surveying and mapping.

Role: Maintain PLSS, provide standards and guidance on cadastral surveying and mapping.

National Aeronautics and Space Administration (NASA).

NASA produces high altitude photography and satellite imagery which are used by Federal, State, local and private entities primarily as a source of natural and physical condition data. NASA also supports and conducts research and development in satellite imagery, aerial photography, and computer technologies.

Areas of Interest: Satellite imagery, high altitude photography

Role: Provide imagery and photography, perform research and development.

Office of Management and Budget (OMB).

OMB oversees all Federal programs. It assigns some organizational responsibilities such as that of Circular A-16 assigning responsibility to the Department of Commerce for National geodetic control networks and for Government-wide leadership in planning and execution of geodetic control activities. OMB will probably determine which, if any, agency will be responsible for coordinating Federal activities in the area of the multipurpose cadastre.

Areas of Interest: Federal management

Role: Assign Federal responsibilities in the multipurpose cadastre.

Tennessee Valley Authority (TVA).

TVA performs and funds surveys and mapping of lands within its area of responsibility, the Tennessee Valley. It also maintains cadastral maps and data for selected lands within its responsibility.

Areas of Interest: Cadastral and control surveying, mapping, environmental data.

Role: Conduct surveying and mapping in accordance with standards and specifications.

Professional and Interest Organizations

National Academy of Sciences (NAS), Committee on Geodesy.

NAS has conducted and sponsored extensive investigations of multipurpose cadastre concepts, techniques, and plans. It has published the key documents on the subject which describe procedures and standards and make recommendations for implementation. Though the Committee remains interested

in the topic, it does not currently have an active program for the multipurpose cadastre.

North American Institute for Modernization of Land Data Systems (MOLDS).

MOLDS is a consortium of Government agencies and professional organizations whose purpose is scientific research and education related to the development and utilization of improved land data systems. MOLDS conducts meetings periodically. It has conducted two major conferences and published proceedings on multipurpose cadastre topics.

National Association of Counties (NACO).

NACO is an organization of county government members which provides information, education, and lobbying services on issues of importance to county government. NACO publishes a newsletter and reports and conducts member meetings. It was recommended by NAS for the key coordination role in the multipurpose cadastre, but may not be in a position to actively pursue that role. NACO is capable of providing support for information exchange and the conduct of meetings.

Council of State Governments.

The Council is a similar organization to NACO operating at the state level. It provides a forum for the exchange of relevant information among member organizations.

American Congress on Surveying and Mapping (ACSM).

ACSM conducts meetings and conferences and publishes materials on mapping and surveying topics, including those related to the multipurpose cadastre. It provides a major conduit for communication with the mapping, photogrammetric, and surveying professions. It is also a focal point for political activity related to surveying and mapping.

American Society of Civil Engineering (ASCE).

ASCE conducts meetings and publishes materials on surveying and other topics related to the multipurpose cadastre. The society is also involved in promoting engineering map accuracy standards.

American Society of Photogrammetry (ASP).

ASP provides a forum for exchange of technical information. It provides guidance, standards and specifications on photogrammetry, including its publication Manual of Photogrammetry. The society is also involved in promoting specifications for large scale mapping, primarily for highways.

American Public Works Association (APWA).

APWA conducts meetings and publishes materials on surveying and mapping among other topics of interest to local public works departments. Through its CAMRASII it is supporting the development of guidance, specifications, and standards for the automation of large scale mapping systems.

American Association of State Surveyors.

Association provides a forum for the exchange of technical information among members on surveying issues. It encourages improvements in professional practices and promotes new and improved techniques.

International Association of Assessing Officers.

As a part of its area of interest the association provides a forum for information exchange on parcel data systems and large scale cadastral or tax mapping. Individuals of the organization are active in multipurpose cadastre activities.

American Bar Association (ABA).

The ABA has participated in prior multipurpose cadastre and land records activities, particularly in the areas of title search, juridical cadastres, and parcel indexing. It is also active in political activities in these areas.

American Land Title Association.

The association is interested in parcel indexing, cadastral mapping, and title searching issues and techniques. It is concerned about land registration systems or other techniques which may conflict with its market sector.

National Association of County Recorders and Clerks.

The association is interested in land records and parcel indexing systems. Individuals have been active in multipurpose cadastre activities.

Urban and Regional Information Systems Association (URISA).

URISA conducts an annual meeting, workshops and local meetings, and publishes proceedings and newsletters on government automation. Land records, automated mapping, and environmental resources are the three major interest areas. URISA provides a technical exchange on these topics. Members are particularly active in decisions regarding cadastre issues in local government.

Lincoln Institute of Land Policy.

The Lincoln Institute performs research and conducts training in areas related to land policy and land taxation. Included in its training program are land records, land management, and parcel information systems. Individuals from the institute have been active in the multipurpose cadastre activities including chairing the NAS Panel on a Multipurpose Cadastre.

Other Organizations and Programs

University of Wisconsin.

The university has a long standing interest in the cartographic and land economics fields affecting a multipurpose cadastre. Personnel have participated in research and development projects including particularly those in Dane County which has been a key prototype site. Wisconsin is currently conducting a course on the multipurpose cadastre, with several senior experts nationwide giving lectures. It is anticipated that a book will result from this effort. The university also publishes a land information newsletter and is actively pursuing the Center of Excellence status as recommended by NAS.

University of Maine at Orono.

This university has also been very active in the multipurpose cadastre field. It has conducted major conferences on land records and has been performing research for the FGCC in related areas, including the value of geodetic control. It too is actively pursuing Center of Excellence status.

States.

Most states have some activities related to multipurpose cadastres. The level of activity and areas of interest vary from state to state. All have the potential to support activities within the State but few do so at present. The areas in which States operate include: State-enabling and regulatory legislation, survey (conduct, regulate, and coordinate), mapping (conduct and provide technical assistance), assessing (regulate, guide, or conduct), natural resources (establish inventories, regulation, and plan) roads and highways (survey, map, and plan), land ownership and management, and public utility regulation.

NAS has recommended that each State form an Office of Land Information Systems to: coordinate activity, review plans, provide technical advice, provide financial assistance, develop guidance, establish standards, enforce standards, and review contracts within the State for conformance to survey, map, or other cadastre standards. Utility regulation boards are also recommended to require conformance to survey, map, or other standards.

Florida.

The Florida Resources and Environmental Analysis Center of Florida State University has undertaken a Land and Boundary Information System (LABINS). The project intends to implement ten elements including horizontal and vertical control points, tidal benchmarks, mean high water line surveys, and coastal control setback line surveys. An advisory committee has been formed and a survey of sources and formats for existing machine readable data bases has been conducted. LABINS is being undertaken as a part of a multipurpose cadastre for Florida.

North Carolina.

The State of North Carolina formed the N.C. Land Records Management Program (LRMP) in 1977. LRMP is working to develop a State-wide set of multipurpose cadastres through a program of technical and financial assistance to county governments. The program focus is primarily on revamping county base and cadastral maps and the assignment of geocoded parcel identifiers. The longer term goal is automation of many county land records. The project is operated at the State level with a few staff members who provide technical assistance and administer the grants-in-aid. Many counties are participating in some aspect of the program.

Local Governments.

City and county governments will carry the major responsibilities for the actual development and use of the multipurpose cadastre. They will utilize the geodetic control, produce or contract for production of large-scale base maps and cadastral and other overlays, build related land records systems, and update and operate all of these components. They will also be the predominant user of the multipurpose cadastres.

Many local governments are currently involved in control densification, large-scale mapping, map automation, and land records system development projects. There is currently a major movement to acquisition computer mapping systems and automate mapping operations, which is stimulating great interest in issues related to the multipurpose cadastre. More and more cities and counties are making decisions and commitments regarding new mapping systems and whether or not to base them on a geodetic reference framework, or to use some expedient approach. Most local governments are finding adequate geodetic control unavailable and densification very expensive. The automated mapping systems being developed, however, are generally intended to serve multiple purposes with several layers of overlay features which must be related to each other through a common control reference.

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