The Evolving Alaska Mapping Program

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ABSTRACT: Historical events mold and accelerate needed action. For Alaska, the purchase, the discovery of gold, World War II, and statehood have triggered phases of activity of immense importance to Alaskan development. Similarly, there is no doubt that the Prudhoe Bay oil discovery has had a significant effect because of intensive Federal, State, and private interest. Development of other natural resources long known in the Arctic is being expanded along with the present activity on the North Slope. It has long been recognized that topographic maps are a necessary base for resource investigations and other development, and that the necessary mapping support must be forthcoming. This paper describes the development of mapping in Alaska, the current status of the National Mapping Program, and future plans for expanding and improving the mapping coverage. Research projects with Landsat Multispectral Scanner and Return Beam Vidicon imagery and real- and synthetic-aperture radar; image mapping programs; digital mapping; remote sensing projects; the Alaska National Interest Lands Conservation Act; and the Alaska High-Altitude Aerial Photography Program are also discussed.

EARLY DEVELOPMENT OF ALASKA MAPPING

In 1867, shortly after purchase of Alaska from Russia, the National Geodetic Survey became active in compiling and publishing charts of Alaskan waters. Much early work had been done by exploratory expeditions and by officers of the U.S. Army and Navy. Surveys to locate the international boundary between Alaska and Canada were begun in 1888 by the Canadian Government, followed by extensive triangulation and astronomical work by the U.S. Coast and Geodetic Survey (now the National Geodetic Survey). Systematic mapping, charting, and geodesy in Alaska dates from about this time. Great impetus was furnished by the discovery of gold and the development that followed. The increased interest in mineral resources prompted the Congress to appropriate funds to the U.S. Geological Survey for a systematic program of geologic and topographic surveys of the interior of Alaska that continued until World War II.

The remote, difficult terrain of much of Alaska encouraged the development of new techniques in surveying and mapping. Terrestrial photogrammetry by the International Boundary Commission was used on Alaska surveys as early as 1894. The need for reconnaissance mapping prompted the design and use of the first American multi-lens camera by J. W. Bagley of the Geological Survey, before World War I.

Extensive aerial photographic coverage was flown by the Navy between World War I and World War II. The U.S. Coast and Geodetic Survey developed new and advanced techniques and instrumentation for coastal charting in Alaskan waters. It was in Alaska in 1940 that trimetrogon mapping was first used by the Geological Survey in cooperation with the Army Air Corps.

Mapping in Alaska from the 1900s through the 1940s was oriented in large measure to the extensive geologic and mineral-resources exploration that the Geological Survey had undertaken. Reconnaissance maps of large areas were made for general studies and research, while larger scale maps were produced in smaller areas in specific support of mineral and mining studies related to such commodities as gold, copper, coal, oil, and tin. By 1946, at the end of World War II, about half of Alaska was covered by a non-uniform series of maps, mostly made by planetable methods but with increasing support from the new developments in photogrammetry. The reconnaissance-type maps were generally at 1:250,000 scale with 200-foot contours, prepared by joint geologic-topographic parties of the Geological Survey. The larger scale mapping was often done at the scale of 1:62,500 but usually covered limited areas, for the most part confined to the Seward Penninsula, and local communities such as Fairbanks and Juneau.

Shortly after World War II, the need for a complete series of 1:250,000-scale maps was recognized. In 1948, the Air Force and the Navy began to photograph large blocks of coverage with vertical single-lens cameras. Using all available source material including published maps and charts, trimetrogon manuscripts, land plats, and field surveys, the Alaska Reconnaissance Topographic Map Series was produced. The series was completed in 1953.

An important milestone in the photogrammetric production of Alaska maps was reached when the Geological Survey mapped the Brooks Range in 1956-57. This remote rugged area, mostly north of the

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Arctic Circle, was mapped at 1:250,000 scale from transverse twin-low-oblique photography. The project was flown by a private contractor, compiled at 1:63,360 scale, and reduced for publication to 1:250,000 scale. The project area covered about 120,000 square miles, and fieldwork was completed in a single season.

INTRODUCTION OF THE 1:63,360 SERIES

A new Alaska mapping program was begun in 1948 to serve both civil and military requirements. The scale chosen for the 15-minute series was 1:63,360, exactly one inch to the mile, with contour intervals of 50 or 100 feet. A system was adopted which divided Alaska into 153 quadranges, each covering 1 degree of latitude and 3 degrees of longitude north of 59th parallel and 2 degrees of longitude south of 59th parallel. Each of these 153 Quadrangles was subdivided into 20 to 32 quadrangles covering 15 minutes of latitude by varying degrees of longitude. To support mapping in this system, the U.S. Coast and Geodetic Survey added several arcs of triangulation. Also, the existing photography was mostly trimetrogon, which was suitable for small-scale compilation only.

The 29th and 30th Engineer Topographic Battallions performed extensive map control surveys in the early 1950's in northern and western Alaska and on the Alaska Peninsula for map compilation by the Army Map Service (AMS) (now the Defense Mapping Agency and various private firms under contract to AMS. A total of 777 quadrangles (about 195,000 square miles) at 1:50,000 scale were compiled. The scribed color-separation materials were turned over to the Geological Survey as the Army Map Service completed them, and civil editions at 1:63,360 scale were completed by 1971.

There was only a map maintenance program in Alaska except for 1:24,000 scale efforts around Fairbanks and Anchorage from 1961 to 1970, when continuation of 1:63,360-scale mapping was accomplished along the proposed Trans Alaska Pipeline route.

CURRENT STATUS OF TOPOGRAPHIC MAPPING IN ALASKA

Alaska High-Altitude Aerial Photography Program

In 1978, the State of Alaska, along with eight Federal agencies in Alaska, signed an agreement to fund a joint Alaska High-Altitude Aerial Photography (AHAP) Program to be flown by National Aeronautics and Space Administration. Imagery for 95 percent of the State has been acquired through this program, and additional coverage is expected during the 1986 season. The State/multi-Federal agency contract with National Aeronautics and Space Administration provides for dual-camera coverage using one 9- by 9-inch format, high-resolution precision camera with a 6-inch focal length using black-and-white film, and a second 9- by 9-inch camera with a 12-inch focal length using color-infrared film. The overall objective of the program is to acquire imagery which is statewide in scope, consistent in scale, uniform in film quality, and which meets the maximum number of user needs in a timely and cost-effective manner.

The Geological Survey has been a major participant in the AHAP Program to obtain photographic coverage for map revision, orthophotoquad, and vegetation and land-cover mapping programs in Alaska.

1:25,000-Scale Topographic Maps

The Survey has an ongoing program to produce 1:25,000-scale maps for urban areas, transportation corridors, and rural areas being developed for agricultural purposes. Projects are in work to provide coverage for Valdez, Cordova, Seward, Willow South, Whittier, a portion of the Kenai Peninsula from north of Kenai to Seldovia, areas in southeast Alaska, and the City of Kodiak. Maps of the Anchorage area were published in 1980, 15 of which were orthophotomaps. Cartography for the Valdez, Cordova, Seward, and Willow South projects has been completed. Valdez and Cordova are being published as standard editions, whereas Seward and Willow are being published as provisional maps. The remaining 1:25,000-scale projects will also be published as provisional maps.

With the exception of the Petersburg and Wrangell projects in southeast Alaska (ten quadrangles), the Survey has completed all fieldwork for authorized projects in the 1:25,000-scale program. The next project to be worked is the Fairbanks area, which is primarily covered by 1:63,360-scale published maps, some of which were last photorevised in 1975. There are also five 1:24,000-scale maps published in 1966 that cover the Fairbanks urban area. The Survey plans to compile 16 new 1:25,000-scale maps adjacent to the Fairbanks urban area, and to convert the five existing 1:24,000-scale maps to 1:25,000 scale to provide a consistent presentation over the entire Fairbanks area.

To provide coverage at 1:25,000 scale for the major village areas such as Bethel, Kotzebue, and Nome, the Survey is proposing a new map product consisting of an inset at 1:25,000 scale to the accompanying 1:63,360-scale quadrangle. The villages being considered for this 1:25,000-scale mapping encompass a small geographic area, and it is not practical to prepare complete 1:25,000 quadrangle maps in these areas.

There is much interest from the State and from oil companies for new maps at 1:25,000 scale for the Prudhoe Bay and Kuparuk oil production areas. The Survey prepared twelve 7.5-minute orthophotomaps at 1:24,000 scale for the Prudhoe Bay area in 1970. These maps combine the photoimagery with the traditional line portrayal to produce a more

comprehensive map, especially in areas of extensive wetlands. However, the maps are outdated and need revising. The construction of roads, buildings, and drilling pads in the Kuparuk and Prudhoe Bay areas should be complete by 1986 and it would be an appropriate time to initiate a mapping program. "As-built" surveys are being prepared for the State by Standard Oil of Ohio. Standard Oil of Ohio and Atlantic Richfield Company have an ongoing mapping program that produces a wide variety of maps and products from 1:63,000 to "as-built" surveys to satisfy in-house and State-Federal requirements. This effort is under contract to local surveying and mapping firms.

1:63,360-Scale Topographic Maps

The Survey is actively closing the gap with the intermediate-scale mapping program to provide coverage of the State at 1:63,360-scale in those areas where only 1:250,000-scale maps exist. At present, 84 percent of Alaska has been published in the 15-minute series and another 11 percent of the State is in work. The remaining 5 percent is in the Aleutian and Pribolof Islands and will be worked on a target-of-opportunity basis.

Currently, there are 355 15-minute quadrangle maps in work. Of these, 258 are being worked under the provisional concept which will enable complete coverage of Alaska, including a portion of the Aleutian Islands, by 1989. Most of these maps being replaced were produced during the 1950's, and were not designed to meet National Map Accuracy Standards. Only a small percentage of these quadrangles have been revised and updated, such as the 44 quadrangles along the Trans Alaska Pipeline.

Thirty-five quadrangles in the Aleutian Islands are currently in work under a contract to International Technology Limited and North Pacific Aerial Survey. The remaining quadrangles in the Aleutian Islands will be worked when aerial photography becomes available.

The 1964 Alaska earthquake also rendered some of the maps obsolete and others need revision of cultural and hydrographic features. A program is being developed to use the new AHAP photographs to photoinspect and revise the published 1:63,360-scale topographic maps. To meet user needs, such as the Alaska National Interest Lands Conservation Act requirements and the Bureau of Land Management's cadastral surveys and the plotting needs for lands being withdrawn under the Alaska Native Claims Act, the Survey plans to begin a photoinspection and photorevision program for this map series.

Currently there are thirty-six 15-minute quadrangles authorized for complete revision. The quadrangles cover a large portion of the Chugach National Forest. Aerial photography was acquired for the area during the 1982 and 1983 flying season. Field operations were completed in the summer of 1984. There are also several 15-minute reprints that are undergoing some limited revision work, especially in the areas where wildlife refuge and national park boundaries have changed.

Statewide Orthophotoquad Program

The Survey's 1:63,360-scale orthophotoquad program in Alaska began with a Memorandum of Understanding between the Bureau of Land Management and the Geological Survey in 1980. There were two types of products produced under this agreement, standard orthophotoquads and nonstandard orthophotos. For the standard orthophotoquads, the Survey is using horizontal and vertical control, aerotriangulation methods, and scanning techniques to meet National Map Accuracy Standards. Aerotriangulation has been performed using the best available control as constraints and the adjustment performed in large blocks to obtain the best relative accuracy. Both rectification and scanning techniques were used to produce the nonstandard orthophoto imagery, but because the accuracy of this product was unknown, it contained the statement "The accuracy of this rectified image has not been determined." Initial funding for the nonstandard orthophoto products was on a fully reimbursable basis.

With the initial Bureau of Land Management requirements for nonstandard orthophoto products complete, the thrust by the Survey has been for the production of standard orthophotosquads. In support of the Alaska National Interest Lands Conservation Act, supplemental funds have been provided to augment the production of orthophotoquads to support Bureau of Land Management requirements.

To meet the long-term needs of a statewide orthophotoquad program in Alaska, a unified and improved system of horizontal and vertical control had to be established. The Geological Survey recognized that an optimum control system could be achieved if the State and Federal agencies now working in Alaska coordinated their efforts in advanced surveying and photogrammetric techniques. The Survey proposed such an effort to the Federal Geodetic Control Committee on 3 June 1982. Considerable coordination has occurred among the National Oceanic and Atmospheric Administration, Defense Mapping Agency, and the Survey, resulting in a thorough review of existing control, establishment of additional points and ties, and an accelerated readjustment of the datum in Alaska (NAD 83).

In 1982, the Survey developed a joint funding agreement with the Alaska Department of Natural Resources for 1:63,360-scale orthophotoquads. For fiscal years 1982 and 1983, the agreement was for $250,000 State funds matched by $250,000 federal funds each year. In 1983, an amendment was made to extend the agreement for another year and to

provide an additional $250,000 from both parties. The statement of work and priorities were prepared by the Association of Village Council Presidents and the Calista Native Corporation, for the Lower Yukon and Kuskokwim area. Additional geodetic control was established during the 1984 field season before the high priority work under this amendment could be accomplished. The State of Alaska was also instrumental in developing a special contract with the Geological Survey to produce orthophotoquads for the Norton Sound area. The project covered 23 1:63,360-scale quadrangles and was completed in September 1983.

Currently, 1,827 1:63,360-scale orthophotoquads have been authorized for the Program to support both State and Bureau of Land Management requirements in those areas where adequate geodetic control exists, the control is photoidentifiable, and suitable imagery exists. Funding for the statewide program is from Geological Survey base and supplemental funds, along with cost-share funds from the State. As of January 1986, 556 orthophotoquads have been completed and delivered to the Alaska Department of Natural Resources and the Bureau of Land Management State Office.

1:250,000-Scale Topographic Maps

When compilation of the 1:63,360-scale mapping is complete for a given 1:250,000-scale area, the Survey is able to complete a 1:250,000-scale topographic map through series conversion. The 1:250,000-scale quadrangles covering Alaska are, therefore, some of the most accurate maps in the United States. For those areas not covered by 1:63,360-scale maps, the 1:250,000-scale quadrangles are still part of the original reconnaissance series. These are the Rat Islands, Amukta, Samalga Island, Umnak, Unimak, False Pass, Port Moller, and the Pribilof Islands. The final 1:63,360-scale sheets of the Port Moller area have just been compiled, and this 1:250,000-scale map could be produced in the topographic series. The Unimak quadrangle will be part of the contract mapping project mentioned above. The Survey recognized the need and has been revising this series to meet requirements to publish the new proclamation boundaries established by the Alaska National Interest Lands Conservation Act of 1980. Since 1981, 96 of these quadrangles have been revised or are in work.

Topographic/Bathymetric Products

Through a cooperative program with the National Ocean Service, the Survey is preparing 1:250,000-scale topographic/bathymetric map products under a work-share agreement. The agreement provides for the National Ocean Service to furnish the bathymetry and the Geological Survey to incorporate the data into topographic products. One sheet (Icy Bay) is published, three (Solomon, Tyonek, and Nome) are nearing publication, and five others (Anchorage, Kenai, Seward, Illiamna, and Seldovia) are authorized. The National Ocean Service has agreed to furnish bathymetric data for additional 1:250,000-scale quadrangles, but a schedule for delivery has not yet been established. In addition to bathymetry, these topographic maps will show the Minerals Management Service's Outer-Continental Shelf Protraction Diagram, which depicts lease-block areas.

SPECIAL PRODUCTS

Landsat Image Mapping

The Geological Survey prepared 25 1:250,000-scale Landsat image maps of the north slope of Alaska (area north of the 68th parallel) for the Minerals Management Service in 1982. Original plans were to use only Return Beam Vidicon (RBV) images. However, due to the lack of suitable RBV imagery, multispectral scanner imagery was used for 11 of the quadrangles.

In January 1983, the Survey initiated a user survey of four renditions of the experimental Meade River Landsat-3 RBV image map and one experimental rendition of the Ikpikpuk River image map. Two hundred copies of each map were distributed at the 18th Annual Alaska Surveying and Mapping Conference in Anchorage, and 25 copies of each map were sent to Geological Survey Mapping Centers for evaluation by State organizations. The purpose of the user survey was to solicit appraisals of the experimental image maps in Alaska. The renditions included two major printing techniques, three methods of portraying geographic names, and products with and without cultural information.

In addition to the five photoimage maps, an information document was included to record user responses. The intent of the document was to identify the acceptability of using screenless printing techniques, using conventional half-tone screens, portraying geographic and cultural features in highlights, and printing in duo- or mono-tone renditions. Four of the image maps were selected for distribution at the Geological Survey Polar Research Symposium held at the National Academy of Sciences in Washington, D.C., 12-14 October 1983. The image maps selected were the Teshekpuk, Beechey Point, Chandlar Lake, and Arctic quadrangles.

The image maps were printed in March 1984 and are available for sale by the Geological Survey. The Survey is contemplating reprinting the Landsat image maps on a case-by-case basis with their companion standard topographic maps on the reverse side when the latter are revised and (or) reprinted.

Federal Lands Subject to Mineral Restrictions Map

One special product of interest is the Federal Lands Subject to Mineral Restrictions Map recently completed. The map was printed on two sides, one side showing the conterminous United States, and

the other side showing Alaska and Hawaii. The map was published at 1:7,500,000 scale, and a text accompanies the map to explain restrictions against mineral development.

Alaska National Interest Lands Conservation Act Maps

To help implement the Alaska National Interest Lands Conservation Act of 1980, a review of cartographic data, maps, and other products was made by the Geological Survey. Two Alaska maps showing the conservation act designations were printed by the Survey, 1:5,000,000-scale map and a 1:2,500,000-scale map. The Survey also prepared the same legislative data at 1:250,000 scale. These maps were published by the Survey in two colors and are the official boundary maps for the United States Government. The maps are available for inspection locally from the appropriate management agency offices and are for sale by the Survey in Alaska. An accompanying legal description will be published, pending final review by the State of Alaska, in the *Federal Register*. The 1:250,000-scale topographic quadrangles affected by the act are being revised and will reflect the new legislative designations.

Side-Looking Airborne Radar Map Products

The House/Senate conference report on H.R. 4930, 1980, stated that the U.S. Geological Survey should "begin the use of side-looking airborne radar imagery for topographic and geologic mapping, and geological resource surveys in promising areas, particularly Alaska." In response to this mandate, the Survey acquired radar data in 1980 and began scientific studies to analyze and interpret these data. About 70 percent of the project funding was used to acquire radar imagery and to evaluate Alaskan applications.

The imagery acquired is X-band (3 cm) because of its more favored use for geologic interpretation. This shorter wavelength radar has better reflection characteristics, hence better image resolution, than longer wavelength radar. Two project areas, the Northern Alaska Project area and the Alaskan Peninsula Project area, were flown in the summer of 1980. The third project area, the Aleutian Islands, was flown in August and September 1982.

To assist with the evaluation of different types of side-looking airborne radar, the Survey acquired both real- and synthetic-aperture radar imagery in various modes: one-look, two-look, and two-look stereoscopic, each for selected areas. The radar imagery was acquired under separate contract with Aero Service Division of Western Geophysical Company using the GEMS 101 radar system and with MARS, Incorporated using the APS 94 radar system. Synthetic-aperture strip images and mosaics were purchased from Aero Service Division of Western Geophysical Company for the 13 quadrangles on the Alaskan Peninsula.

Stereoscopic strip images in both northwest and southeast look directions and the corresponding mosaics were obtained for three of these quadrangles: Bristol Bay, Ugashik, and Karluk. The data acquisition contract with MARS, Incorporated included coverage of these same three quadrangles with real-aperture stereoscopic strip images and corresponding mosaics in both north and south look directions. Similar strip images and mosaics in two-look directions also were acquired by MARS, Incorporated for the eight quadrangles in the Northern Alaska Project. Synthetic-aperture strip images, in a north look direction only, were acquired under contract with Aero Service Division of Western Geophysical Company for the Aleutian Islands project area.

A report, U.S. Geological Survey Open-File Report 81-1358, *Evaluation of Radar Imagery for Geodetic and Cartographic Applications*, has been prepared based on the 1980 radar data acquisitions. The 1982 radar imagery for the Aleutian Islands was used by the Survey to construct controlled 1:250,000-scale image mosaics. Lithographic prints of these mosaics were published back-to-back with the accompanying 1:250,000-scale line map and were available in the spring of 1985.

Federal Mineral Land Information System

A new Geological Survey program is the Federal Mineral Land Information System (FMLIS). The purpose of FMLIS is to provide existing land status and description data and mineral occurrence and mineral potential data in digital form integrated through a geographic information system to land managers, policymakers, and others involved in resource development issues. Alaska has been selected to be the first State for data input into FMLIS. The Bureau of Land Management's Automated Land Record System is being used to provide land status and description data. Mineral occurrence and mineral potential data are being prepared from the Survey's Regional Alaska Mineral Resource Assessment Program and Alaska Minerals Resource Assessment Program. In addition, the Survey has a 1:2,000,000-scale digital cartographic data base available for Alaska. The effort in Alaska is providing a good test of capabilities of FMLIS and feedback on the system from a variety of interested users.

VEGETATION AND LAND-COVER MAPPING

Since 1976, offices of the Geological Survey's National Mapping Division have been engaged in numerous cooperative land-cover and vegetation mapping projects, using digital Landsat multispectral scanner data together with digital terrain data, with several State and Federal resources management agencies. Several of the major land-cover mapping activities are summarized in the following sections. Land-cover classifications resulting from these projects can be ordered from the Geological Survey in both map and digital tape format.

National Petroleum Reserve, Alaska

The National Petroleum Reserve, Alaska (NPRA) was mapped by the Geological Survey using computer-aided analysis of Landsat digital data. The land-cover classification scheme devised for the 97,000-square kilometre area (23 million acres) was based on plant communities optimally delineated with Landsat multispectral scanner data. Digital tapes and photocopy maps containing land-cover classifications for Barrow, Wainwright, Meade River, Teshekpuk, Harrison Bay, Utukok River, Lookout Ridge, Ikpikpuk River, Umiat, Misheguk Mountain, and Howard Pass 1:250,000-scale quadrangles are available. U.S. Geological Survey Open-File Report 81-0315 describes the results of the mapping in NPRA.

Arctic National Wildlife Refuge

A land-cover map of the coastal plain of the Arctic National Wildlife Refuge was produced by the Survey for the U.S. Fish and Wildlife Service (FWS). The FWS used the map as part of an environmental impact statement which addressed potential exploration for oil and gas along the coastal plain of the wildlife refuge. A 1:250,000-scale land-cover map, I-443, was prepared in cooperation with the FWS and the U.S. Army Cold Regions Research and Engineering Laboratory. The 12 classes of vegetation and land cover were produced from digital analysis techniques using Landsat multispectral scanner data.

Beechey Point and Sagavanirktok Quadrangles

The Geological Survey is currently working on a report and land-cover maps for the Beechey Point and Sagavanirktok 1:250,000-scale quadrangles. Both maps will be similar to the wildlife refuge coastal-plain land-cover map, but will be based on the standard 1:250,000-scale quadrangle format. These maps are also a Landsat-derived product, whereby the classification of vegetation and land cover is a result of machine processing of digital Landsat Multispectral Scanner data.

Interagency Land-Cover and Terrain Maps

The Geological Survey EROS Field Office Anchorage, Alaska, has been using a digital image processing computer (IDIMS) to produce land-cover and terrain maps in Alaska since March 1980. Survey personnel, together with their government cooperators and operational IDIMS users, have produced or are currently working on land-cover classifications for over 245 million acres in Alaska through digital analysis of Landsat and digital terrain data. Table 1 lists the cooperating agency, project name, and size of land-cover mapping projects completed or in progress in the State.

Geological Survey Interim Land-Cover Mapping Program for Alaska

As a result of the land-cover mapping effort performed by Geological Survey offices, the Survey was given tentative approval to produce a land-cover map series for Alaska based upon a 1:250,000-scale quadrangle format. The map series would utilize the existing land-cover classifications produced for various agencies, but would reformat the maps according to a statewide interagency land-cover classification legend. In 1984, two interagency workshops were conducted, which resulted in concurrence on a statewide classification legend for Alaska. In 1985, this legend was used in the formatting of land-cover classifications for six 1:250,000-scale quadrangles. They include (a) the Fairbanks quadrangle, based on classifications produced by the U.S. Forest Service; (b) the Valdez quadrangle, based on classifications produced by the Survey for the Alaska Department of Natural Resources; (c) the Dillingham quadrangle, based on classifications performed by the State of Alaska Department of Natural Resources in cooperation with the Survey and the U.S. Fish and Wildlife Service; (d) the Arctic quadrangle, based on classifications produced by the Survey for the U.S. Fish and Wildlife Service; (e) the Mount Michelson quadrangle, based on classifications by the Survey for the U.S. Fish and Wildlife Service and the U.S. Army Cold Regions Research and Engineering Laboratory; and (f) the Meade River quadrangle, based on classifications by the Survey for a Bureau of Land Management environmental impact statement. Prototype lithographic maps are being prepared by the Survey in Reston, Virginia.

SMALL-SCALE MAP PRODUCTS

1:1,000,000-Scale Maps

The statewide 1:1,000,000-scale International Map of the World (IMW) map coverage, consisting of 18 maps, is available. Thirteen of the maps were prepared by the Army Map Service in 1956 and two maps were prepared by Canada in 1969. The remaining three maps were prepared by the Geological Survey in 1971 in accordance with the United Nations 1962-1964 IMW specifications. There are no current plans to revise or update the maps at this time.

State Base Maps

State base maps are available at scales of 1:1,584,000 (Map B), 1:2,500,000 (Map E), 1:5,000,000 (Map A), and 1:12,000,000 (Map C). These maps are also available in several editions, i.e., planimetric, topographic, and shaded relief. The Alaska Maps B and E are currently being revised to show the recent legislative changes in the national parks, national forests, wildlife refuges, wild and scenic river systems

TABLE 1. ALASKA LAND-COVER MAPPING PROJECTS

AGENCY	ACREAGE
Bureau of Land Management	
National Petroleum Reserve, Alaska	23 million*
Unalakleet	6 million*
Anvik-Bonasilla	8 million*
Iditarod-George (in progress)	5 million
Kvichak	2 million*
TOTAL:	44 million
U.S. Forest Service	
Tanana River Basin	35 million*
Southeast Alaska (in progress)	35 million*
TOTAL:	70 million
U.S. Fish and Wildlife Service	
Tetlin National Wildlife Refuge	1 million
Yukon Flats	10 million*
Kenai National Wildlife Refuge	4 million
Arctic National Wildlife Refuge	20 million*
Kanuti National Wildlife Refuge	2 million
Yukon Delta National Wildlife Refuge (in progress)	20 million
Koyukuk National Wildlife Refuge (in progress)	8 million
Nowitna National Wildlife Refuge (in progress)	3 million
Selawik National Wildlife Refuge (in progress)	3 million
Innoko National Wildlife Refuge (in progress)	4 million
TOTAL:	75 million
Alaska Department of Natural Resources and U.S. Fish and Wildlife Service	
Bristol Bay	40 million
TOTAL:	40 million
Alaska Department of Natural Resources	
Copper River	16 million
TOTAL:	16 million
GRAND TOTAL:	245 million

*Analysis for these projects performed by agency personnel; analysis for all other projects performed by U.S. Geological Survey or cooperatively with other agencies.

boundaries, and other cultural and geographic features.

The Survey has suggested using a new map projection for Map B and E. The current projection is a Modified Transverse Mercator. However, it is not a Transverse Mercator, and lacks the conformal characteristics of a Universal Transverse Mercator Projection. It is also not equal-area, but approximates an Equidistant Conic Projection. The Survey has recommended a new Conformal Map Projection developed by computer on which the scale varies less than $+0.3$ percent from the nominal scale for all the land, islands, and adjacent waters of the State. This is only a fourth of the variation of $+2.0$, -0.4 percent using a standard Lambert Conformal Conic Projection.

DIGITAL DATA

The Survey recognizes that digital cartographic and geographic data are needed as Federal, State, and local agencies respond to their newly legislated responsibilities. Most land and natural resource managing agencies are well along in developing computer-based information and management systems that require digital cartographic and (or) geographic data as a reference base. These agencies are adopting computer-based systems because the manually, graphically oriented procedures previously used do not permit the rapid analysis of large amounts of data associated with land management decisions.

At present the only digital data available for Alaska are the 1:2,000,000-scale planimetric digital data base, digital terrain data at 1:250,000 scale, and a small project at 1:25,000 scale currently in work. The Survey digitized the 1:2,000,000-scale National Atlas sectional maps to provide a small-scale data base in

a relatively short time. This data base of planimetric features, drainage, transportation networks, and political boundaries was completed in 1981. The digital terrain data at 1:250,000 scale were prepared by the Defense Mapping Agency directly from contour drawings. Digital line graphs (DLGs) and digital elevation models (DEMs) are being prepared for 31 1:25,000-scale quadrangles (Big Lake Project) within the Anchorage area. The DLGs, land net, and boundaries for the 31 quadrangles have been completed. The DEM work on this project has been split using two methods; line following techniques and scanning. DEM for ten of the quadrangles have been completed. At this time no 1:63,360-scale quadrangles have been authorized for digitizing; however, a Geological Survey/Alaska Department of Natural Resources cooperative research mapping project has recently been approved to investigate revision and digitization of the hydrologic data layer for the 1:63,360-scale map series.

GEOGRAPHIC NAMES INFORMATION SYSTEM

The Geographic Names Information System (GNIS) data base is in preparation and is expected to be an important component of the National Digital Cartographic Data Base. From this data base the Survey will publish the first complete gazetteer of the United States on a State-by-State basis. More importantly though, the more than 2 million names in the system, all spatially identified and feature coded, are being made available in computer form on tapes, as computer printouts, and as microfiche. At this time only phase one of the GNIS for Alaska has been completed, and the information needs to be edited. The Survey is working on a cooperative agreement with the State of Alaska to begin editing the GNIS for Alaska and to complete phase two.

STATE MAPPING ADVISORY COMMITTEE

In 1980, the State Mapping Advisory Committee was reactivated after many years of inactivity. The purpose of the committee, which is composed of State mapmaking and map-using agencies, is to consider and report statewide interest, needs, and requirements for topographic maps, basic cartographic data, orthophotoquads, and other map products, and to allow coordinated budgeting and priority setting for the Geological Survey and State projects in Alaska. Continued committee efforts are necessary to ensure mapping needs and priorities are addressed from the State agencies; to exchange information on mapping efforts in which the various Federal and State agencies are engaged; to determine where certain expertise, capabilities, and cooperative efforts can be utilized to increase map production opportunities and decrease chances for duplication of efforts; and to review existing agreements and develop recommendations for changes.

INFORMATION AND DATA SERVICES

Alaska Office

To meet the major objectives of the National Mapping Program for Alaska in 1980, the Geological Survey established the Alaska Office within the National Mapping Division. The Alaska Office directs and coordinates with the Mapping Centers all Division activities in Alaska. This office is directly under the Chief of the Division and is staffed with experts on space and aerial imagery, cartography, photogrammetry, geodesy, and digital mapping. The staff (a) provides technical advice and assistance to map users on cartographic products and procedures to help meet their requirements; (b) disseminates cartographic information in formats and scales most easily accessed by researchers and other users; (c) plans for the development of digital image processing and remote sensing products and a geobased information management system capable of performing computer cartography as well as data base management; (d) provides cartographic support services as required by other Survey divisions and possibly other Federal and State agencies in Alaska; and (e) conducts surveys of user needs and requirements and coordinates and negotiates agreements with Federal, State, and local agencies in Alaska.

EROS Field Office

The Survey's EROS Field Office in Anchorage was established in March 1980 with a small staff of resource specialists who have experience in digital data manipulation. The Field Office has an Interactive Digital Image Manipulation System (IDIMS), a computer system with software designed for spatial data analysis. The EROS staff is transferring spatial data technology to Federal and State resource management agencies in Alaska and is encouraging agencies with qualified data analysts to utilize IDIMS for their own operational projects. In addition to the land-cover mapping projects discussed previously, the EROS Field Office is active in geologic and hydrologic resource assessments. For example, the EROS Field Office has produced an Arctic lake inventory data base for 16 quadrangles comprising most of Alaska's North Slope for the Geological Survey Water Resources Division. The data bases assign an index number and geographic reference for all Arctic lakes greater than 5 acres. An estimate of surface area is provided along with an attribute file for assigning additional lake characteristics such as depth, water quality, etc. In addition, lake inventory data bases have been produced for nine National Wildlife Refuges for the Fish and Wildlife Service.

The Field Office has a growing digital data base and a number of map output products, including land-cover maps and digital terrain data reformatted to fit 1:250,000-scale quadrangles. Moreover, geographic information system software permits the

integration of data such as terrain data (elevation, slope, and aspect), land cover, land ownership, and mineral availability to produce wildlife habitat suitability and other interpretive maps using digital data sets that are archived at the Field Office, or have been provided to the Field Office from data bases maintained by its cooperators. The recent addition of software permits the Field Office to convert and integrate both raster and vector digital data to formats that are exchangeable with any cooperator in Alaska, and to assist cooperators in the development of digital data bases.

Public Inquiries Office

The primary function of the Public Inquiries Office (PIO) is to provide convenient public access to information regarding the work of the U.S. Geological Survey and its products. Inquiries may be made by letter, telephone, or in person. The Anchorage PIO, staffed by information specialists, is part of a network of 11 field offices throughout the U.S.

One function of the Office is to maintain a library for public use. The library contains a collection of Survey book reports (bulletins, professional papers, circulars, and water-supply papers), thematic maps, and open-file reports dealing with Alaska. It also contains several scientific journals, selected publications of other government agencies, and a few books relating to Alaska. A number of bibliographies and lists are available for research, and the staff will provide assistance whenever possible. The library is primarily for reference, and most of its holdings must be used in the office.

The staff has special expertise in researching Survey publications and can recommend appropriate materials (books, maps, and data) relating to specific subjects and areas. The PIO also provides a referral service to the public for obtaining technical information and data from appropriate scientific offices. Complementing its informational services, the Office sells Survey reports and maps of various geographic areas in Alaska as well as selected general interest reports, and provides over-the-counter sales services for thematic and topographic maps of Alaska.

National Cartographic Information Center

The National Cartographic Information Center-Alaska Office (NCIC-A), located in Anchorage, provides information about maps, aerial photographs, satellite imagery, and other cartographic data and where these products may be obtained. Each month a wide variety of customer requests is received for this information, often in support of land development or resource engineering activities in Alaska. These materials are also popular with outdoor enthusiasts who want more detailed information about their favorite recreation areas.

To facilitate research and identification, NCIC-A maintains various reference systems on microfiche. The recent color-infrared coverage of the Alaska High-Altitude Aerial Photography Program is on 16-mm microfilm for customer assistance, as well as approximately 50,000 prints of aerial mapping photographs acquired during the 1950s. Autopositives (mylars) of Alaska maps at scales of 1:250,000 and 1:63,360 are maintained in the NCIC-A Office and are available for loan.

To support these customer-oriented activities, NCIC-A acquires information about various types of cartographic data from Federal, State, and local government agencies and, where possible, from private companies. NCIC-A provides assistance to customers purchasing both Survey and non-Survey products.

NCIC-A, the University of Alaska's Geophysical Institute, and Alaska's Department of Natural Resources signed an agreement which established the Institute's browse facility as a State Affiliate of NCIC. This formalized a relationship that has existed for some time between the Survey and the Geophysical Institute, which also provides remote sensing information to Alaskans.

Alaska Distribution Section

The National Mapping Division also has a Map Distribution Office located in Fairbanks. It is through this office that the Survey distributes topographic and thematic maps, indexes, and leaflets by mail to customers and supplies Survey maps to commercial map dealers throughout the State. Because of its location in Fairbanks, the office is the focal point for Survey information for interior Alaska residents.

CONCLUSION

There are immediate needs in Alaska for modern, improved cartographic products and data. Accordingly, the Survey has expanded its activities to work more closely with other Federal agencies, the Alaska State Mapping Advisory Committee, and other elements of the user community in Alaska to document their requirements and priorities, provide technical assistance, and increase the allocation of the Survey's mapping capacity to meet the State's cartographic product and data needs. In the fall of 1984 the Survey co-located its offices in new facilities at Alaska Pacific University. As part of the co-location of the Survey at the University, a small NCIC and PIO office in the new Federal Building was opened to continue to serve the downtown Anchorage area with cartographic products and data and publications of the U.S. Geological Survey. All of these new activities, facilities, and challenges of the National Mapping Division in Alaska are directed toward being more responsive to the user community in Alaska in meeting their mapping needs.

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