Geographic Control Data Base (GCDB)
User Guide

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INTRODUCTION

This User's Guide has been written to provide a basic knowledge of the Geographic Coordinate Data Base (GCDB) for Wyoming. The GCDB is being developed by the Bureau of Land Management and is mandated as the base land lines theme for all federal agency mapping and Geographic Information System (GIS) efforts. As a component of the National Spatial Data Infrastructure (NSDI), GCDB will be a common reference to the Public Land Survey System (PLSS) and greatly facilitate integration of separate GIS systems.

The need for a common reference to allow spanning traditional administrative boundaries was outlined in the executive summary of the 1980 publication by the National Academy of Sciences: NEED FOR A MULTI-PURPOSE CADASTRE: "There is a critical need for a better land-information system in the United States to improve land-conveyance procedures, furnish a basis for equitable taxation, information for resource management and environmental planning."

The current phase of GCDB consists of generating PLSS coordinates in ten western states using official BLM survey records. The second phase of GCDB will consist of generating coordinates for the rest of the western states. The third phase of GCDB, will be generation of coordinates on the eastern states.

GCDB data is referenced to the North American Datum (NAD) 27 Universal Transverse Mercator (UTM) or State Plane Coordinate System (SPCS) projections. Wyoming has developed public domain programs used to convert GCDB data to generic Drawing Exchange Format (DXF) files.

Although graphical depiction of the PLSS are available from many sources, there are several unique aspects of the GCDB.

GCDB portrays the PLSS at a more detailed level than other sources including subdivision of sections to the 40 acre parcel and non-rectangular surveys like mineral surveys, tracts, official riparian (water) boundaries, homestead entry surveys, desert land entry surveys and other surveys performed for the purpose of patenting the public lands.

GCDB is generated from official BLM survey records and control coordinates of varying accuracy. GCDB software has been designed to facilitate incorporating future surveys performed for the purpose of more accurately locating the boundaries of lands.

GCDB data includes an estimate of the positional accuracy of the coordinates. This estimate is based on residual errors in adjusting survey data between known coordinates. This data allows the GIS user to determine suitability of the GCDB for various applications.

GCDB data collection in Wyoming was initiated in September 1990. At that time, the Public Land Survey System Coordinate Computation Software (PCCS) was used for coordinate generation. In May of 1993, a second, and vastly improved, generation of GCDB software named Geographic Measurement Management (GMM) was released. There are very significant differences in the

philosophy and meaning of the output of these two software systems though many of the end products are identical.

At the time of release of GMM, initial data collection in Wyoming was 80% complete using PCCS. To avoid the confusion of combining data produced by two software packages with different philosophies, the decision was made to complete Wyoming data collection using PCCS.

GCDB is not a legal data base but rather attempts to maintain the spatial relationships as depicted on the legal survey records. The reliabilty of GCDB coordinates is dependent upon the quality of the data used to generate it which in many cases is poor. Given this, the user should be aware acreages which can be generated from GCDB data rarely reflect the legal acreages from the official survey records and are therefore invalid.

If the reader has further questions regarding Wyoming GCDB data, they should feel free to contact any of the following persons:

Milbert Krohn - 307 775 6225
Paul Fisher --- 307 775 6226

THE GCDB CONCEPT

GCDB coordinate generation begins with 2 components: control coordinates and survey vectors. Control is defined as corners of known geographic location, at varying levels of certainty. Beginning at a known coordinate, GCDB generates geographic coordinates for a series of survey vectors to a position near another control corner. By comparing these coordinates against the known control coordinates, we can estimate the accuracy of intermediate coordinates of the traverse. The intervening coordinates are then adjusted using a variety of adjustment procedures.

A TYPICAL WYOMING GCDB FILE

Below is a portion of the GCDB file for T55NR69W, 6th PM, Wyoming. This is representative of the file format for all GCDB files.

```
 TWP 55N  RNG 69W  PM  6 th           Wyoming(WY)   DATE 03/30/93
 ORIGIN  444458.0000 1050925.0000  1.0   1.0000 502525.841487896.04
 100100   444158.37  1051225.66  6000.0  7  11   489479.271469707.95
 100120   444211.45  1051225.63  6000.0  9  11   489481.881471032.73
 100140   444224.53  1051225.60  6000.0  9  11   489484.511472357.46
```

The first line of data is called a "header". It contains information regarding the Township, Range, Principal Meridian, State, and the date the data was processed.

The second line of data is an approximate origin, or center, of the township. Because lands within Wyoming are covered by 2 UTM zones, the longitude of the origin is used to determine the appropriate UTM zone. Coordinates in GCDB UTM files with an origin longitude of 108° or more are referenced to UTM zone 12. Coordinates in GCDB UTM files with a origin longitude less than 108° are referenced to UTM zone 13. Townships are converted to the appropriate State Plane Zone by county.

The remainder of the data in the GCDB files consists of multiple lines which look like this:

```
 100100      444158.37    1051225.66    6000.0   7    11   489479.271469707.95
    |           |            |            |       |    |         |
GCDB Point |               |            |       |    |         |
Identifier |               |            |       |    |         |
           |-Latitude      |            |       |    |         |
             NAD27         |            |       |    |         |
                           |-Longitude  |       |    |         |
                             NAD27      |       |    |         |
                                        |       |    |         |
   Elevation data was processed at.-|           |    |         |
   In feet.                                     |    |         |
                                                |    |         |
                        Unresolved error in feet-|   |         |
                                                     |         |
                UTM or SPCS Easting to 2 decimals-|            |
                                                              |
                       UTM or SPCS Northing to 2 decimals-|
```

GCDB POINT IDENTIFIERS

It is necessary to assign unique identifiers to GCDB coordinates for a variety of reasons. The system chosen for GCDB is a 6 digit number composed of a 3 digit prefix (Xxx) followed by a 3 digit suffix (Yyy). In order to deal with the complexities of the PLSS, this numbering scheme is extremely flexible.

In the most basic terms, surveys of the PLSS consist of 2 types of data. The rectangular system, or sections, and non-rectangular, or metes and bounds, surveys. Some examples of non-rectangular surveys include mineral surveys, homestead entry surveys, riparian boundaries, and tract surveys. General guidelines for PLSS survey point IDs are:

```
XxxYyy   XxxYyy
000000 - 000009  Reserved for software codes
095000 - 704999  Rectangular Surveys
705000 - 799999  Boundaries with Mileposts
800000 - 836999  Riparian Boundaries
837000 - 899999  Tracts
900000 - 999989  Mineral Surveys, Homestead Entries, Etc.
999990 - 999999  Reserved for software codes
```

The southwest corner of each township is assigned a point ID of 100100. Remaining section corners in a township are assigned an X value in the prefix (Xxx) and a Y value in the suffix (Yyy) indicating how many sections east and north the corner is from the southwest corner of the township which is given a point ID of 100100. So a point ID of 400400 indicates a section corner 3 miles east and 3 miles north of the southwest corner of the township or the corner of sections 15, 16, 21 and 22.

In a simple township, section corners would carry the point Ids below:

4

100700	200700	300700	400700	500700	600700	700700

6	5	4	3	2	1
100600	200600	300600	400600	500600	600600	700600
7	8	9	10	11	12
100500	200500	300500	400500	500500	600500	700500
18	17	16	15	14	13
100400	200400	300400	400400	500400	600400	700400
19	20	21	22	23	24
100300	200300	300300	400300	500300	600300	700300
30	29	28	27	26	25
100200	200200	300200	400200	500200	600200	700200
31	32	33	34	35	36
100100	200100	300100	400100	500100	600100	700100

Users familiar with the PLSS will recognize that, in many cases, the PLSS can be much more complex than the example above. As stated previously, the point ID scheme shown here is, by necessity, extremely flexible. It would be extremely confusing and futile to attempt to list all possible variances of our point ID scheme. Public domain programs are provided, at no cost, which have the logic necessary to define connectivity of the GCDB points.

The corners interior to a section are incremented in the xx and yy values of the 6 digit point ID XxxYyy by an amount equal to their distance in chains[1] east and north of the SW point ID of the section.

As an example, the standard point ID scheme for section 15 would look like this:

---

[1] Chains are required by law as the unit of measurement for official surveys of the PLSS. 1 Chain = 66 U.S. Survey ft., 80 ch. = 5,280 U.S. Survey ft.
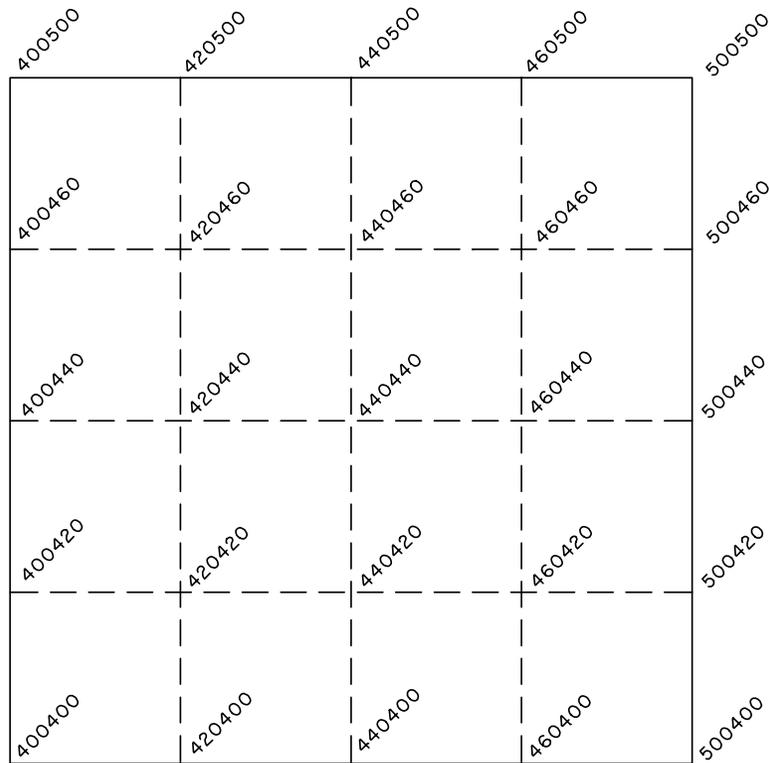
PUBLIC DOMAIN PROGRAMS

Because of the complexity of the GCDB point ID scheme, Wyoming has developed DOS based public domain (free) programs that allow the user to convert GCDB files to a graphical format. These programs are provided as a courtesy to the user and no warranty is provided for correct usage of them. These programs permit a graphical depiction of the PLSS.

The following pages give a short explanation of the purpose of the programs with printouts of screens you see when running them. Input values are in bold, underlined print.

MAKESCR.EXE

Created to convert either UTM or SPCS files to an AutoCAD(TM) .SCR format. AutoCAD is used by Wyoming GCDB staff to perform inspection of GCDB data. This software was chosen because of familiarity with its operations and capabilities. Existence of this program is not an endorsement or recommendation of AutoCAD or any AutoCAD related software. Inclusion of township and section line data is automatic. Subdivision and non-rectangular data may be included at the option of the user. An AutoCAD drawing (GCDB.DWG) with layer and block definitions is also provided to the requestor. Here is what MAKESCR looks like:

```
========== Created by Mark F. Browne 1990 ==========
         Geographic Coordinate Data Base Staff
            Wyoming State Office, Cheyenne
              Bureau of Land Management
```

```
            United States Department of the Interior
        ********************************************************
        *   MAKESCR 4.8 (1994) creates an AutoCAD (TM)'SCRIPT'  *
        *   file from a BLM GCDB SPC or UTM file.               *
        *               ----------                              *
        *       Use the SCRIPT file to build 4 layers:          *
        *            -- Township boundary                       *
        *            -- Section lines                           *
        *            -- Section subdivision (optional)          *
        *            -- Special surveys (optional)              *
        ********************************************************


        IMPORTANT !!!

        NO WARRANTY IS MADE BY THE BUREAU OF LAND MANAGEMENT AS TO THE
        ACCURACT, RELIABILITY, OR COMPLETENESS OF THESE DATA FOR
        INDIVIDUAL USE OR AGGREGATE USE WITH OTHER DATA

 Enter name of existing file you wish to process if
 you agree to the terms above. (Q to QUIT):
S55N69W

 Enter a name (up to 8 characters) for
 'script' file you will be creating--Q to QUIT:
S55N69W

 Do you want to include sixteenths (and any smaller divisions)? (Y/N):
Y

 Do you want to include special surveys? (Y/N):
Y
 ----------------------------------------------------------------------

 Please wait a few moments

        ********** Done!  Script file is: S55N69W.SCR

 ======================================================================
Stop -Program terminated.
```

ERRORS.EXE

Creates an AutoCAD SCR file E(township).SCR which inserts a circle of radius maximum error on section corners and 1/4 section corners from input U(township) for UTM data or S(township) for SPCS data. Scaling of radius to the appropriate unit of measurement is automatic. This program serves as a vehicle to graphically display the estimated positional accuracy of the coordinates contained in GCDB. Here is what ERRORS looks like:

```
Enter the file to process. (I.E. - S37N67W):
S55N69W
```

SCR2DXF.EXE

As it is not our intent to suggest or mandate software for use of GCDB, this program was created to convert from the above AutoCAD specific format to a generic DXF format. This allows importing GCDB data into software other than AutoCAD. Here is what SCR2DXF looks like:

```
+----------------------------------------------------------+
|                    * MakeDXF 1.0 *                       |
+----------------------------------------------------------+
|         By Mark Browne, GCDB, WYSO, BLM, June 1993       |
|         Modified by JANE TU June 21, 1994                |
|         Modified by Milbert Krohn August 24, 1995        |
|                                                          |
|     Converts the script file (*.SCR) created by MAKESCR  |
|     or ERRORS to a DXF file for use by AutoCAD,          |
|     AutoSketch or any software that reads the DXF format. |
|                                                          |
|     * Type the FULL name of the script file you want to  |
|       convert, including the '.SCR' extension.           |
|                                                          |
|     * A new file will be created with the same name, but |
|       with the '.DXF' extension.                         |
|                                                          |
|     * The original script file remains unchanged.        |
|                                                          |
+----------------------------------------------------------+
     AutoCAD, AutoSketch and DXF are registered trademarks
     of Autodesk, Inc.

Name of file to convert (Q to Quit) -> S55N69W.SCR
 Creating X43N88W.DXF...

 Done!
```

It is possible minor errors in the data will be encountered from time to time. The GCDB is initial data only. Future improvements to this data by BLM are assumed but not assured. It is the responsibility of the user to recognize and correct errors which may exist. Densification of the land grid beyond the data contained in these files is also the responsibility of the user. Finally, the executable programs provided were developed and used by Wyoming and may not be valid with data from other states.

AVAILABILITY OF GCDB

GCDB has been completed and is available for 2,377 townships in Wyoming, or approximately 90% of the state. The remaining 10% of Wyoming townships have been excluded from initial data collection due to difficulty and cost of producing this data. It is unknown at this time if or when authority and funding to collect these townships will be given to us.

WYOMING GCDB AVAILABILITY

(HATCHED AREAS ARE NOT AVAILABLE)

UNAVAILABILITY STATUS: ▨ - EXCLUDED ▨ - UNSURVEYED

The survey information used to develop Wyoming's Geographic Coordinate Data Base (GCDB) was collected by contract. This data was inspected by BLM personnel using a variety of tools designed to ensure a 98 percent minimum acceptable quality level (AQL) with a 95 percent level of confidence in accordance with the GCDB Quality Assurance Plan of January 1991 (see Attachment X in OARDD).

The quality of the survey records used to generate the GCDB varies widely. Consequently the accuracy, or positional reliability, of the coordinates generated from this data varies widely also. As a result, the acreages which GCDB allows to be calculated have no legal standing.

Determination that Wyoming's GCDB data meets the minimum AQL will be made by Wyoming's GCDB Manager, the data steward, who will verify the quality and the confidence levels on a township-by-township basis, in coordination and concurrence with the State Records and Data Administrators. The concurrence of the State Records and Data Administrators will be required to

determine that the GCDB data meets the minimum AQL for the purposes of preparing the official agency record designation documentation (OARDD).

Goshen, Laramie, Niobrara, Platte, and Weston counties have 100% coverage.

TOWNSHIPS NOT AVAILABLE
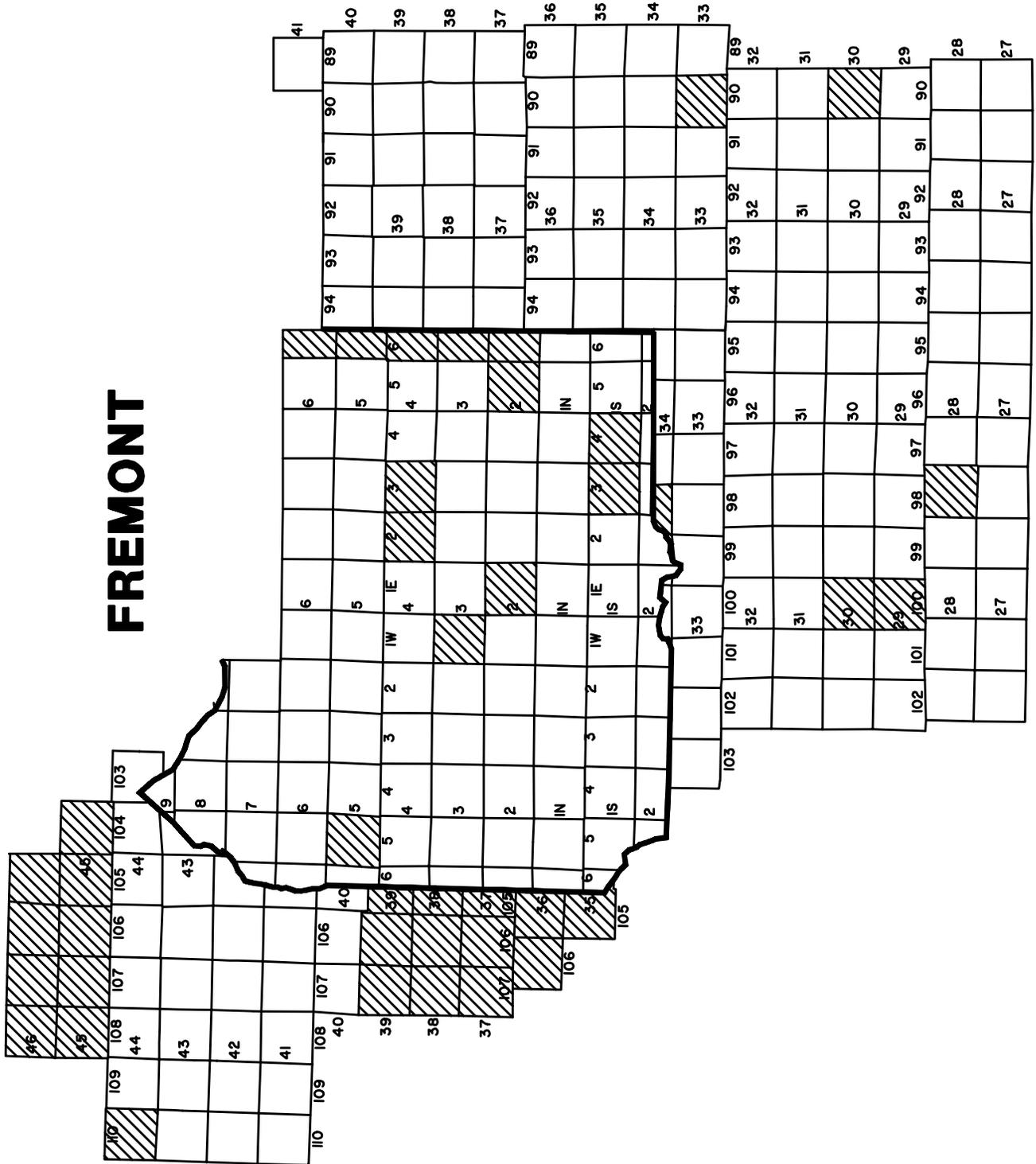
Counties with slight to moderate gaps in coverage are:

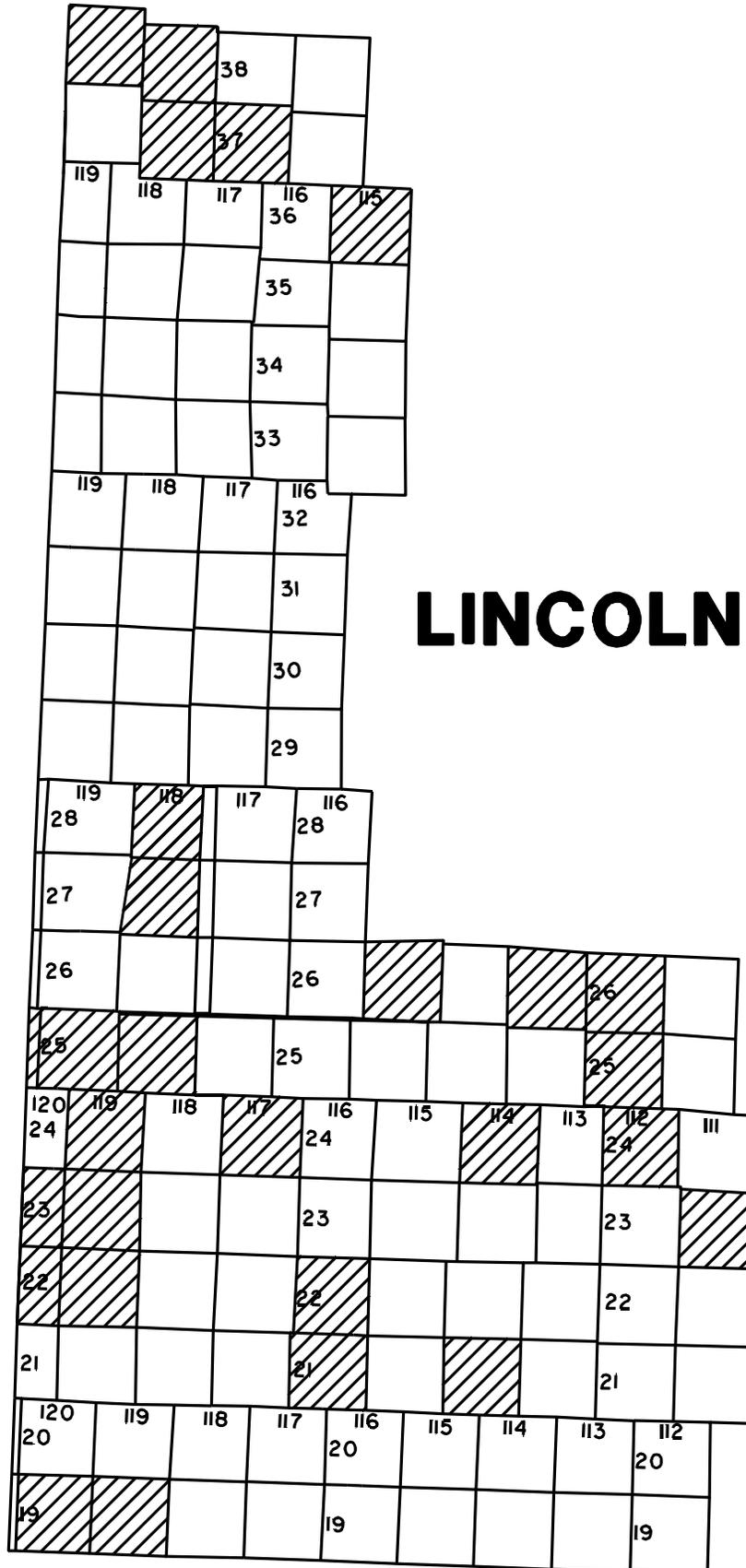| COUNTY	TOWNSHIPS NOT COLLECTED
Albany	T14NR79W
Campbell	T55NR73W, T55NR74W, T57NR73W, T57NR74W, T57NR76W, T58NR74W, T58NR75W, T58NR76W
Carbon	T12NR86W, T12NR87W, T12NR88W, T12NR89W, T12NR90W, T13NR88W, T14NR84W, T14NR85W, T14NR86W, T15NR88W, T16NR88W, T16NR89W, T21NR85W, T27NR78W, T28NR78W
Converse	T31NR71W, T32NR77W
Crook.	T50NR67W, T51NR60W, T51NR67W, T52NR67W, T53NR68W, T54NR68W, T55NR66W, T57NR68W, T58NR67W, T58NR68W
Hot Springs Wind River Meridian: 6th Principal Meridian:	 T06NR06E, T07NR06E T43NR92W, T43NR94W, T43NR95W, T44NR94W
Johnson	T41NR85W, T43NR83W, T43NR84W, T44NR80W, T44NR84W, T50NR77W, T51NR77W, T51NR80W, T52NR77W, T52NR78W, T52NR79W, T52NR80W, T53NR77W, T53NR79W
Natrona	T32NR77W, T32NR79W, T41NR85W, T41NR86W, T41NR87W, T41NR88W
Sheridan	T53NR77W, T53NR79W, T55NR77W, T55NR78W, T56NR77W, T56NR78W, T56NR79W, T57NR76W, T57NR77W, T57NR88W, All of T58N
Sublette	T27NR112W, T27NR115W, T28NR112W, T28NR113W, T30NR110W, T33NR104W, T33NR105W, T34NR105W, T34NR106W, T35NR106W, T36NR106W, T36NR107W, T36NR108W, T36NR115W, T37NR106W, T37NR107W, T38NR107W, T39NR107W
Sweetwater	T13NR103W, T14NR108W, T15NR103W, T23NR111W
Uinta	T12NR112W, T17NR119W, T17NR120W, T18NR119W, T18NR120W
Washakie	T41NR86W, T41NR87W, T41NR88W, T46NR88W, T46NR92W, T46NR93W, T47NR88W, T47NR93W, T48NR87W, T48NR90W

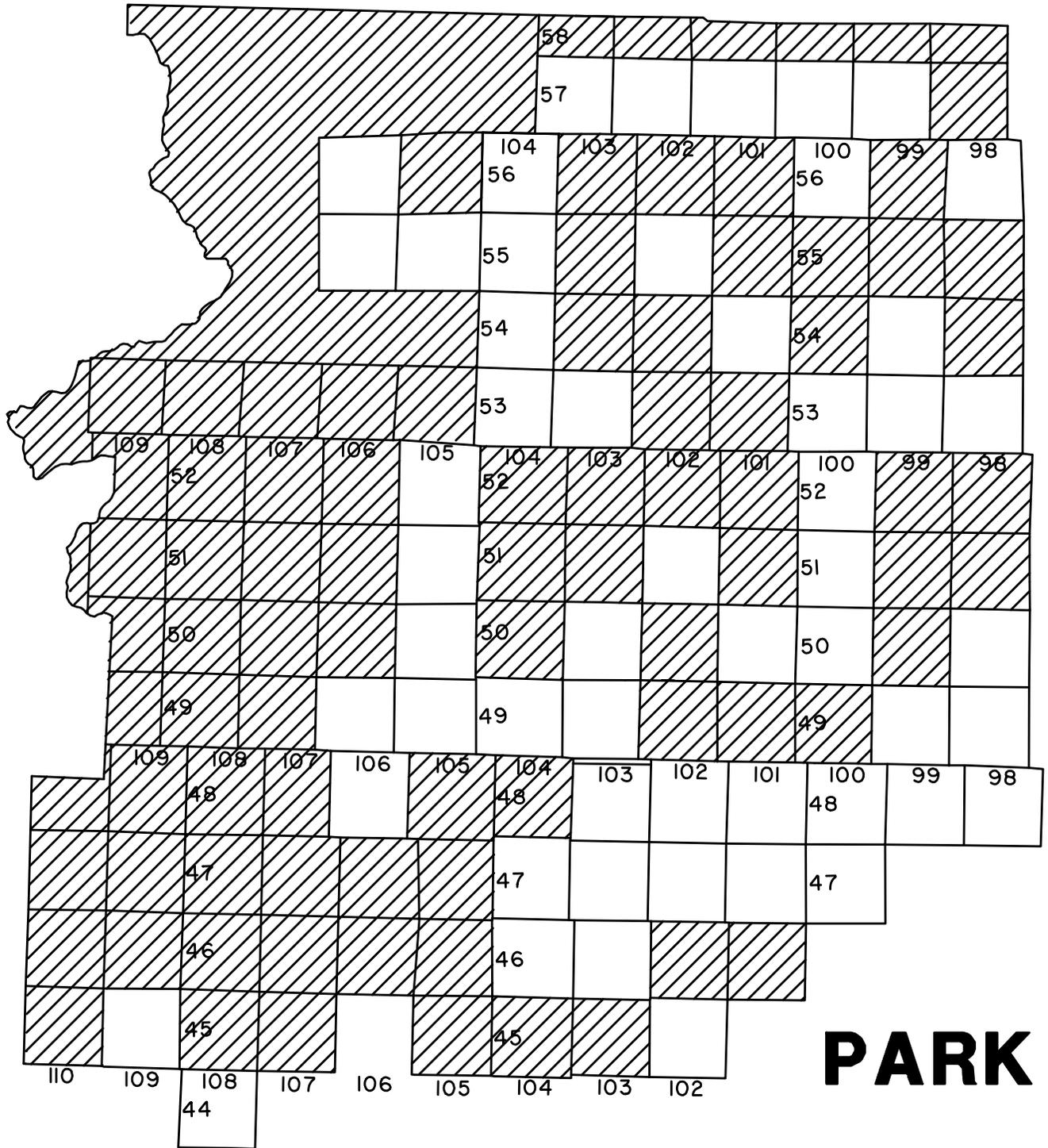Graphics of counties with significant gaps in coverage follow. Unavailable townships are hatched.
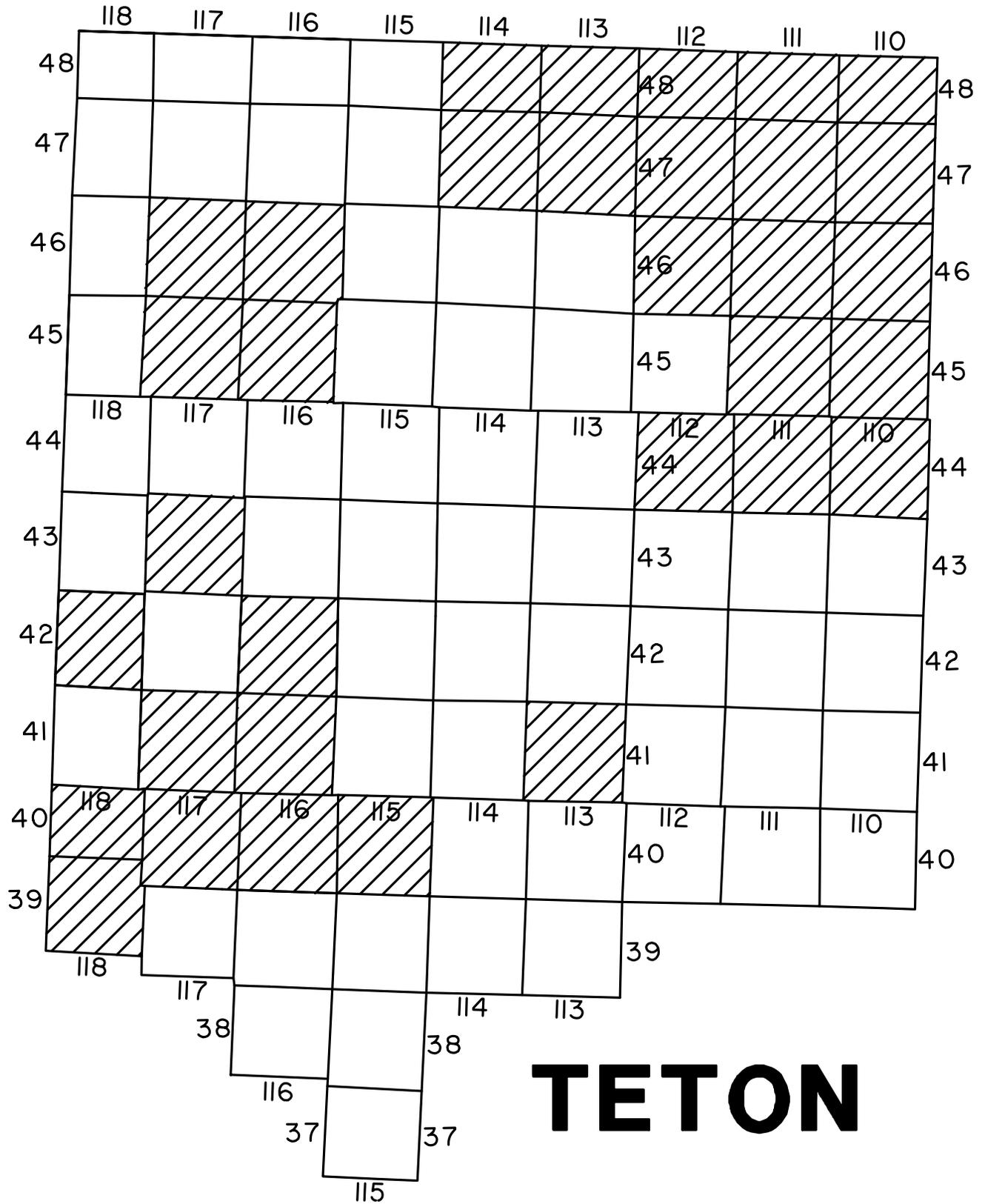
BIGHORN

FREMONT

LINCOLN

58

57

| 104 | 103 | 102 | 101 | 100 | 99 | 98 |

56

56

55

55

54

54

53

53

| 109 | 108 | 107 | 106 | 105 | 104 | 103 | 102 | 101 | 100 | 99 | 98 |

52

52

52

51

51

51

50

50

50

49

49

49

| 109 | 108 | 107 | 106 | 105 | 104 | 103 | 102 | 101 | 100 | 99 | 98 |

48

48

48

47

47

47

46

46

45

45

| 110 | 109 | 108 | 107 | 106 | 105 | 104 | 103 | 102 |

44

PARK

118 117 116 115 114 113 112 111 110

48 48 48

47 47 47

46 46 46

45 45 45

118 117 116 115 114 113 112 111 110

44 44 44

43 43 43

42 42 42

41 41 41

118 117 116 115 114 113 112 111 110

40 40 40

39 39

118

117

38 38

116

37 37

115

TETON

NUMBER OF TOWNSHIPS, SIZE OF FILES, AND COSTS

COUNTY	# TPS AVAILABLE	# TPS MISSING	SIZE IN KB (SPCS)	SIZE IN KB (UTM)	COST[2]
ALBANY	134	1	1677.273	1829.638	$14.44
BIGHORN	62	38	892.098	1025.718	$13.56
CAMPBELL	137	8	1642.494	1745.392	$14.43
CARBON	223	15	2677.493	3010.599	$15.37
CONVERSE	146	2	1788.495	1942.911	$14.46
CROOK	85	10	994.758	1083.942	$13.56
FREMONT	258	40	3183.536	3609.436	$15.44
GOSHEN	72	0	887.146	965.334	$13.55
HSPRINGS	67	6	744.039	850.380	$13.54
JOHNSON	122	14	1537.186	1691.516	$14.43
LARAMIE	83	0	902.001	978.900	$13.55
LINCOLN	114	28	1131.797	1243.325	$13.59
NATRONA	164	6	2004.627	2230.976	$14.49
NIOBRARA	88	0	988.128	1073.985	$13.57
PARK	55	86	734.312	852.709	$13.54
PLATTE	64	0	785.992	850.691	$13.54
SHERIDAN	65	26	807.829	906.015	$13.55
SUBLETTE	131	18	1528.938	1707.333	$14.43
SWEET	301	4	3507.529	4012.196	$16.28
TETON	57	33	486.990	533.440	$13.50
UINTA	65	5	691.768	764.116	$13.53
WASHAKIE	56	11	713.656	825.241	$13.54
WESTON	72	0	807.094	877.726	$13.54
STATE[3]			31115.179	34611.519	$27.50

In addition a data set specific to the Wind River Meridian is available:

WRM	107	14	1368.111	1584.273	$13.41

- The data is provided in a DOS, self-extracting format. Total storage requirements average 5.5 times the listed size. For example, 4.25 Mb. hard drive capacity is required for UTM files in Uinta county.

- Public domain DOS programs are provided to convert GCDB data files to .SCR and .DXF formats. These formats allow graphic depiction of the boundaries of the Public Land Survey System (PLSS) via a wide variety of mapping and GIS software packages.

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[2] Based on cost recovery for media, plus $18.60 per hour for preparation time, and an $8.00 administrative charge. Costs are approximate and subject to change without notice.

[3] Total townships available statewide are 2,377. Total townships not collected statewide are 237. These numbers do not equal sumations of individual county figures because many townships are included in more than one county data set.

- For more information or questions regarding the GCDB, contact Milbert Krohn, GCDB Manager, at 307-775-6225.

GCDB is classified as category 2 information - Public information subject to dissemination at the discretion of the BLM. This data is available by submitting a written request. A Sample request follows:

SAMPLE GCDB REQUEST

```
State Director
Attn: GCDB Manager
Bureau of Land Management
Wyoming State Office
P.O. Box 1828
5353 Yellowstone Ave.
Cheyenne, WY 82003-1828

We request all available GCDB data for Campbell county.

Please provide this data on DOS 3.5 inch floppy diskettes in SPCS27 (or UTM27)
datum.

If you have any questions, please contact _____ at ###-###-####.
```

GLOSSARY OF TERMS

AQL   Acceptable Quality Level

BLM   Bureau of Land Management

DOS   Disk Operating System

DXF   Drawing Exchange Format. An ANSI standard for exchanging graphics

GCDB -------- Geographic Coordinate Data Base

GIS ------------ Geographic Information System

GMM --------- GCDB Measurement Management

NAD27 ------- North American Datum of 1927. Also known as Clarke ellipsoid of 1866

NSDI ---------- National Spatial Data Infrastructure

OARDD ------ Official Agency Record Designation Document

PCCS --------- Public Land Survey System Coordinate Computation Software

PLSS ---------- Public Land Survey System

SPCS ---------- State Plane Coordinate System

UTM ---------- Universal Transverse Mercator