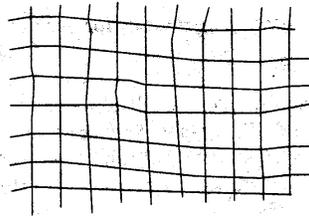


24K Landnet
Spatial Database
Technical Documentation



Wisconsin Department of Natural Resources
Bureau of Enterprise Information Technology and Applications
Geographic Services Section

8/7/96

Document prepared by Andrew Hanson, Lee Meilleur, James A.Cory, Paul A.Tessar, and Michael F.Bohn.

Geographic Services Section, ET/8
Wisconsin Department of Natural Resources
101 South Webster St.
P.O. Box 7921
Madison, WI 53707-7921

<http://www.dnr.state.wi.us/geo>

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1. Introduction

1.1. Purpose

In order to maintain a more accurate system for tracking land parcels that the Wisconsin Department of Natural Resources (WDNR) manages, the Bureau of Facilities and Lands (LF), formerly the Bureau of Property Management (PM), has contracted with the Bureau of Enterprise Information Technology and Applications (ET), formerly the Bureau of Information Management, Geographic Services Section (GEO) to create a spatially referenced digital representation of all WDNR managed lands in the state. To provide the geographic framework necessary for creating this property boundaries layer at 1:24,000 scale, GEO has constructed a statewide, topologically structured, 1:24,000 scale *representation* of the Public Land Survey System (PLSS). This 1:24,000 scale Landnet spatial database will, for convenience sake, be referred to as *24K Landnet*.

The purpose of this document is to provide a technical description of the *data* in the 24K Landnet. Previous drafts of this document, mainly "24K Landnet Spatial Database Design - Review Draft 1.2", described some design alternatives which have not been implemented in the database. Hence these alternatives are not documented here. A general description of the *process* used during production of the database can be found in Appendix L, while a much more detailed description of the process can be found in "24K Landnet Process Documentation".

1.2. History

Wisconsin's PLSS began in 1831 when the U.S. Government surveyor Lucius Lyons determined the position of the *initial point*, thereby creating the intersection of the Principal Meridian and Base Line (see Map A). During the next forty years, a dense survey was created to assist in the inventory and transfer of public lands to private ownership. Gradually, most land passed into private ownership. In 1900, however, the State of Wisconsin re-acquired a parcel of land along the St. Croix River for the creation of Interstate Park. Since that time, the state has continued to acquire various parcels for the purpose of conserving some of the state's outstanding natural resources for the benefit of present and future generations. Today, the WDNR manages over 48,000 parcels in approximately 900 project areas. All of this property is referenced to the original surveys.

As WDNR's legislatively-mandated task of land management grew with the acquisition of new parcels, so did its administrative work load. The task of administering 48,000 parcels scattered over Wisconsin's approximately 55,000 square miles became a daunting one. This problem was amplified by the fact that until 1993, no automated means of spatially referencing all WDNR managed lands existed - at any scale. At that time, GEO completed a 1:100,000 scale representation of all WDNR managed lands in the state. This was accomplished by linking PM's existing Oracle® database of each parcel to the 1:100,000 scale Landnet and flagging all quarter-quarter sections (40 acres) where there was WDNR management responsibility. Although this approach resulted in some obvious inaccuracies, it did demonstrate the utility of a topologically structured database linked to a wealth of geo-referenced tabular parcel information. This prototype demonstrated the need for a more accurate database. Before this could be accomplished, however, a better statewide reference framework was needed.

As mentioned, the 1:100,000 scale Landnet, which had been derived from the U.S. Geological Survey's (USGS) 1:100,000 scale Digital Line Graph (DLG) files, had previously been used as a spatial framework for statewide property mapping. The scale and accuracy of this database could not meet the WDNR's specific needs for a statewide spatial reference system in the future. Furthermore, PM's immediate needs could not be satisfied by waiting for the completion of a statewide survey-level parcel database. Thus work was initiated to develop the 24K Landnet database to serve as an affordable, statewide, more accurate framework for representing WDNR property boundaries.

1.3. Goals

The 24K Landnet database is a spatial representation of the PLSS including such features as: Government Lots; Townships; Sections; Section Corners; and Correction Lines. This Landnet provides a framework for representing WDNR properties at 1:24,000 scale, a statewide inventory of land control features, and a system for the linkage to survey-level data. It is designed with the intent of making a statewide survey-level database possible, while maintaining the ability to have a pure 1:24,000 scale database.

Users of the 24K Landnet database should note that the features in it are presented for cartographic reference only and are not intended to be official or authoritative. *Survey by a registered land surveyor is the only legal basis for determining actual land boundaries or locating PLSS corners.*

1.4. Data Sources

The original sources for the majority of data incorporated in the 24K Landnet are the USGS 7.5 minute topographic map series, and 1:100,000 scale. On these USGS maps, section lines, section numbers, and other important PLSS features are all printed in red. Approximately 73% of the section corner coordinates for the Wisconsin 24K Landnet have been provided by the following data share cooperators at no or incidental charge: Chequamegon National Forest; Nicolet National Forest; Northern States Power Company; United States Geological Survey; and Wisconsin Power and Light Company. GEO has digitized standard PLSS corners from USGS 7.5' maps where no data were provided by cooperators. In most cases, GEO staff manually added attribute data to the spatial data from cooperators. Data for a few areas were obtained from resurvey maps, plat maps, or digital county data. See Appendix M for more information on the data share cooperators and Map B to see the extent of each data source.

1.5. Spatial Processing Environment

The WDNR's standard GIS (Geographic Information System) software is ARC/INFO®, a product of Environmental Systems Research Institute, Inc. (ESRI). The 24K Landnet database was produced using unix workstation ARC/INFO - Rev 7, running on a network of Digital Equipment Corporation (DEC) Alpha OSF/1 workstations at the central office in Madison, WI. ARC/INFO Regions® are incorporated in order to more easily manage the variously related themes. Data from cooperators were created on a variety of software and hardware platforms and converted to an ARC/INFO format database. For a complete description of the *process* used to create 24K Landnet, please refer to "24K Landnet Process Documentation".

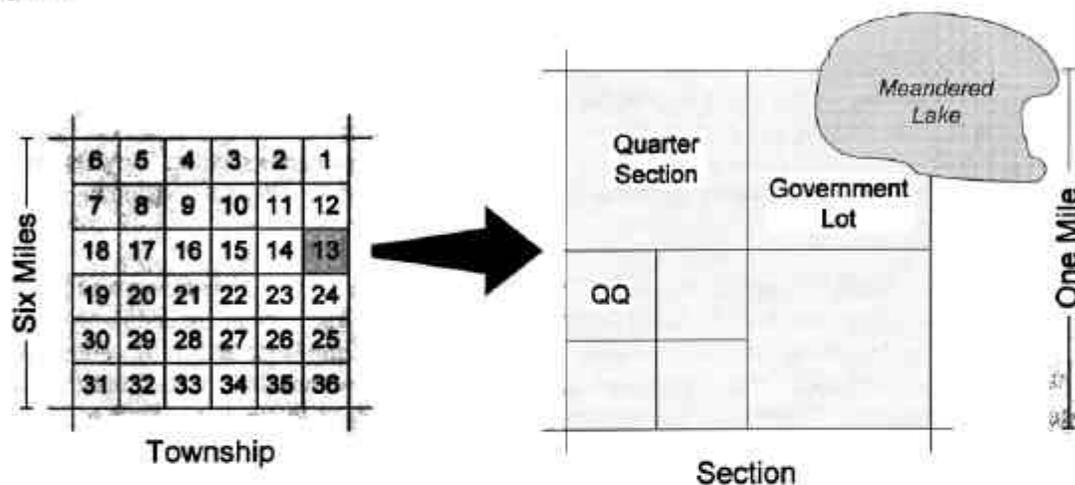
2. Feature Descriptions

This section will discuss the spatial features, from area to line features and to the most primitive spatial entity, node features.

2.1. Polygon Features

Most area features follow the subdivision methods of the PLSS, from townships to sections, etc. (see Figure 1). There are, however, unique circumstances that precluded these construction rules. These features include government lots and grants of land.

Figure 1



2.1.1. Townships

Townships are areas of approximately 36 square miles created from standard parallels and meridians (see Map A and Figure 1). These standard parallels and guide meridians form standard quadrangles of approximately 576 square miles. Each of these areas are normally divided into 16 townships. But because of the curvature of the Earth, topographic features on the landscape, and the survey methods used by the original government surveyors, the original townships rarely equate to exactly 36 square miles. To control these problems, new initial points were periodically established as the basis for correction lines. Because township lines were extended north and west from the southeast corner of each standard quadrangle, townships accumulate errors along the northern and western boundaries. Appendix D outlines the structure of the township region.

2.1.2. Sections

Each township is partitioned into 36 one square mile parcels of approximately 640 acres, called sections. Every section has a number from 1 to 36, depending on its position within the township. A section can be further subdivided into halves, quarters, quarter-quarters (see the QQ in Figure 1), and similar fractional or aliquot parts.

The basic framework of a section consists of 9 control points, referred to as section corners, a section center, and quarter section corners (see Figure 8). The interior of each section is subdivided by various methods prescribed over the years in instructions to U.S. Government surveyors. The WDNR 24K Landnet uses a variation of The Federal *Straight Line* Method to determine the center of section. This method establishes the center of section by intersecting straight lines connecting the quarter corners. The quarter corners in the WDNR variation are derived by subdividing the section lines into equal halves using an automated protraction routine, and continuing this process down to the quarter-quarter section. *The actual accuracy of these corners is limited by the source data from which section corners were derived and uncertainty created by approximate methods of section subdivision.* During digitizing of the section corners, if an obvious deflection was found and determined to be a quarter section corner, its location was captured. These digitized quarter section corners were later observed by the protraction routine and used during subdivision of the section.

In western and northern sections within a township the evidence of survey and plat maps, as well as the current federal statutes, imply that a regular SE quarter was laid out if the section was greater than $\frac{1}{2}$ mile square. If the section was greater than $\frac{3}{4}$ mile on a side, the northern and western tier can be further subdivided into an additional regular ($\frac{1}{4}$ mile square) quarter-quarter section. Any regular quarter section can be subdivided by equidistant protraction. Beyond $\frac{3}{4}$ mile, subdivision becomes relatively less routine.

The 24K Landnet database contains “extended” sections which have been extended over meandered water bodies (including portions of Lakes Michigan and Superior). These were created in order to create a “seamless” coverage of quarter-quarter sections for most of the lands and waters administered by Wisconsin state agencies. It also contains some sections which are outside of the administrative boundary of Wisconsin. These occur along the northwest part of the state within the State of Minnesota which was originally surveyed from the same base line as Wisconsin. In this area, several sections span across the state administrative boundary. Where these *two-state* sections maintain a shape which is sufficiently regular to allow for subdivision into aliquot parts, the section corners in Minnesota will appear in this database. This is done to allow the protraction routine to create the maximum number of quarter-quarter sections in the state as possible.

Separate *regions* exist in the ARC/INFO 24K Landnet database for sections, quarter sections, and quarter-quarter sections. These are outlined in Appendices E, F, and G.

2.1.3. Government Lots

When a full quarter-quarter section could not be created by the original government surveyors, often because natural features such as water bodies were encountered, government lots were created (see Figure 1) to comprise that area (see 2.2.2. for a discussion of meander features). This included noting the location, acreage and lot number of each government lot as it was surveyed. Initially, the only government lots coded in the 24K Landnet database will be those in which there is some WDNR management. Government lots are represented in their own region as outlined in Appendix H.

2.1.4. Grants of Land

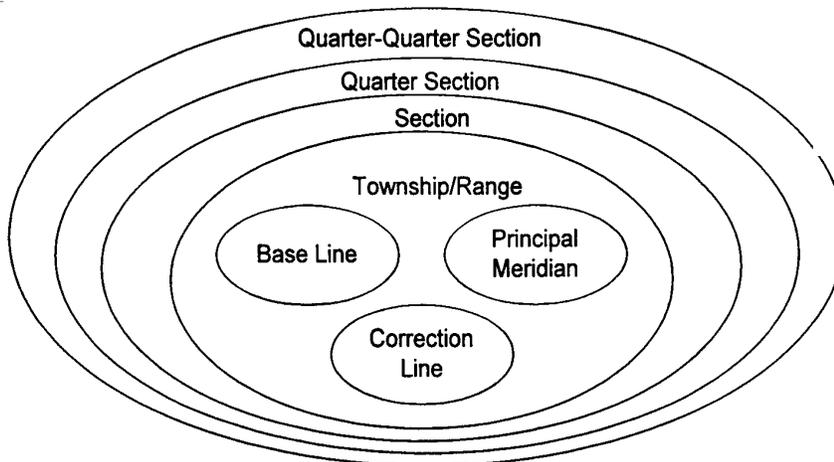
Several areas in Wisconsin (Prairie du Chien, Green Bay, Kaukauna, De Pere, Portage, Brothertown, and Stockbridge) were excluded from the PLSS due to the fact that authenticated and officially confirmed claims to these areas existed before the time of survey. An area of Green Bay, for instance, was originally laid out as French Long Lots (included here in a broader category for *private claims*). This area was settled along the Fox river, with boundaries running back from the waterfront as parallel lines. By maintaining waterfrontage for each parcel during subsequent subdivisions, the parcels often became quite narrow. The areas east of Lake Winnebago have a different history; they were originally Reservations of the Stockbridge and Brothertown Indians. These Indian Claims were later subdivided into Township Lots.

The 24K Landnet does contain the majority of these “anomalous” PLSS features for Wisconsin. However, omissions of the individual lots within grants of land are known to exist. For example, the boundaries of the individual lots within the Main Village Lot area of Prairie du Chien and within the Military Reservation of Green Bay are not depicted. An outline of the anomalous areas region appears in Appendix I.

2.2. Line Features

The line entities of the 24K Landnet are divided into 10 classes. Each class, except those representing grants of land, represents a hierarchical characteristic of the linear infrastructure of the 24K Landnet database (see Figure 2). For example, if a line represents the boundary between two quarter-quarter sections, quarter sections, sections, and townships, it will be attributed as a township line. Each line is also coded for status and source (see Appendix B). The status attribute indicates how the line was represented on the USGS 7.5' quadrangle map. The source attribute indicates where the information was obtained. No attempt has been made to show coincidence with other features, such as roads (see 2.2.4. for details).

Figure 2:



2.2.1. PLSS Line Features

The Fourth Principal Meridian and Base Line form the basis for all of the PLSS in Wisconsin (see Map A). All other PLSS lines were surveyed out from these two features. To reduce the effect of converging meridians due to the curvature of the Earth's surface, correction lines were added at convenient intervals. Range lines were then surveyed along meridians at six-mile intervals north of the base line, and township lines were surveyed along parallels at six-mile intervals east and west of the principal meridian. Section lines were placed at one-mile intervals, with quarter corners marked at the approximate mid-point of two section lines. Although quarter-quarter lines were not laid down in the original surveys, they were developed as further subdivision of parcels became necessary. PLSS line features are represented as straight lines between standard PLSS corners. However, shape points or vertices sometimes do occur in the 24K Landnet in certain areas which were obtained from cooperators (see Map B).

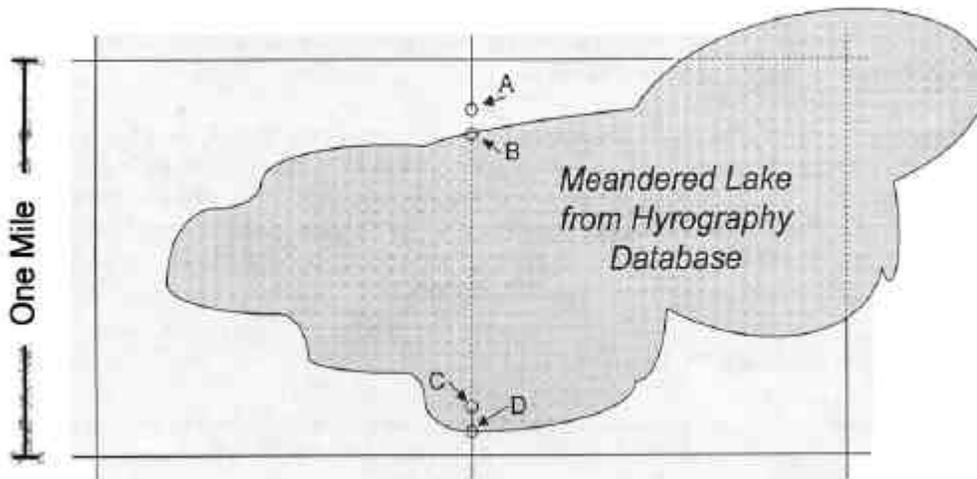
2.2.2. Meander Features

The border of a large permanent natural body of water is termed a meander line. These meander features (see Figure 1) form part of the boundary for most government lots (see 2.1.3. for details) and many grants of land (see 2.1.4. for details). All navigable bodies of water and other important rivers and lakes are segregated from the public lands at mean high-water elevation. The ordinary high-water mark is the line which the water impresses on the soil by covering it for sufficient periods to deprive it of upland vegetation. Meander lines are run not as boundaries, but to approximately define the sinuosity of the high water mark of the stream or body of water and calculate the quantity of land. The water body high water mark, not the meander line, is the boundary. When, by action of water, the bed of the body of water changes, high-water mark also changes, and the ownership of adjoining land changes with it. Meander lines are not established at the segregation line between upland and swamp or overflowed land, but at the ordinary high-water mark of the actual margin of the river or lake on which such swamp or overflowed lands border (see Bureau of Land Management 1973 for a further discussion).

The 24K Landnet database uses the WDNR's 1:100,000 scale Hydrography database (HYDNT100) as a source for all meandered features. Water bodies which appear as "open water" in HYDNT100 and are intersected by section lines are included in 24K Landnet. This set of water bodies consists of more features than were identified as meandered water bodies at the time of the original survey. Once the 1:24,000 scale Hydrography database is completed, this more accurate representation of surface water shorelines will be used to delineate meandered water bodies for 24K Landnet.

Figure 3 shows the *modern shoreline points* (B and D) which are created when the meandered water bodies from the Hydrography database are intersected. The meander corners as captured from the USGS 7.5' maps are represented by points A and C. Landnet data users should note that where data cooperators (see Map B) failed to capture a meander corner, GEO approximated the location of the meander corner as a place-holder until more accurate data could be referenced (see SOURCE item in Appendix C). The line features which bound the meandered lake all have the same class (see Appendix B).

Figure 3:



2.2.3. Administrative Boundaries

The only administrative boundary explicitly referenced spatially in this database is the generally recognized cartographic boundary for the State of Wisconsin. The official boundary, as described in Article II of the Wisconsin Constitution, is not shown in Lakes Michigan and Superior in 24K Landnet. The linework for this boundary comes from either the WDNR 1:24,000 scale Watershed database or has been digitized by WDNR staff explicitly for the 24K Landnet from USGS 7.5' maps. "Lesser" administrative boundaries were not captured as line entities. However, most polygons do have a county code - although all county boundaries are not portrayed. Other administrative boundaries may also be referenced in the Feature field on node entities (see Appendix C).

2.2.4. Transportation Features

A topic for future consideration will be how to show coincidence of the PLSS with transportation features. This work will likely require the cooperation of WDNR, the Wisconsin Department of Transportation (WisDOT), and local governments, and take advantage of dynamic segmentation technologies. Line coincidence information was not included in this database because of the complexity of road networks and the fact that they sometimes waver on and off of section lines - even within the length of a quarter-quarter section. In the future, the use of *group features* could be explored in order to allow databases to share primitive coincident features such as meandered water bodies or transportation rights of way.

2.3. Node Features

There are over 1,000,000 nodes in the 24K Landnet. These features are divided into 17 classes (see Appendix C) to represent the different types of PLSS corners or other significant points. The node features provide the framework for constructing line and area features. Like the line features, these classes represent a hierarchical characteristic of the node features of the Landnet database. For example, if a node represents a section corner and a township corner, it is attributed as a township

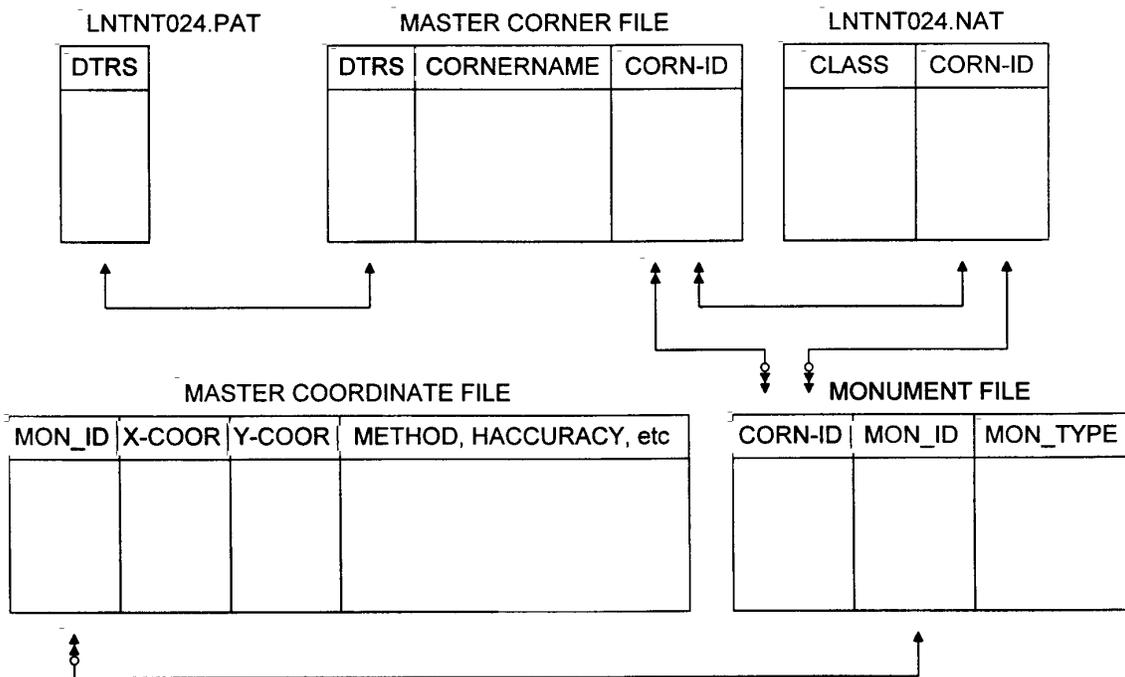
corner. Most nodes are also assigned a unique identifying code (see CORN_ID in Appendix C). It represents the link between this 24K Landnet database, the 100K Landnet database, and an eventual statewide survey-level PLS corner database. Meander corners, grant-of-land and state administrative boundary intersections have a zero for CORN-ID.

In order to accommodate differing coding schemes in use for uniquely identifying PLS corners in the state, a cross-reference or lookup table may eventually need to be created. This table could contain all identifiers using coding schemes from the counties, WDNR, and the Bureau of Land Management, with linkages between them. This lookup table, however, will be a costly endeavor to create. A much more far-sighted and cost-effective approach for all parties interested in identifying PLS corners would be to adopt a standard unique coding scheme for all PLS corners in Wisconsin.

3. Linkages to Survey-Level Data

The WDNR has had discussions with various local government entities as well as private organizations regarding linkages to survey-level data (see Figure 4, WDNR 1/11/96, and Wisconsin GPS Standards Work Group 1/22/96). The key to linking the 24K Landnet to survey-level data is the unique corner identification scheme. Once such a scheme has been defined, seamless linkages can be utilized for managing tie-sheet databases, identifying monumented and derived corners, protracting new section polygon and line features, and traversing surveyed descriptions of properties. The process for inclusion of more accurate data should include capturing information about coincident line features, such as transportation features or meander features.

Figure 4:



4. Attribute Data Geo-Referenced by Legal Description

The 24K Landnet will provide a basic framework for mapping information about WDNR properties. This will be achieved by linking quarter-quarter sections in the Landnet database to parcel information from PM's Oracle® Land Records database, which contains data on property type, purchase date, school district, surveyed acreage, and several others. This approach is only an intermediate step until the 1:24,000 scale Property Boundaries spatial database is complete, however it does demonstrate how a tabular database geo-referenced by legal description can be displayed spatially. A significant amount of data maintained by various other agencies are also geo-referenced to the quarter-quarter section and could be linked to 24K Landnet for display and analysis.

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Wisconsin Land Information Association, 12/95, "Parcel Geo-Locator Standard", 10 pages.

Appendix A - Basic Area Entity Definitions

Information on all area entities (townships, sections, quarter-quarter sections, etc.) is stored in the Polygon Attribute Table (PAT). The following describes each item in this table.

DATAFILE NAME: LNTNT024.PAT

COL	ITEM NAME	WDTH	OPUT	TYP	N.DEC	ALT NM
25	DTRS	7	7	I	-	DIR_TWP_RNG_SEC
32	QQ	2	2	I	-	
34	TRACT_TYPE	2	2	C	-	
36	ENTITY_CD	5	5	N	1	
41	WATER	1	1	I	-	
42	STATE_FIPS	2	2	I	-	

** REDEFINED ITEMS **

25	D	1	1	I	-	
26	T	2	2	I	-	
28	R	2	2	I	-	
30	S	2	2	I	-	
32	Q	1	1	I	-	Q_N
33	QQ_N	1	1	I	-	
25	DTR	5	5	I	-	
25	DTRSQ	8	8	I	-	
25	DTRSQQ	9	9	I	-	

DTRS: This item uses a seven-digit code to uniquely identify all PLSS sections in Wisconsin. A "2" in the first digit indicates a range direction of West; a "4" in the first digit indicates a range direction of East. The second and third digits contain the township number (01 through 53). The fourth and fifth digits contain the range number (01 through 20 West, 01 through 30 East).[†] Digits six and seven contain the section number (01 through 36).

QQ: This is a two-digit Wisconsin Land Information Program (WLIP) standard identifying key for the quarter-quarter section. The first digit identifies the quarter section and the second digit identifies the quarter-quarter section. The northeast quarter receives a value of "1", the northwest quarter receives a value of "2", the southwest quarter receives a value of "3", and the southeast quarter receives a value of "4". Extending these codes to the quarter-quarter sections, Figure 5 shows the range of possible codes. This field will also be used for storing quarter-quarter equivalent values or locational information about government lots and other types of tracts which are further referenced in the TRACT_TYPE and ENTITY_CD fields.

[†] A range value of "99" identifies a unique occurrence of a half range in Wisconsin. It is made up of narrow sections surveyed in 1870 to fill a gap caused by a measurement discrepancy. The sections extend north and south of the eastern part of the Marinette/Oconto County line. They do not appear on the 24K USGS maps.

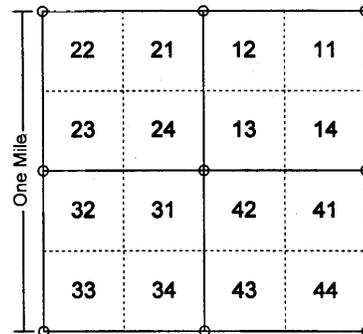


Figure 5

TRACT_TYPE: This two-digit field will be filled for any of the entities listed below. Non-null values represent a special or non-standard survey area. Values 05 through 14 are identical to those outlined in the Wisconsin Land Information Association "Parcel Geo-Locator Standard". Values 15 through 38 have been added by WDNR. For quarter-quarter sections, this field will be null. For government lots, only those government lots within sections where there is WDNR management will have values for this field and ENTITY_CD. Eventually, when additional data are incorporated, all government lots may be included. See 2.1.3. for a general discussion of government lots and 2.1.4. for a discussion of grants of land. This field will contain blanks for other features not listed as follows:

- 05 Government Lot
- 06 Native American Claim (as in former reservations east of Lake Winnebago)
- 08 Private Claim (as in lots north of Kaukauna but excluding those in Brown county)
- 09 Military Reserve (as in reserve in Green Bay)
- 10 Named Grants or Tracts (as in Williams Grant)
- 11 Farm Lot (as in Prairie du Chien)
- 12 Upper Village Lot (as in Prairie du Chien)
- 13 Half Range (as in resurvey area between Marinette and Oconto counties)
- 15 Main Village Lot (as in Prairie du Chien)
- 16 Outagamie-Fox Elongated PLSS (along the Fox River in Outagamie county)
- 28 Private Claim northwest of the Fox River in Brown county
- 38 Private Claim southeast of the Fox River in Brown county

ENTITY_CD: A 5-digit label identifying the entity in the tract code. The fourth byte in the field stores a decimal. For example, the tract type for government lot is 05, the entity code would express 012.0 for government lot 12. Thus 05012.0 equals government lot 12.

WATER: Identifies modern water bodies which appear as "open water" in the 1:100,000 scale GIS layer for all hydrography (HYDNT100) and are intersected by section lines. This set of water bodies consists of more features than were considered meandered water bodies at the time of the original survey (see 2.2.2. for a discussion).

- 0 Land polygon
- 1 Water body polygon

STATE_FIPS: Designation for polygons which are within the generally recognized cartographic boundaries of the State of Wisconsin. Off-shore water polygons in Lakes Superior and Michigan (including the bay of Green Bay), as well as those in Minnesota which are based on the Fourth Principal Meridian, are populated with a zero. All others "within" Wisconsin are populated with a '55'.

Appendix B - Line Entity Definitions

Information on each PLSS line entity (townships, sections, grants of land, etc.) are stored in the Arc Attribute Table (AAT). The following describes each item in this table.

DATAFILE NAME: LNTNT024.AAT

<u>COL</u>	<u>ITEM NAME</u>	<u>WIDTH</u>	<u>OPUT</u>	<u>TYP</u>	<u>N.DEC</u>	<u>ALT NM</u>
33	CLASS	2	2	I		
35	STATUS	1	1	I		
36	SOURCE	2	2	I		

CLASS: The highest order of classification (or lowest value) applicable is used when attributing an arc (see Figure 2). For example, an arc may represent a section line, a township line and a correction line. It will be attributed as a correction line. The following describes each possible value of this field:

- 1 Principal Meridian - the base line in a north-south direction from the initial point, established as a reference system for the PLSS surveys (see Map A).
- 2 Base Line - the base line in an east-west direction from initial point, established as a reference system for the PLSS surveys (see Map A).
- 3 Standard Parallel/Correction - adjustments made for the curvature of the earth and laid out along parallels generally every 10th row of townships, except for Wisconsin's 5th correction line being only six rows from the previous correction line (see Map A).
- 4 Township - the lines forming the sides of a township.
- 5 Section - the lines forming the sides of a section within a township.
- 7 Aliquot Part - the lines forming the quarter and quarter-quarter sections **within** a section, often referred to as '8th' and '16th' lines. These lines are created by the protraction routine.
- 8 Grant of Land - the lines forming the boundary of a grant of land or lot within a grant of land. See 2.1.4. for details.
- 9 State Administrative Boundary - the lines forming the state administrative boundary (see 2.2.3. for details).
- 10 Meander - the lines forming the boundaries (shorelines) of meandered bodies of water.

STATUS: Between PLSS corners a line may be made up of several types of features on the USGS 7.5' quadrangle map. The highest status is used to populate this field. The following describes each possible value of this field:

- 1 Clear - a PLSS solid red line
- 2 Doubtful - a PLSS dashed red line
- 3 Coincidence - occurs when another feature has cartographic dominance over the PLSS line on the USGS 7.5' quadrangle map.
- 9 Unknown or Not Applicable - lines not visited or not shown on the USGS 7.5' quadrangle maps. These include: lot lines of native american claims, meander lines, lines extended over meandered water bodies, quarter-quarter lines, and some lines from data share cooperators.

SOURCE: The source describes where the line originated (see Appendix M), and in some cases, the method of data automation used to prepare it for inclusion in 24K Landnet. The following describes each possible value of this field:

- 1 USGS 7.5' Quadrangle - lines digitized by WDNR staff from USGS 7.5' quadrangle maps.
- 2 Subdivision - lines derived from WDNR's protraction routine.
- 3 Arbitrary - derived lines within meandered bodies of water.
- 4 USGS DLG - lines obtained from the USGS 1:24,000 Digital Line Graphs (DLG).
- 5 WP&L - lines obtained from 1:24,000 Wisconsin Power & Light (WP&L) data. These were originally digitized from USGS 7.5' quadrangle maps.
- 6 US Forest Service - lines obtained from the 1:24,000 US Forest Service Cartographic Feature Files (CFF).
- 8 NSP - lines obtained from 1:24,000 Northern States Power Company (NSP) data. These were originally digitized from USGS 7.5' quadrangle maps.
- 9 24K Hydrography - meander lines obtained from the WDNR's 1:24,000 scale Hydrography database.
- 10 24K Watershed - administrative boundary lines obtained from the WDNR's 1:24,000 scale Watershed database (see 2.2.3. for details).
- 11 100K Hydrography - temporary meander lines obtained from WDNR's 1:100,000 scale Hydrography database.
- 13 Stockbridge/Brothertown - lines obtained from the 1893 Plat of Stockbridge or 1893 Plat of Brothertown (scale = 1:21,120). Lines were hand-drawn on USGS 7.5' quadrangle maps and digitized in the same manner as those with a SOURCE of 1.
- 14 Oconto/Marinette Half Ranges - lines obtained from the 1983 resurvey of Township 29 North, Range 21½ East in Oconto and Marinette counties. Lines were digitized using a "heads-up" method of entry.
- 15 Williams Grant - lines obtained from a Brown County survey of the Town of Lawrence. The data were provided as a DXF-formatted file, which was converted to a coverage, attributed, and projected.

Appendix C - Node Entity Definitions

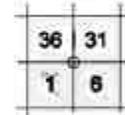
Information on each standard corner (townships, sections, meanders, etc.) is stored in the Node Attribute Table (NAT). The following describes each item in this table.

DATAFILE NAME: LNTNT024.NAT

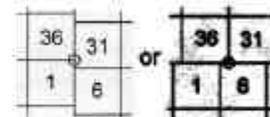
COL	ITEM NAME	WIDTH	OPUT	TYP	N.DEC	ALT NM
13	CLASS	2	2	I		
15	STATUS	1	1	I		
16	FEATURE	2	2	I		
18	SOURCE	2	2	I		
20	DTRCORNER1	4	9	B		
24	DTRCORNER2	4	9	B		
28	DTRCORNER3	4	9	B		
32	DTRCORNER4	4	9	B		
36	CORN_ID	11	11	I		
** REDEFINED ITEMS **						
43	SECGRD_CD	4	4	I		SG_CD
43	SECGRD_COL	2	2	I		SG_COL
45	SECGRD_ROW	2	2	I		SG_ROW

CLASS: The highest order of classification with the most complete description is used when populating this field for a corner. For example, a node which is both a section corner and a township corner is attributed as a township corner. The following describes each possible value of this field:

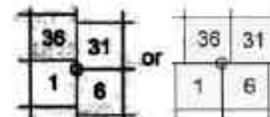
1 Township - the corners marking the extremity of four townships.



2 Offset Township - the corners marking the extremity of two townships which lie either immediately north of an east-west township boundary or west of a north-south township boundary. This particular coding is necessary for the protraction routine.



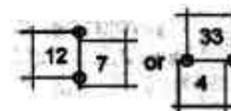
3 Closing Township - the corners marking the extremity of two townships which lie either immediately south of an east-west township boundary or east of a north-south township boundary.



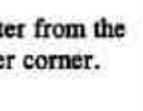
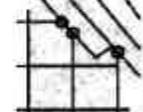
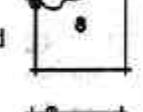
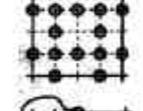
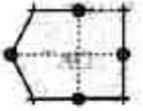
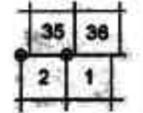
4 Section - the corners marking the extremity of four sections.



5 Offset Section - the corners marking the extremity of two sections which lie either immediately north of an east-west section boundary or west of a north-south section boundary. This particular coding is necessary for the protraction routine.



- 6 Closing Section - the corners marking the extremity of two sections which lie either immediately south of an east-west section boundary or east of a north-south section boundary.
- 7 Quarter - corners that mark the extremity of four quarter-sections. Only deflected and/or found quarter corners are being captured from the USGS 7.5' quadrangles maps. All others are created at the midpoint of adjacent section corners by the protraction routine.
- 8 Offset Quarter - quarter corners marking the extremity of only two sections. These will only be captured during the editing process if the offset quarter corner is found or deflected. All others are created at the midpoint of adjacent section corners by the protraction routine.
- 9 Section Center - the corner marking the center of the section. These will only be created by the protraction routine.
- 10 Quarter-Quarter - corners that mark the extremity of a quarter-quarter section. These will only be created by the protraction routine.
- 11 Meander - corners established at the intersection of a township or section line with the meander line of a navigable stream or meanderable body of water. Since not all water bodies are meandered, the USGS 7.5' quadrangle map is used to determine if there is a meander corner on a particular body of water.
- 12 Witness - a monumented point usually on a section line, near the true corner location. Witness corners are established if the true corner cannot be occupied or monumented because of difficult terrain or an obstruction at the corner site.
- 13 Angle Point - a point of survey where the alignment of boundary deflects from a straight line. Any break in bearing on a survey can be considered an angle point.
- 14 Grant of Land - corners marking the extremities of a grant of land (see 2.1.4. for details), or corners marking the extremities of lots within a grant of land.
- 15 Closing at Grant of Land - corners marking the intersection of the Public Land Survey System with a grant of land boundary.
- 16 State Administrative Boundary - corners marking the intersection of the Public Land Survey System with the state administrative boundary.
- 17 Modern Shoreline - nodes created by the intersection of meandered bodies of water from the hydrography database with the Landnet database, not the actual surveyed meander corner. See 2.2.2 and Figure 3 for details.



STATUS: The status of a corner as indicated by the symbolization used on the USGS 7.5' quadrangle maps. The following describes each possible value of this field:

- 1 Found - corners whose original or re-established monuments have been recovered or whose positions are definitely established by other evidence. These are represented on the maps (in red) as:
 - + for found township, section, quarter, witness, and angle corners
 - ⊥, ⊥, etc. for found meander and closing corners
- 2 Indicated - intersections of Landnet lines where no "Found" symbol occurs.
- 3 Deflection - quarter corners that appear on the USGS 7.5' quadrangle maps where a PLSS line has a definite change in direction of approximately 5° or more.
- 9 Unknown or Not Applicable - corners not visited or not shown on the USGS 7.5' quadrangle maps. These include: center of sections, quarter-quarters, arbitrary corners within meandered water bodies, lot corners of native american claims, and some nodes from data share cooperators.

FEATURE: The lowest accuracy line feature beginning or ending at a node. For example, a section corner shown on a USGS 7.5' quadrangle map may be formed by the intersection of a solid PLSS line, a dashed PLSS line and a major road. The feature item for this corner is populated with 'Major Road'. USGS 7.5' quadrangle maps incorporate a system of cartographic dominance with respect to PLSS features, thus displaying only a minor road on the maps if a the road is coincident with a PLSS feature. The following describes each possible value of this field:

- 1 PLSS - a solid red PLSS line on the USGS map.
- 2 PLSS Dashed - a dashed red line on the USGS map to show that there is not enough evidence to ascertain that their positions are within the horizontal accuracy tolerance of the National Map Accuracy Standards. (These should not be confused with fence lines which are indicated by a lighter-weight dashed red line.)
- 3 Administrative Boundary - a feature used to delineate a civil boundary or cemetery boundary that is coincident with the PLSS line and which has cartographic dominance on the USGS map.
- 4 Major Road - a feature used to indicate a primary or secondary highway or railroad that is coincident with the PLSS line and which has cartographic dominance on the USGS map.
- 5 Divided Hwy - a feature used to indicate a divided highway or double railroad track that is coincident with the PLSS line and which has cartographic dominance on the USGS map.
- 6 Minor Road - a feature used to indicate a light duty road, unimproved road, pipeline, or powerline that is coincident with the PLSS line and which have cartographic dominance on the USGS map.
- 7 Fence - a feature used to indicate a fence line on the USGS map.
- 8 Trail - a feature used to indicate a trail that is coincident with the PLSS line and which has cartographic dominance on the USGS map.
- 9 Hydro - a feature used to indicate surface water that is coincident with the PLSS line and which has cartographic dominance on the USGS map.
- 10 Grant of Land - a feature used to symbolize grant of land boundaries on the USGS map.
- 11 Quad Boundary - used to indicate that the feature fell on the USGS 7.5' quadrangle boundary and it was therefore difficult to ascertain positional accuracy.
- 12 Extended - a line extended over a meandered water body.
- 13 Protraction - a line derived from WDNR's protraction routine.

- 19 Unknown - nodes not visited or not shown on the USGS 7.5' quadrangle maps. These include: lot corners of native american claims, and some nodes from data share cooperators.

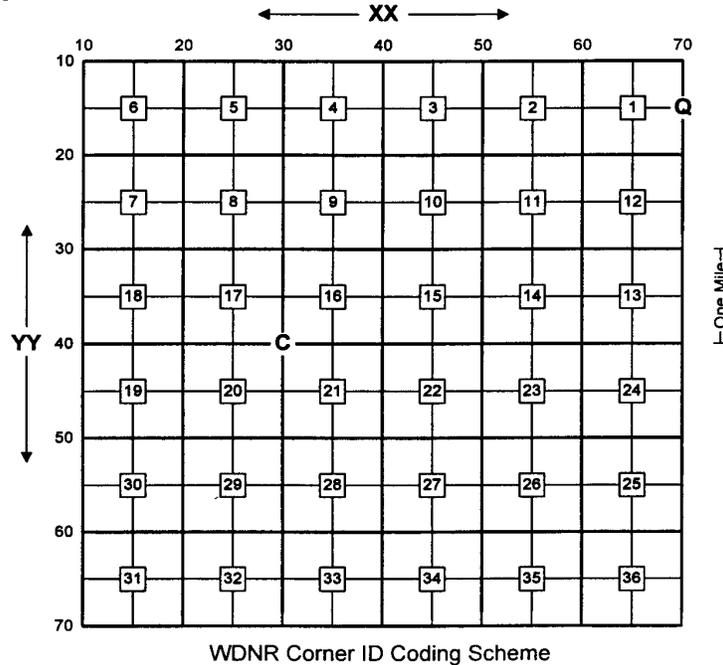
SOURCE: The source describes from where the corner originated (see Appendix M), and in some cases, the method of data automation used to prepare it for inclusion in 24K Landnet. The following describes each possible value of this field:

- 1 USGS 7.5' Quadrangle - nodes that were digitized by WDNR staff from USGS 7.5' quadrangle maps.
- 2 Protraction - nodes derived from WDNR's protraction routine.
- 3 Arbitrary - nodes derived from the intersection of two arbitrary lines within a meandered body of water or added during the editing process of certain cooperator's data to show the approximate location of meander corners.
- 4 USGS DLG - nodes obtained from the USGS 1:24,000 Digital Line Graphs (DLG).
- 5 WP&L - nodes obtained from 1:24,000 Wisconsin Power & Light (WP&L) data. These were originally digitized from USGS 7.5' quadrangle maps.
- 6 US Forest Service - nodes obtained from the 1:24,000 US Forest Service Cartographic Feature Files (CFF).
- 8 NSP - nodes obtained from 1:24,000 Northern States Power Company (NSP) data. These were originally digitized from USGS 7.5' quadrangle maps.
- 9 24K Hydrography - nodes created by the intersection of WDNR's 1:24,000 scale Hydrography database with the 24K Landnet.
- 10 24K Watershed - administrative boundary nodes created by the intersection of WDNR's 1:24,000 scale Watershed database with the 24K Landnet.
- 11 100K Hydrography - nodes created by the intersection of WDNR's 1:100,000 scale Hydrography database with the 24K Landnet.
- 12 Adjusted - Adjusted nodes sometimes necessary for creating section polygons when the digitized closing corners fell short of the correction line.
- 13 Stockbridge/Brothertown - nodes obtained from the 1893 Plat of Stockbridge or 1893 Plat of Brothertown (scale = 1:21,120). Nodes were hand-drawn on USGS 7.5' quadrangle maps and digitized in the same manner as those with a SOURCE of 1.
- 14 Oconto/Marinette Half Townships - nodes obtained from the 1983 resurvey of Township 29 North, Range 21½ East in Oconto and Marinette counties. Nodes were created using a "heads-up" method of entry.
- 15 Williams Grant - lines obtained from a Brown County survey of the Town of Lawrence. The data were provided as a DXF-formatted file, which was converted to a coverage, attributed, and projected.

DTRCORNER1, DTRCORNER2, DTRCORNER3, DTRCORNER4: These items contain the WDNR corner identifier. Depending on the section corner being identified, one or more of these items contains a 9-digit code describing the position of the section corner node within the indicated PLSS township. Digits 1 through 5 identify a township contiguous to or containing the section corner.

Digits 6 through 9 use a "YYXX" encoding scheme to identify the section corner location within the indicated township; refer to Figure 6.

Figure 6:



For example, the northeast corner of Section 20, which is also the southwest corner of Section 16 and the northwest corner of Section 21 and the southeast corner of Section 17, (indicated on the diagram by a "C") would be identified by 4030. Quarter-section corners are identified by the digit 5; the corner indicated on the diagram by a "Q" would be identified by 1570. Meander corners that fall between two section corners are numbered sequentially from 1 to 4 if falling after the section corner but before the quarter-section corner, and 6 to 9 if falling after the quarter-section corner but before the next section corner (e.g., 1170 would be the first meander corner in the Y direction encountered between section corner 1070 and quarter-section corner 1570). The same logic applies to meander corners along the X-axis.

If a node represents a section corner for only one township, the DTRCORNER1 item will contain the section corner identifier, and the items DTRCORNER2 through DTRCORNER4 will be blank. If a node represents a section corner for two adjacent townships, the items DTRCORNER1 and DTRCORNER2 will contain a section corner identifier, and the remaining two items will be blank. The same coding convention is followed for nodes representing section corners in four townships (each of the four items is filled).

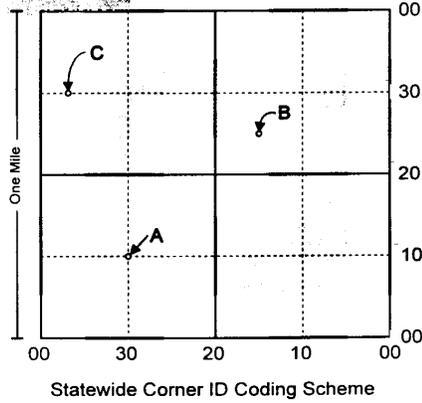
CORN_ID: This item contains the corner identifier used to uniquely identify all PLSS survey corners (see Figure 7). It is based on a scheme (see Romportl 5/94) which grids a section similar to a regular section and its 16 quarter-quarter sections. Each major horizontal row (or line) and each vertical column (or line) is assigned a number incremented by 10 and each corner then receives a row and column number. The corner becomes unique by prefixing the row and column number by its principal meridian indicator, either east or west of the 4th principal meridian, and the township, range, and section. Locations between the major rows and columns can also be identified with this scheme which allows for 100 possible locations within a quarter-quarter section to be uniquely identified.

The use of this code in 24K Landnet differs slightly from that proposed by Romportl in the Wisconsin County Surveyors Association Newsletter (5/94) in two respects. First, for elongated sections (those longer than one mile east-west), in 24K Landnet no subdivision occurs after $\frac{3}{4}$ mile from the southeast corner. Therefore, the row or column values within CORN-ID do not exceed 40. Second, when township interior sections are offset, in 24K Landnet they are assigned CORN-ID as they would if they were township boundary offsets.

Assuming figure 7 refers to Section 21, Township 36 N, Range 9 E, the following corner IDs would result:

A = 43609211030
 B = 43609212515
 C = 43609213037

Figure 7:



SECGRD_CD: This redefined item contains the portion of the item CORN-ID which is unique within a section.

Appendix D - Township Area Entity Definitions

Information on each township is contained within a single region, known as DTR. The following describes each item in this table.

DATAFILE NAME: LNTNT024.PATDTR

<u>COL</u>	<u>ITEM NAME</u>	<u>WDTH</u>	<u>OPUT</u>	<u>TYP</u>	<u>N.DEC</u>	<u>ALT NM</u>
25	DTR	5	5	I	-	
30	STATE_FIPS	2	2	I	-	
** REDEFINED ITEMS **						
25	D	1	1	I		DIR
26	T	2	2	I		TWP
28	R	2	2	I		RNG

DTR: A concatenation of direction, township, and range. See Appendix A for more details.

STATE_FIPS: See Appendix A for details.

D: Direction

T: Township

R: Range

Appendix E - Section Area Entity Definitions

Information on each section is contained within a single region, known as DTRS. The following describes each item in this table.

DATAFILE NAME: LNTNT024.PATDTRS

<u>COL</u>	<u>ITEM NAME</u>	<u>WIDTH</u>	<u>OPUT</u>	<u>TYP</u>	<u>N.DEC</u>	<u>ALT NM</u>
25	DTRS	7	7	I	-	

** REDEFINED ITEMS **

25	D	1	1	I		
26	T	2	2	I		
28	R	2	2	I		
30	S	2	2	I		SEC
25	DTR	5	5	I		

DTRS: A concatenation of direction, township, range, and section. See Appendix A for more details.

Appendix F - Quarter Section Area Entity Definitions

Information on each quarter section is contained within a single region, known as DTRSQ. The following describes each item in this table.

DATAFILE NAME: LNTNT024.PATDTRSQ

<u>COL</u>	<u>ITEM NAME</u>	<u>WIDTH</u>	<u>OPUT</u>	<u>TYP</u>	<u>N.DEC</u>	<u>ALT_NM</u>
25	DTRSQ	8	8	I	-	

** REDEFINED ITEMS **

25	D	1	1	I		
26	T	2	2	I		
28	R	2	2	I		
30	S	2	2	I		
32	Q	1	1	I		Q_N
25	DTR	5	5	I		
25	DTRS	7	7	I		

DTRSQ: A concatenation of direction, township, range, section, and quarter section. See Appendix A for more details. Also included are half sections, which have the following values for Q:

- 5 North half section
- 6 West half section
- 7 South half section
- 8 East half section

Appendix G - Quarter-Quarter Section Area Entity Definitions

Information on each quarter-quarter section is contained within a single region, known as DTRSQQ. The following describes each item in this table.

DATAFILE NAME: LNTNT024.PATDTRSQQ

<u>COL</u>	<u>ITEM NAME</u>	<u>WIDTH</u>	<u>OPUT</u>	<u>TYP</u>	<u>N.DEC</u>	<u>ALT NM</u>
25	DTRSQQ	9	9	I	-	

** REDEFINED ITEMS **

25	D	1	1	I		DIR
26	T	2	2	I		TWP
28	R	2	2	I		RNG
30	S	2	2	I		SEC
32	Q	1	1	I		Q_N
32	QQ	2	2	I		
33	QQ_N	1	1	I		
25	DTR	5	5	I		
25	DTRS	7	7	I		
25	DTRSQ	8	8	I		

DTRSQQ: A concatenation of direction, township, range, section, quarter section, and quarter-quarter section. See Appendix A for more details. Also included are half quarter sections, which have the following values for QQ_N:

- 5 North half quarter section
- 6 West half quarter section
- 7 South half quarter section
- 8 East half quarter section

Appendix H - Government Lot Area Entity Definitions

Information on each government lot is contained within a single region, known as GOVLOT. The following describes each item in this table.

DATAFILE NAME: LNTNT024.PATGOVLOT

<u>COL</u>	<u>ITEM NAME</u>	<u>WIDTH</u>	<u>OPUT</u>	<u>TYP</u>	<u>N.DEC</u>	<u>ALT NM</u>
25	DTRS	7	7	I		
32	TRACT_TYPE	2	2	C	-	
34	ENTITY_CD	5	5	N	1	
** REDEFINED ITEMS **						
25	D	1	1	I		DIR
26	T	2	2	I		TWP
28	R	2	2	I		RNG
30	S	2	2	I		SEC
25	GOV_LOT_ID	14	14	I		

DTRS: A concatenation of direction, township, range, and section. See Appendix A for more details.

TRACT_TYPE: All polygons within this region will contain a value of '05'. See Appendix A for more details.

ENTITY_CD: Government lot number. Only a small percentage of the government lots in the state are represented. See Appendix A for more details.

GOV_LOT_ID: Unique identifying code for government lots statewide, represented as a concatenation of direction, township, range, section, tract_type (05), and entity_cd.

Appendix I - Anomalous Area Entity Definitions

Information on each anomalous area or lot within a grant of land is contained within a single region, known as GRANTS. The following describes each item in this table.

DATAFILE NAME: LNTNT024.PATGRANTS

<u>COL</u>	<u>ITEM NAME</u>	<u>WIDTH</u>	<u>OPUT</u>	<u>TYP</u>	<u>N.DEC</u>	<u>ALT NM</u>
25	DTR	5	5	I		
30	TRACT_TYPE	2	2	C	-	
32	ENTITY_CD	5	5	N	1	
** REDEFINED ITEMS **						
25	D	1	1	I		DIR
26	T	2	2	I		TWP
28	R	2	2	I		RNG
25	LOT_ID	12	12	I		

DTR: A concatenation of direction, township, and range. See Appendix A for more details.

TRACT_TYPE: A code representing the type of grant of land or other anomalous area. See Appendix A for more details.

ENTITY_CD: The lot number within a grant of land. See Appendix A for more details.

LOT_ID: Statewide unique identifying code for anomalous areas, represented as a concatenation of direction, township, range, tract_type, and entity_cd. An example is lot 376½ within the Stockbridge Native American Claim, which would have a unique identifier of 4181906376.5.

Appendix J - Water Area Entity Definitions

Information on each water area is contained within a single region, known as WATER. The following describes each item in this table.

DATAFILE NAME: LNTNT024.PATWATER

<u>COL</u>	<u>ITEM NAME</u>	<u>WIDTH</u>	<u>OPUT</u>	<u>TYP</u>	<u>N_DEC</u>	<u>ALT NM</u>
25	WATER	1	1	I	-	

WATER: Modern water bodies which intersected section lines. See Appendix A for more details.

Appendix K - Master Corner Definitions

Because corners often define the extremities of different sections, it is necessary to store alternate SECGRD_CD values for a single corner. This allows for a fairly simple selection of all corners which define a section. For example, most section corners define the extremities of four different sections, however, offset corners may define the extremities of only two sections. This table contains those alternate codes for identifying corners. The table can be related (linked) to LNTNT024.NAT on the item CORN-ID. The following describes each item in this table.

DATAFILE NAME: LNTNT024.MCT

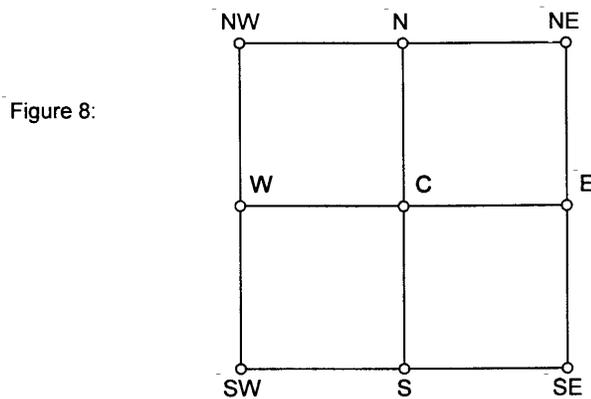
<u>COL</u>	<u>ITEM NAME</u>	<u>WIDTH</u>	<u>OPUT</u>	<u>TYP</u>	<u>N.DEC</u>	<u>ALT NM</u>
1	DTRS	7	7	I	-	
8	ALTGRD_CD	4	4	I	-	
12	CORNERNAME	2	2	C	-	
14	CORN-ID	11	11	I	-	

DTRS: A concatenation of direction, township, range, and section. See Appendix A and Appendix C for a further discussion.

ALTGRD_CD: This item contains the alternate SECGRD_CD values. See Appendix C for a further discussion.

CORNERNAME: The quarter-section (north, east, south, etc.) corners of a section as illustrated in Figure 8.

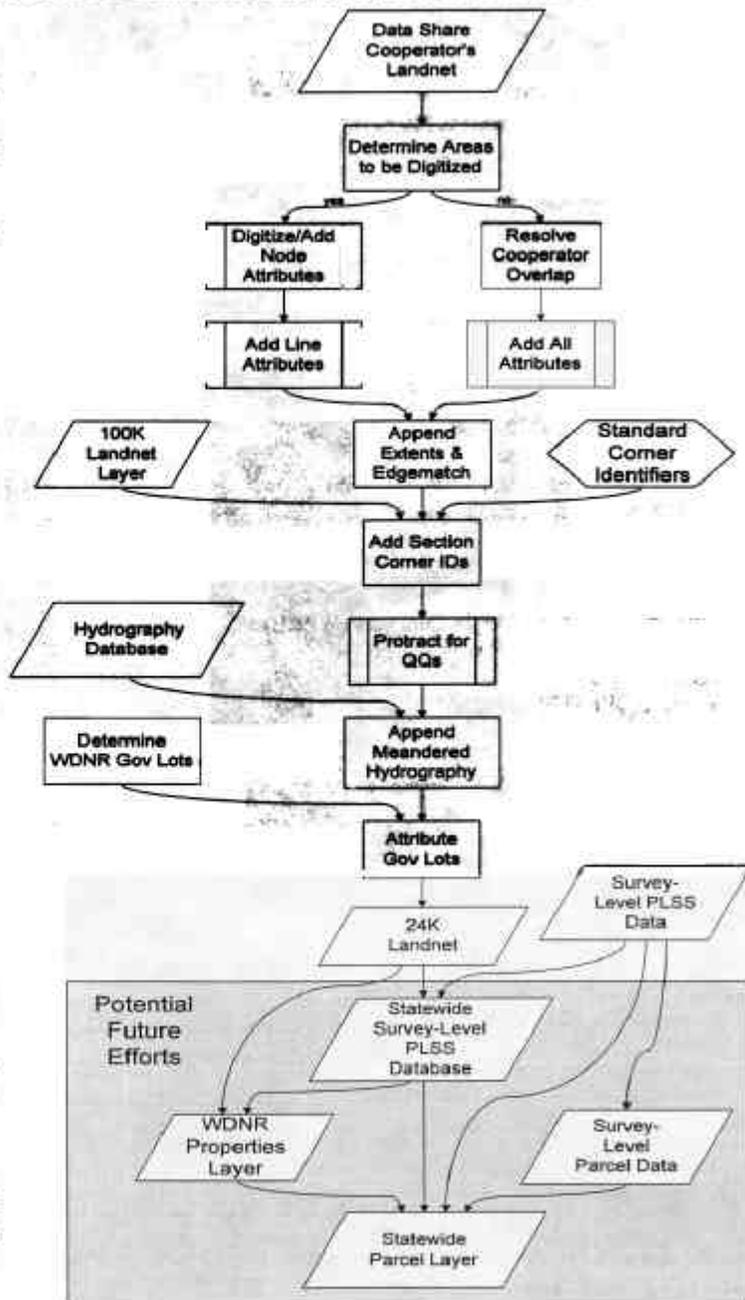
CORN-ID: Unique corner identifying code. See Appendix C for a further discussion.



Appendix L - Generalized Landnet Development Data Flow

Figure 9:

This is a very generalized view of a process which required over two years to complete. For a full description of the processing steps see "24K Landnet Process Documentation". Data from the various data share cooperators were first evaluated to determine which areas needed to be digitized by GEO staff. Both sets of data, that which were digitized and those provided by the cooperators, received basic attributes before all areas were appended together. A corner identifier (see Appendix C) was then added to uniquely identify all corners statewide. WDNR corner identifiers came from the existing 1:100,000 scale Landnet database via conflation. Sections were then subdivided into quarter sections and quarter-quarter sections, and grants of land and meandered water bodies were intersected. Finally, government lots were attributed to create the final statewide 24K Landnet database. Possible future integration with survey-level data can follow.



Appendix M - Data Share Cooperators

Brown County LCD
1150 Bellevue
Green Bay, WI 54302

Chequamegon National Forest
1170 South 4th Ave
Park Falls, WI 54552

Nicolet National Forest
68 South Stevens St.
Rhineland, WI 54501

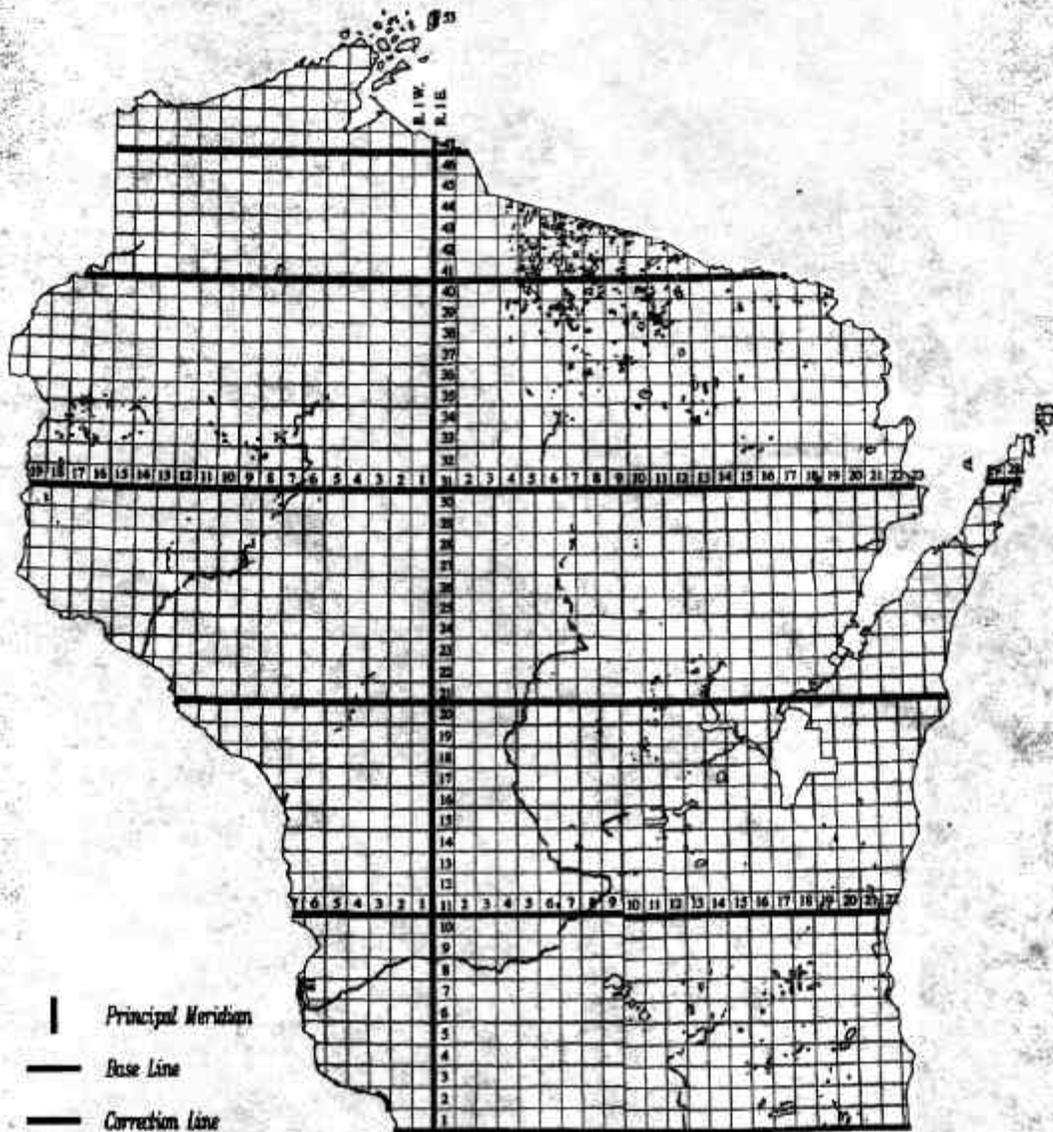
Northern States Power Company (NSP)
P.O. Box 8
Eau Claire, WI 54702-0008

United States Geological Survey (USGS)
Earth Science Information Center
507 National Center
Reston, VA 22092

Wisconsin Power and Light Company (WP&L)
222 West Washington Ave
P.O. Box 192
Madison, WI 53701-0192

Map A:

Public Land Survey System Framework for Wisconsin



-  Principal Meridian
-  Base Line
-  Correction Line
-  Township, Range, Meandered Water Body, or Grant of Land

Scale 1:3,000,000



Map B:

Landnet Data Sources

