

COORDINATE SYSTEM COMPARISON FOR WISCONSIN

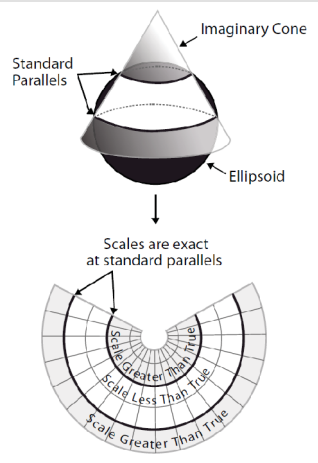
DIFFERENCES BETWEEN DATUMS

A datum is a mathematically-defined reference surface used to represent the size and shape of the Earth. A horizontal datum is defined by an ellipsoid, and its fixation with respect to the surface of the earth. The two most commonly used horizontal datums in Wisconsin are the North American Datum of 1927 (NAD 27) and the North American Datum of 1983 (NAD 83).

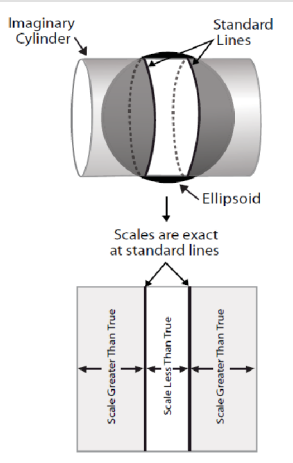
NAD 27 was based on Clarke's 1866 model of the earth's surface. It was used for original surveying of state/county/township lines and over the decades many mapping measurements have been referenced to NAD 27 by local, state, and federal agencies.

NAD 83 was a revision based on a more accurate understanding of the earth's surface and has replaced NAD 27 as the datum of choice throughout Wisconsin. Significant distortion on the local level that had accumulated over the years in NAD 27 was removed, making it more compatible with modern survey technologies and practices. There is no mathematical correlation between NAD 27 and NAD 83 because each was computed from differing sets of measurements referenced to different ellipsoids. However, transformation software is available to interpolate the differences.

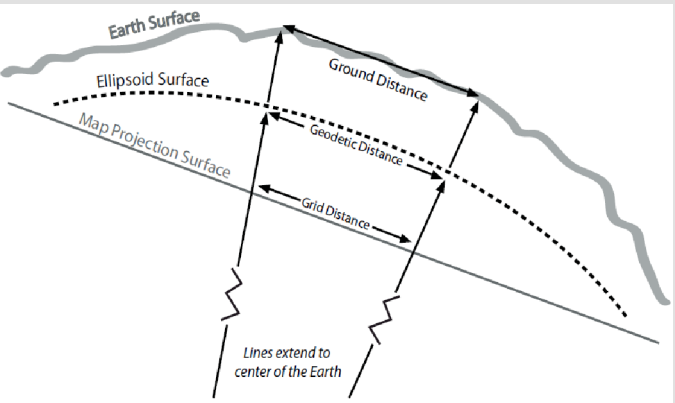
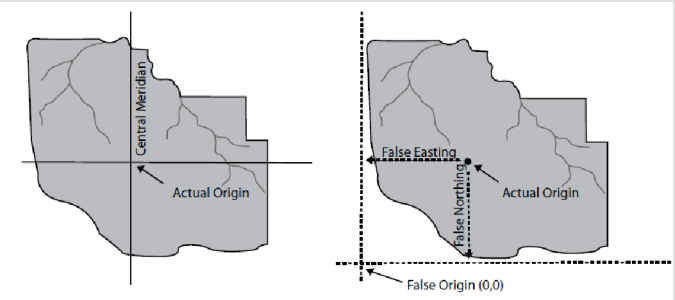
With the introduction of high-precision instruments, another adjustment was made, creating the High Accuracy Referenced Network (HARN), also known as NAD 83 (1991). The difference between NAD83 and NAD 83 (1991) varies roughly from zero to seven centimeters for most of Wisconsin. Due to this, comparisons of NAD 83 (1991) and NAD 83 are not given in this document. It is the preferred system in use by the Wisconsin DNR.



Lambert conformal conic projection



transverse Mercator projection



WHICH COORDINATE SYSTEM/PROJECTION IS APPROPRIATE?

The accuracy of a projection is given as a ratio such as 1:10,000. This means for every 10,000 units (it doesn't matter whether it's inches, feet, meters, etc.), the actual measurement could fall anywhere between 9,999 and 10,001 units. The following coordinate systems are listed from least accurate to most accurate.

The Universal Transverse Mercator (UTM) coordinate system was developed by the Department of Defense and is a global coordinate system with 60 north-south zones. Wisconsin falls within UTM zone 15 and 16 about equally. Each zone width is 6 degrees, which creates a scale difference of no more than 1:2,500. UTM parameters are the same for NAD 27 and NAD 83, making datum adjustment information critical. In Wisconsin, UTM coordinate differences for the two datums are approximately 200 meters in northing, and less than 10 meters in easting.

The Wisconsin Transverse Mercator (WTM) was developed by the Wisconsin Department of Natural Resources to avoid problems caused by having the state divided into two UTM zones. This system centers a UTM-like zone on the 90th meridian (west), thereby covering the state with one zone. The distortion in the projection increases from the center toward the eastern and western extremes of the state. A false easting of 500,000 meters and a false northing of -4,500,000 meters are used. WTM was redefined for the NAD 83 datum and has a different false easting and northing than WTM 27. WTM 83 coordinates are based on a false easting of 520,000 meters and a false northing of -4,480,000 meters.

The State Plane Coordinate (SPC) System was introduced nationally in the 1930's and is based on both the Lambert conformal conic and transverse Mercator projections. In Wisconsin there are three Lambert projections comprising North, Central, and South State Plane Coordinate zones. The system maintains an accuracy of at least 1:10,000. When NAD 83 was developed the SPC parameters were redefined. SPC 83 was assigned a different false easting than SPC 27 so that coordinate values in the two systems could easily be distinguished by a six mile difference in easting. At the federal level SPC 83 uses the meter as a unit of measure, but in the Wisconsin Statutes, Chapter 236 specifies the U.S. Survey Foot as the official unit of measure for Wisconsin.

The Wisconsin County Coordinate System (WCCS) was created by the Wisconsin Department of Transportation (WisDOT) and became available in 1995. It uses metric units and has a maximum distortion of 1:30,000 in rural areas and 1:50,000 in urban areas. There are also distinct numeric differences between adjacent county coordinate systems to avoid confusion. The WCCS is mathematically based on, and related to NAD 83. WisDOT wanted to eliminate the need for ground-to-grid conversion of distances, which could vary by as much as one foot per mile in other coordinate systems. In order to do this each county coordinate system used its own enlarged and elevated local reference surface, effectively creating its own unique horizontal geodetic datum. This created usage problems as WCCS was more widely adopted.

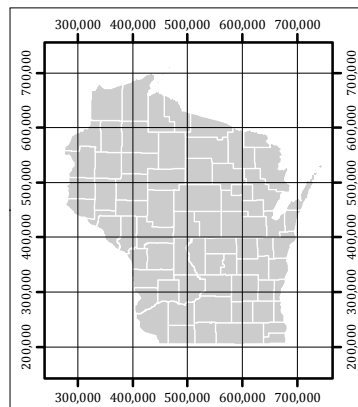
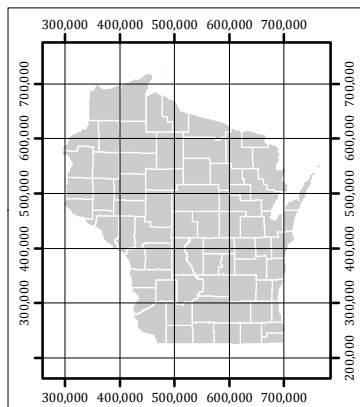
The Wisconsin Coordinate Reference System (WISCRS) was created in 2004 by the Wisconsin Land Information Association (WLIA), who analyzed the existing usage problems with WCCS. WLIA concluded the best solution available was to redesign the system, and WISCRS was the result of their efforts. In WISCRS all county coordinate systems now use the same reference ellipsoid. The largest difference in coordinate values between WCCR and WISCRS is 5 millimeters in four counties, with most counties averaging a difference of only three millimeters or less.

POSITIONING SHIFTS DUE TO DATUM CHANGES

| Datum & Coordinate System | Amount of Change (approx.) |
|--|---|
| Difference between UTM 27 and UTM 83 projected positions | 200 meters in northing and less than 10 meters in easting |
| Difference between WTM 27 and WTM 83 projected positions | 20,000 meters (13 miles) in northing and easting |
| Difference between SPC 27 and SPC 83 projected positions | 6 miles in easting |

The information above was adapted from the Wisconsin Coordinate Reference Systems (2nd Edition) handbook, published in 2009 by the Wisconsin State Cartographer's Office of the University of Wisconsin - Madison. This publication is available online at the Wisconsin State Cartographer's Office website through the following link: http://www.sco.wisc.edu/images/stories/publications/WisCoordRefSys_January2012.pdf

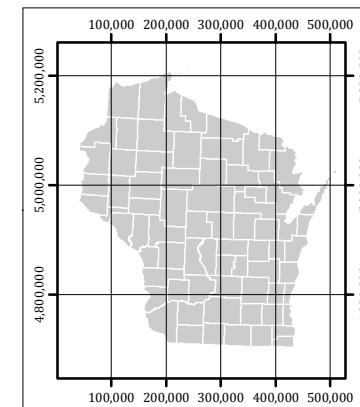
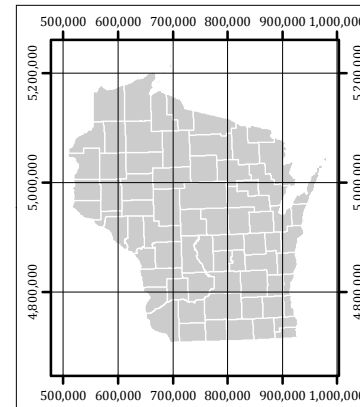
WISCONSIN TRANSVERSE MERCATOR



Coordinate System: Wisconsin Transverse Mercator 1983 (1991)
Datum: NAD 83 HARN (aka: NAD 83/91 or HPGN)
Projection: Transverse Mercator
Scale Factor at Central Meridian: 0.9996
Longitude of Central Meridian: 90°W (-90°)
Latitude of Origin: 0°
False Easting: 520,000 meters
False Northing: -4,480,000 meters
Unit: meter

Coordinate System: Wisconsin Transverse Mercator 1927
Datum: NAD 27
Projection: Transverse Mercator
Scale Factor at Central Meridian: 0.9996
Longitude of Central Meridian: 90°W (-90°)
Latitude of Origin: 0°
False Easting: 500,000 meters
False Northing: -4,500,000 meters
Unit: meter

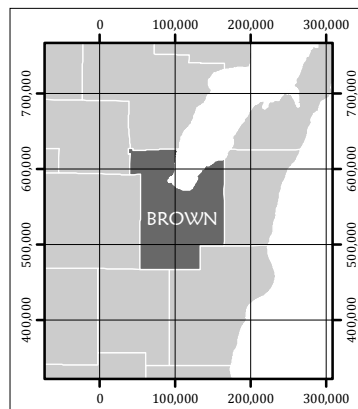
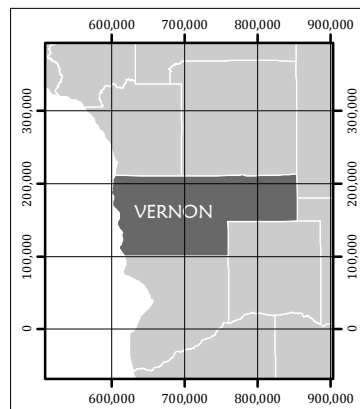
UNIVERSAL TRANSVERSE MERCATOR



Coordinate System: UTM Zone 15 North
Datum: NAD 83
Projection: Transverse Mercator
Scale Factor at Central Meridian: 0.9996
Longitude of Central Meridian: 93°W (-93°)
Latitude of Origin: 0°
False Easting: 500,000 meters
False Northing: none
Unit: meter

Coordinate System: UTM Zone 16 North
Datum: NAD 83
Projection: Transverse Mercator
Scale Factor at Central Meridian: 0.9996
Longitude of Central Meridian: 87°W (-87°)
Latitude of Origin: 0°
False Easting: 500,000 meters
False Northing: none
Unit: meter

WISCONSIN COORDINATE REFERENCE SYSTEMS



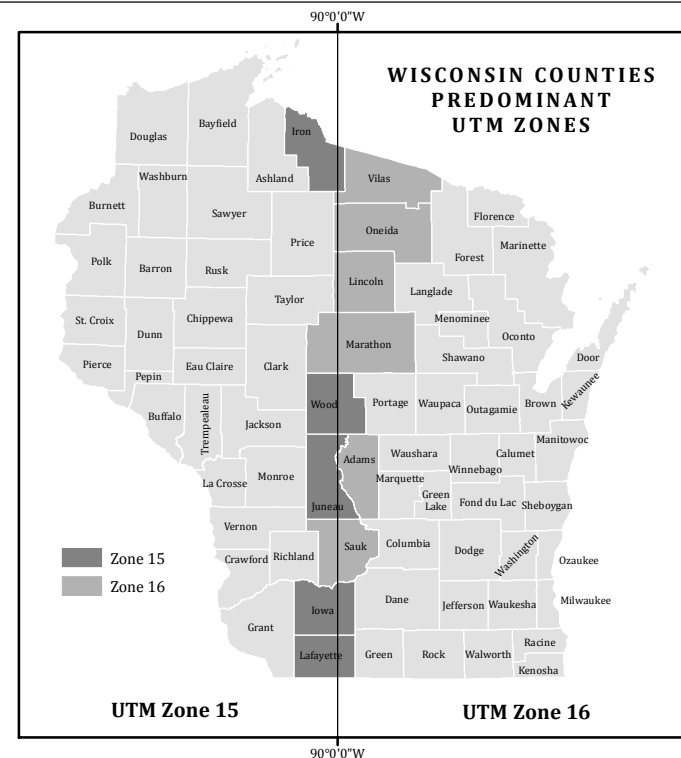
Coordinate System: WISCRS, Vernon County
Datum: NAD 83 HARN (aka: NAD 83/91)
Projection: Lambert Conformal Conic
Scale Factor at Central Meridian: 1.0000408158
Longitude of Central Meridian: 90°47'00.000000"W
Latitude of Origin: 43°34'30.118583"N
False Easting: 730000.000 U.S. Survey Feet
False Northing: 155944.768 U.S. Survey Feet
Unit: U.S. Survey Foot

Coordinate System: WISCRS, Brown County
Datum: NAD 83 HARN (aka: NAD 83/91)
Projection: Transverse Mercator
Scale Factor at Central Meridian: 1.0000200000
Longitude of Central Meridian: 88°00'00.000000"W
Latitude of Origin: 43°00'00.000000"N
False Easting: 103674.333 U.S. Survey Feet
False Northing: 15091.833 U.S. Survey Feet
Unit: U.S. Survey Foot

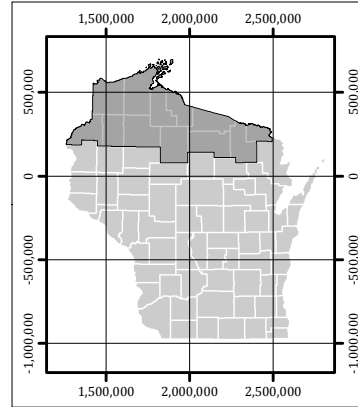
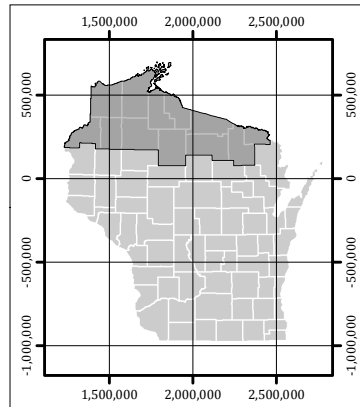
For more information on a specific county's WISCRS visit the following link:

http://www.sco.wisc.edu/images/stories/publications/WisCoordRefSys_January2012.pdf

WISCONSIN COUNTIES PREDOMINANT UTM ZONES



NORTH ZONE



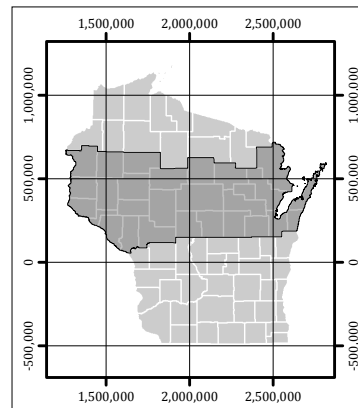
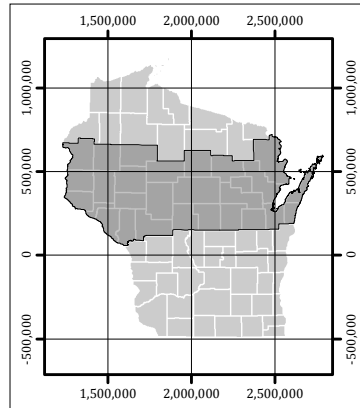
Coordinate System: State Plane Coordinate System (SPC) - North
Datum: NAD 83
Projection: Lambert Conformal Conic
Scale Factor at Central Meridian: 1.0
1st Standard Parallel: 45° 34'
2nd Standard Parallel: 46° 46'
Longitude of Central Meridian: -90° 00'
Latitude of Origin: 45° 10'
False Easting: 1,968,500 U.S. Survey Feet
False Northing: 0
Unit: U.S. Survey Foot

Coordinate System: State Plane Coordinate System (SPC) - North
Datum: NAD 27
Projection: Lambert Conformal Conic
Scale Factor at Central Meridian: 1.0
1st Standard Parallel: 45° 34'
2nd Standard Parallel: 46° 46'
Longitude of Central Meridian: -90° 00'
Latitude of Origin: 45° 10'
False Easting: 2,000,000 U.S. Survey Feet
False Northing: 0
Unit: U.S. Survey Foot

STATE PLANE COORDINATE SYSTEM ZONES



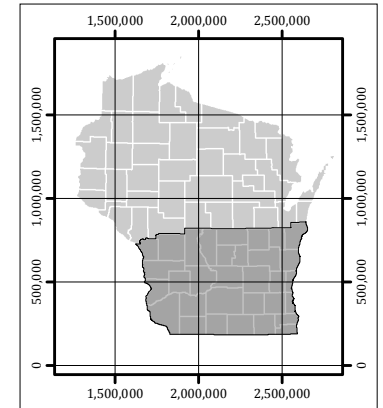
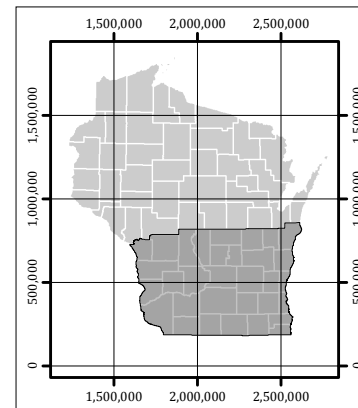
CENTRAL ZONE



Coordinate System: State Plane Coordinate System (SPC) - Central
Datum: NAD 83
Projection: Lambert Conformal Conic
Scale Factor at Central Meridian: 1.0
1st Standard Parallel: 44° 15'
2nd Standard Parallel: 45° 30'
Longitude of Central Meridian: -90° 00'
Latitude of Origin: 43° 50'
False Easting: 1,968,500 U.S. Survey Feet
False Northing: 0
Unit: U.S. Survey Foot

Coordinate System: State Plane Coordinate System (SPC) - Central
Datum: NAD 27
Projection: Lambert Conformal Conic
Scale Factor at Central Meridian: 1.0
1st Standard Parallel: 44° 15'
2nd Standard Parallel: 45° 30'
Longitude of Central Meridian: -90° 00'
Latitude of Origin: 43° 50'
False Easting: 2,000,000 U.S. Survey Feet
False Northing: 0
Unit: U.S. Survey Foot

SOUTH ZONE



Coordinate System: State Plane Coordinate System (SPC) - South
Datum: NAD 83
Projection: Lambert Conformal Conic
Scale Factor at Central Meridian: 1.0
1st Standard Parallel: 42° 44'
2nd Standard Parallel: 44° 04'
Longitude of Central Meridian: -90° 00'
Latitude of Origin: 42° 00'
False Easting: 1,968,500 U.S. Survey Feet
False Northing: 0
Unit: U.S. Survey Foot

Coordinate System: State Plane Coordinate System (SPC) - South
Datum: NAD 27
Projection: Lambert Conformal Conic
Scale Factor at Central Meridian: 1.0
1st Standard Parallel: 42° 44'
2nd Standard Parallel: 44° 04'
Longitude of Central Meridian: -90° 00'
Latitude of Origin: 42° 00'
False Easting: 2,000,000 U.S. Survey Feet
False Northing: 0
Unit: U.S. Survey Foot