

# Low Distortion Projections in Wisconsin

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## DEFINITIONS

- LDP = Low Distortion Projection
- LPDs = County Coordinate Systems (in Wisconsin)
- WCCS = Wisconsin County Coordinate Systems (1995)
- WISCRS = Wisconsin Coordinate Reference Systems (2006)



## It Started in 1993



In 1993, Jackson County found a need and developed a Low Distortion Projection for use with its Public Land Survey System GPS projects.

# Wisconsin Department of Transportation Took the Process Statewide

- In 1993 WisDOT hired a consultant to develop LDPs for all 72 counties in Wisconsin, to be known collectively as the Wisconsin County Coordinate Systems (WCCS)
- In 1995 the results of that project were published in an educational instruction manual by the Wisconsin state cartographer's office
- In 1997 WisDOT adopted official policy to begin using the WCCS for DOT projects

## What Wisconsin DOT Received



Consultant created a mathematically sound (but non-typical) set of projections

- Some counties shared the same projection- 59 different projections were developed
- Projections were based on a modified ellipsoid created by the vendor at approximate average ground surface
- 59 different ellipsoids!
- Not user-friendly projections
- Misapplications occurred among non-DOT users

## One Small Problem- Two LDPs for Jackson County

- The DOT system created another LDP for Jackson County
- Very different systems, one Transverse Mercator by the county and one Lambert Conformal by WisDOT
- Coordinates drastically different
- Much data had already been developed by Jackson County in the Transverse Mercator projection
- Everyone was using the County's TM projection



## One Problem Is Eventually Resolved

- Jackson County tested both projections and found the TM to better fit the County. Formally adopted the TM projection as the “Official Jackson County Projection” by County Board action.
- Confusion continued for several years. DOT kept their LDP. DOT consultants were completing projects in the County’s TM projection rather than the WisDOT WCCS (unknown to WisDOT)
- A solution was implemented ..... later
- Now back to the rest of the State

## Statewide Use of Original WCCS Increased

- Use of WCCS LDPs expanded
- A few problems began to appear in the GIS community
  - Difficulties installing the WCCS in software packages
  - Time consuming support requests fell on the Wisconsin State Cartographer's Office. (DOT developed WCCS for their own use, so little external support)
  - Users were very confused by the modified ellipsoid
  - Different software packages were determining different coordinates for the same point!

## The Land Info Community Works On a Solution

- The Wisconsin Land Information Association (WLIA) recognized that a solution was needed. In 2004 they organized a Task Force to study the problems and develop a solution
- Committee consisted of 20 members with diverse but related interests
  - State, County and Local GIS experts
  - Wisconsin DOT-Geodetic Survey Unit members
  - Wisconsin State Cartographer and staff
  - County Surveyors and private surveyors
  - National Geodetic Survey's Wis. State Advisor
  - Surveying Professors
  - ESRI Regional Rep



## After Two Years of Work by the Committee

- The WLIA Task Force met bi-monthly for 2 years
- The group eventually concluded that the best solution was to redesign the original Wisconsin County Coordinate Systems projections for each county
- The committee fixed Jackson County's problem
- A grant from the Wisconsin Land Information Program funded the WISCRS project
- UW Madison professor was contracted to do project
- The project was completed in 90 days and report submitted to the Task Force for approval

## Concerns That Had To Be Resolved Before Implementing a Redesign of the System

- Would it force GIS departments to re-project their existing datasets, causing them to reject it?
- Would it create new/different coordinates on the Public Land Survey System (PLSS) monuments and cadastral data, causing surveyors to reject it?
- Would the more casual-use Land Information community adopt the new (more user-friendly) coordinate system?

## The Solution to Gain Community Acceptance

Redesign parameters for the new LDP were defined so that coordinates of a feature determined by each system would differ by less than 5 mm. After discussions with the Land Info organization, it was determined that the two most interested groups were the GIS people and the land surveyors.

- GIS departments were then comfortable that new LDP values would be consistent with existing data (in nearly all cases)
- Surveyors would accept coordinates determined by LDP if differences were less than 5 mm (usually 0-3 mm)

## It Helps If The Software Vendors Come Along

- The Task Force involved software vendors in the process as we went along. The goal was to get the LDP parameters hard-coded into the vendors' software, typically as a pull down menu, etc.
- If you examine software by ESRI, AutoDesk, Leica etc. you will find the new WISCRS LDP's are now hard-coded into their software.
- This makes it easy for people to properly use the LDPs.



## Suggestions If You Decide To Move Ahead

- Work diligently to discover all LDPs that are in use in your state
- If workable, incorporate those existing LDPs into your statewide system.
- Choose names that are logical and not confusing or ambiguous
- Involve the local users!
- Involve the software vendors

## Remember: LDPs Are VERY Good

Wisconsin people who work in surveying and mapping love the Low Distortion Projections that have been developed through the Wisconsin Department of Transportation and later through the Wisconsin Land Information Program.



## For Additional Information:

- To learn more about the WISCRS process and obtain the final report, visit the Wisconsin State Cartographer's Office website:  
<http://www.sco.wisc.edu/coordsys/index.php>

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# Sample Page From WISCRS Report

## Dunn County

WISCRS (Wisconsin Coordinate Reference Systems)



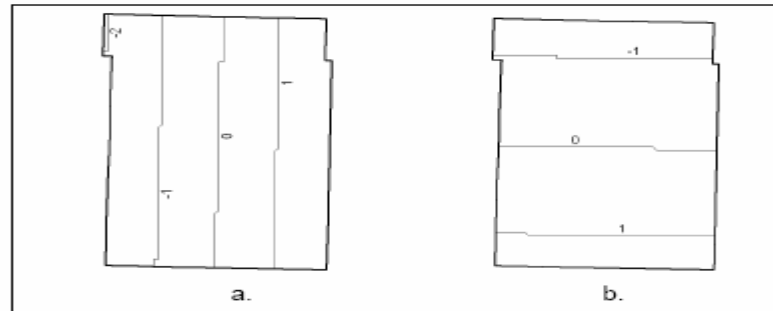
**Projection: Transverse Mercator**

The parameters for this projection are

1. Origin Longitude ( $\lambda_0$ ): 91°53'40.000000"
2. Origin Latitude ( $\Phi_0$ ): 44°24'30.000000"
3. False Easting ( $E_0$ ): 51816.1040 meters (170000.001 U.S. survey feet)
4. False Northing ( $N_0$ ): 0.0030 meters (0.010 U.S. survey feet)
5. Scale Factor on Central Meridian ( $k_0$ ): 1.0000410324

NOTE: Distance units in meters; angular units in degrees, minutes, seconds; and the scale factor are exact.

### Coordinate Shifts (WISCRS minus WCCS)



Isoline Maps of a) Easting (X) Shift and b) Northing (Y) Shift (in Millimeters) for Dunn County

The maximum absolute value in any easting shift is less than 3 millimeters.

The maximum absolute value in any northing shift is less than 2 millimeters.

#### NOTES:

1. WISCRS parameters, above, are for use with the GRS 80 ellipsoid. WCCS parameters, published in 1995, were for use with enlarged or raised ellipsoids.
2. The *de facto* horizontal geodetic datum and adjustment for WISCRS is NAD 83 (1991). However, ground-to-grid ratios, for most applications, are also negligible for other adjustments of NAD 83 (e.g., NAD 83 (1986), NAD 83 (1997)).

