Assessing the Ecological Status and Vulnerability of Springs in Southern Wisconsin

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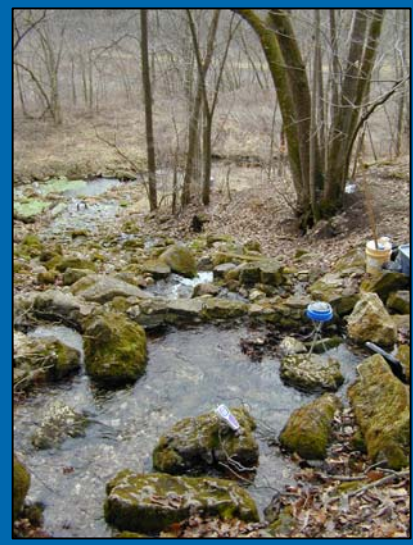
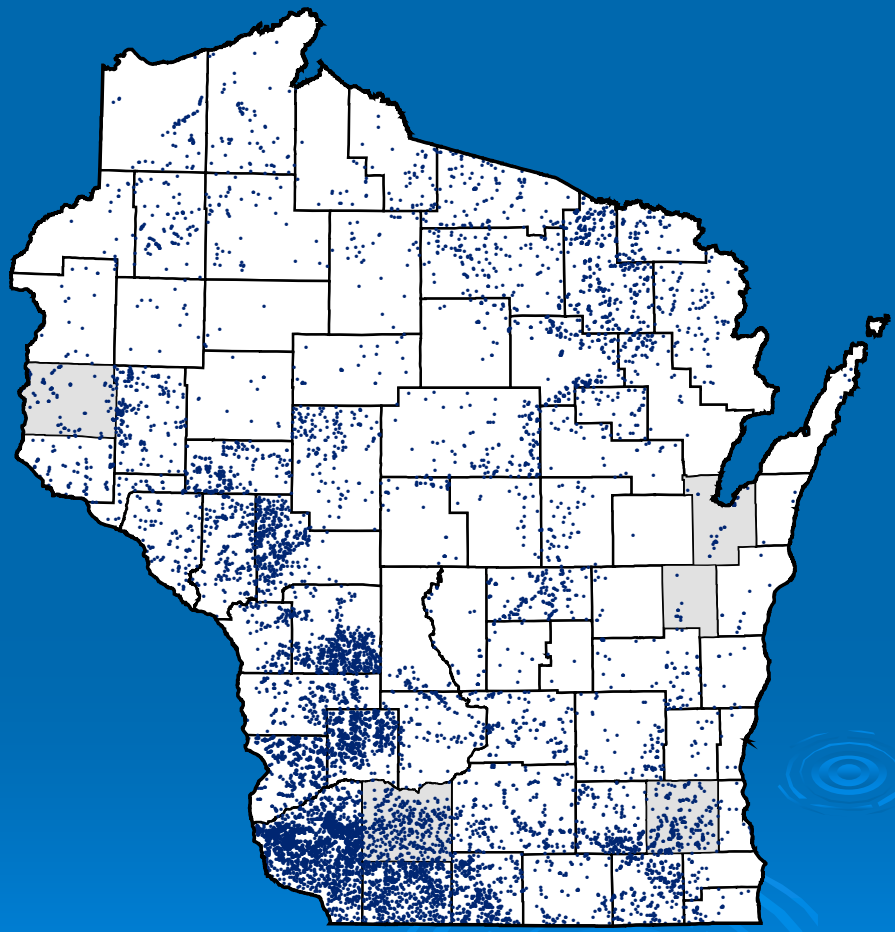
The Range of Spring Resources in Wisconsin



Background: The range of Wisconsin's spring resources

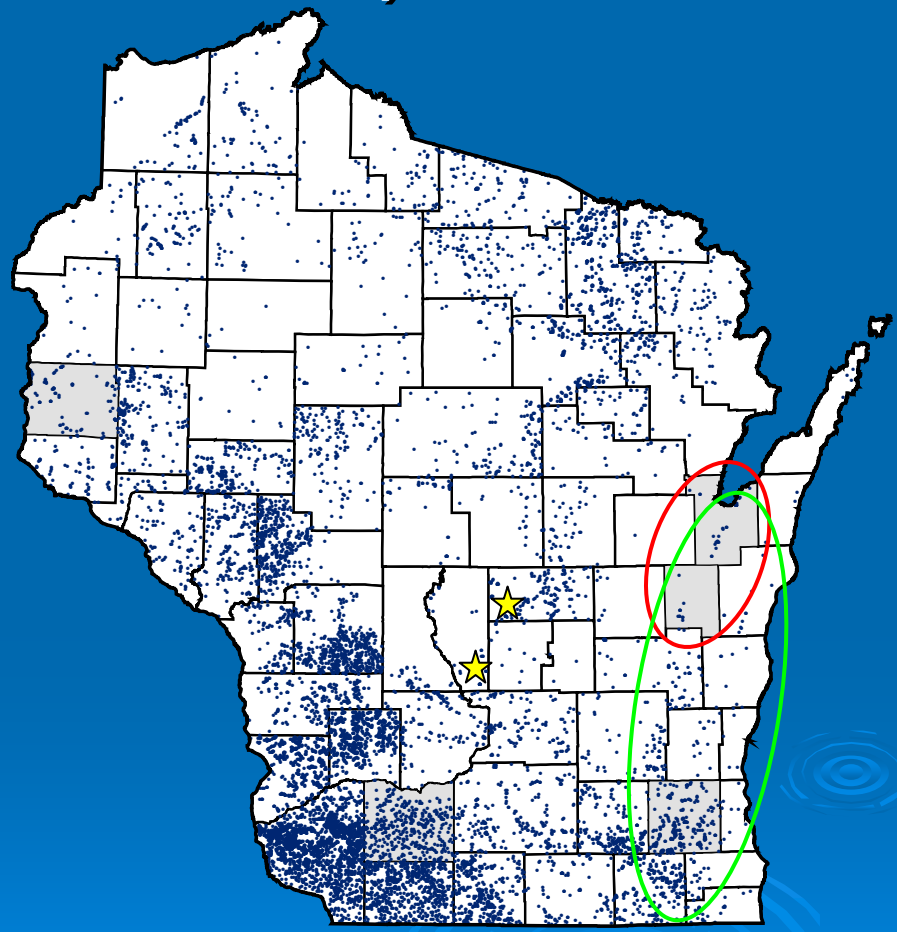
- Wisconsin Land Economic Inventory (1927-1947)
- Wisconsin Conservation Dept. spring surveys (1957-1962)
- Recent Studies
  - Wisconsin Wildlife Federation (Macholl 2007)
  - This study – Iowa and Waukesha Counties (Swanson et al. 2007, 2009)
  - Brown, Calumet, St. Croix Counties (Fermanich et al. 2006; Grote 2006)



Source: Macholl 2007 and Swanson et al. 2007

Background: Wisconsin's Groundwater Protection Law (2003 WI Act 310)

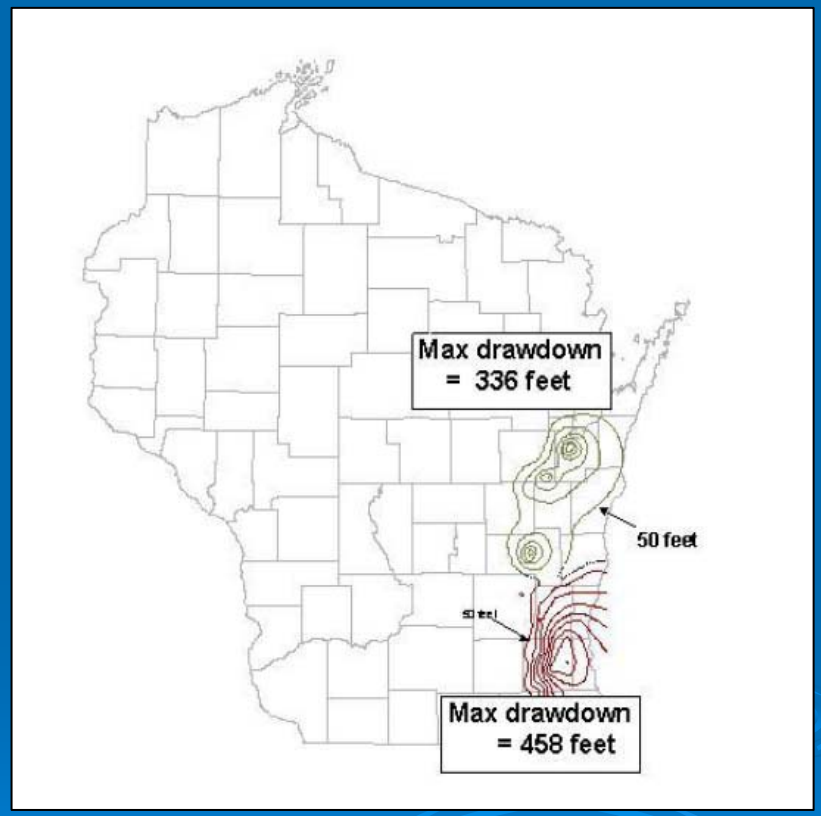
- Groundwater protection prior to Act 310
  - Considered impacts of high capacity wells (>100,000 gpd) to public water utilities.
  - Did not consider impacts to surface water features.
  - Did not address impacts of use on water quality.
- Perrier Group of America (Nestle Corp.)
  - Mecan Springs, Waushara County
  - Big Springs, Adams County
- Highly publicized water quality issues
  - Arsenic in northeastern Wisconsin
  - Radium in eastern Wisconsin



Source: Macholl 2007 and Swanson et al. 2007

Background: Wisconsin's Groundwater Protection Law (2003 WI Act 310)

- Created two groundwater management areas (GMAs): where pumping has caused water levels to drop >150 feet.
- Expanded the State's authority over high capacity wells (>100,000 gpd) to include consideration of impacts to trout streams, outstanding and exceptional resource waters, and **springs**.
  - **An area of concentrated discharge occurring at the surface of the land that results in a flow of at least 1cfs at least 80% of the time.**
  - **Aims to prevent significant environmental impact.**
- Created the Wisconsin Groundwater Advisory Committee (WGAC)
  - Legislative charge: to consider the new law and formulate reports pertaining to the two main elements of the law.



Source: 2006 Groundwater Advisory Committee Report to the Legislature (Based on Conlon 2000 and Feinstein et al. 2003)

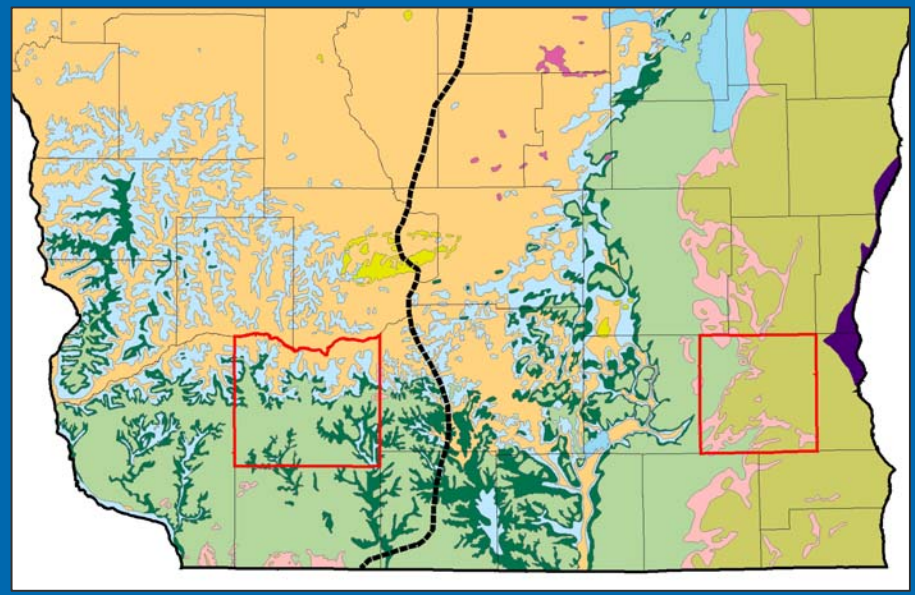
Purpose

- Begin documenting hydrogeological and ecological characteristics of Wisconsin's spring resources in a few typical settings.
  - Iowa County
  - Waukesha County
- Help assess a framework for collecting physico-chemical, biological and cultural characteristics of springs.
  - *Comprehensive Springs Classification System* by Springer et al. (2009)
- Evaluate the ecological status of springs and the vulnerability of springs to groundwater withdrawals in these regions.
  - Formulate conceptual models of spring flow in each region.
- Address the question of whether springs covered under WI Act 310 are sufficient to protect the range of Wisconsin's spring resources.

Study Areas

- Iowa County
  - 407 historical springs
  - Cambrian to Ordovician bedrock
  - Non-glaciated
  - Primarily agricultural land uses
  - Lower development pressures
  - WGNHS Geologic and Hydrogeologic Investigation
- Waukesha County
  - 282 historical springs
  - Ordovician to Silurian bedrock
  - Glaciated
  - Commercial, industrial and residential land uses
  - High development pressures
  - Well-studied region

Bedrock Geology of southern Wisconsin

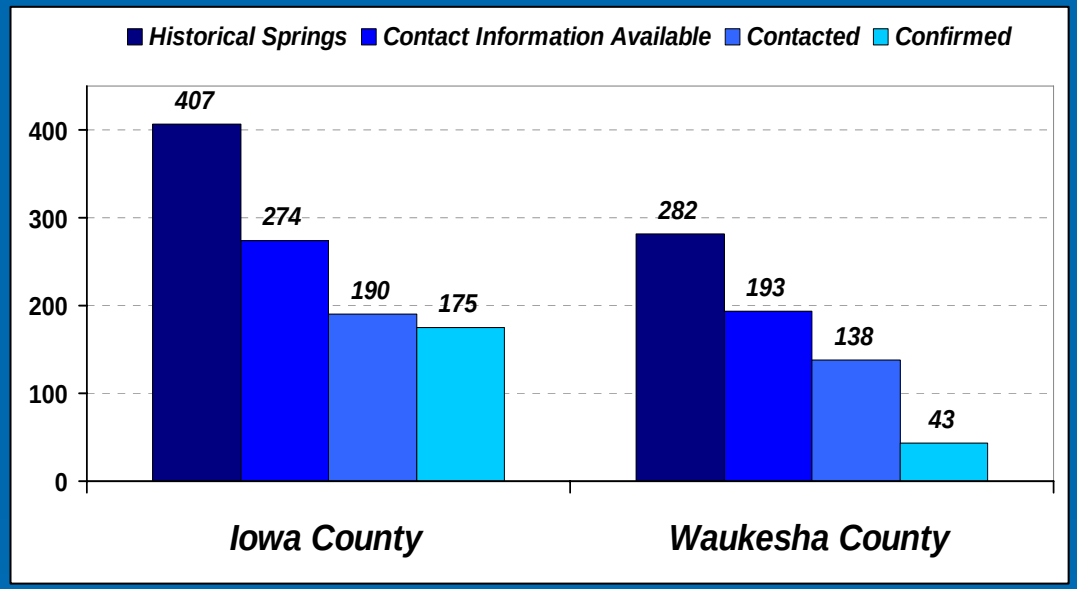


Source: Mudrey et al. 2007

Silurian dolomite (Su)
Ordovician Maquoketa Formation (Om)
Ordovician Sinnipee Group (Os)
Ordovician Ancell Group (Oa)
Ordovician Prairie du Chien Group (Opc)
Cambrian sandstones (Cu)

Confirmation of Spring Locations

- Identify property owners
  - Tax parcel data
  - Plat books
- Compile contact information
  - ~67% in each county
- Contact property owners
  - Spoke with 47% of the owners in Iowa County
  - Spoke with 49% of the owners in Waukesha County
- Confirm spring locations
  - Iowa County: 175
    - Permission granted to nearly all
    - Surveyed 24
  - Waukesha County: 43
    - Permission granted to 25
    - Surveyed 20



Field Surveys: *Comprehensive Springs Classification System* (Springer et al. 2009)

SITE DESCRIPTION FORM

SITE INFORMATION /PHOTOS

Site Code: _____-- S_____ Site Name: _____ Date: _____

Surveyors SITEDES: _____ GEO/H2O/CLIM: _____ VEG: _____ INVERTS: _____

Start time: _____ End Time: _____ USGS quad map: _____ State: ____ Ownership: NPS BLM USFS Private

Access Description:

Photos Taken: yes no Camera Name and Model: _____ Photo Kind (circle one): film (NCPN) digital(SCPN)

Extra Photo Log Sheet Used: yes no

Photo Pt#	Photo Type*	Roll#	Fr ame#	Time	Hgt (cm)	Photographer	Caption
Photo Relocation Comments:							
Photo Relocation Comments:							
Photo Relocation Comments:							
Photo Relocation Comments:							
Photo Relocation Comments:							
Photo Relocation Comments:							

*Note: Photo Type Choices: Site; Landscape, Feature, Fieldwork, Fauna, Vegetation, Disturbance, Other

CLIMATE

Wind Code (enter number): _____

[0 = calm; 1 = smoke drifts; 2 = light breeze; 3 = breeze with constant motion; 4 = sm branches move, dust rises; 5 = small trees sway; 6 = lg branches moving, wind whistling]

Rain Code (enter number): _____ [0 = no rain; 1 = mist or fog; 2 = light drizzle; 3 = light rain; 4 = heavy rain; 5 = snow]

Cloud Cover (enter number): _____ Air Temperature: _____ °C _____ °C _____ °C

SITE ENVIRONMENTAL DESCRIPTION

Aspect: _____ deg. Slope: _____ deg. Slope variability (check one): high medium low none

Site Area (check one) < 2 m^2 2–10 m^2 10-100 m^2 100-1,000 m^2 0.1-1 ha 1-10 ha 10-100 ha >100 ha

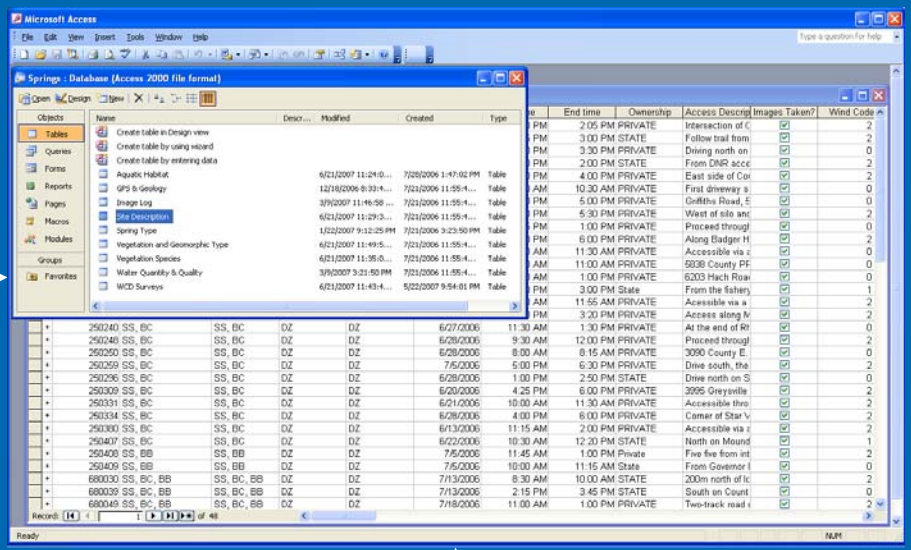
Landscape context | Another spring within 500 m: yes no | Other riparian vegetation within 500m: yes no

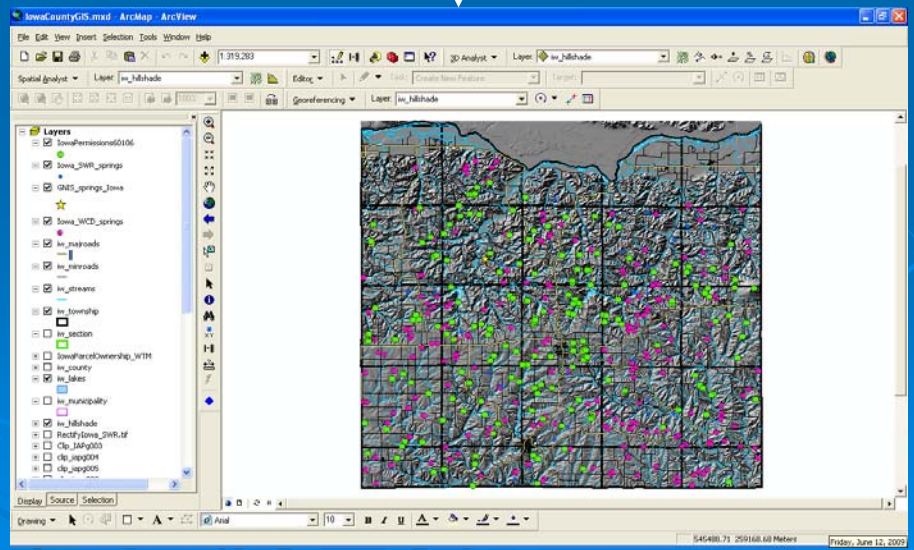
Landscape context comments:

2005: APR 14 Page -

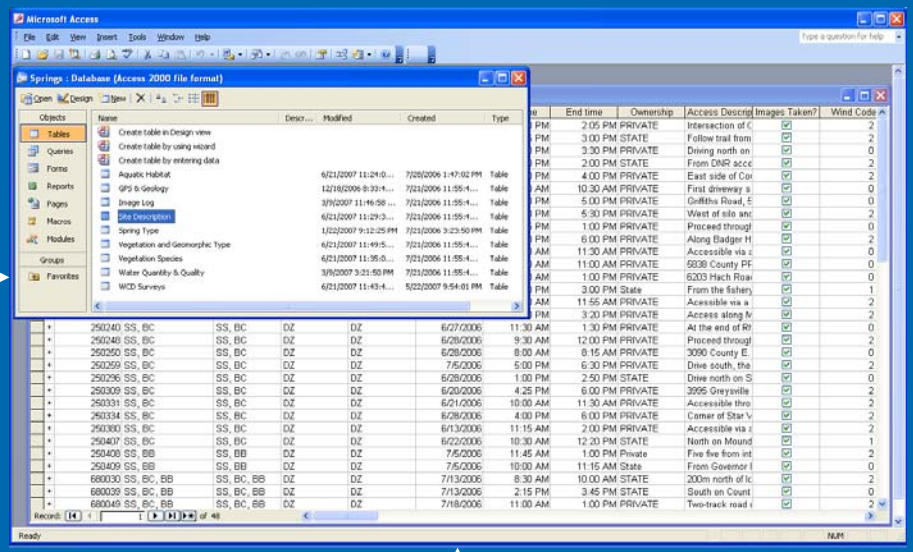
- Site description, wildlife, aquatic invertebrates, vegetation, geologic materials, geomorphology, channel characteristics, water quantity, water quality
- 13 pages long!

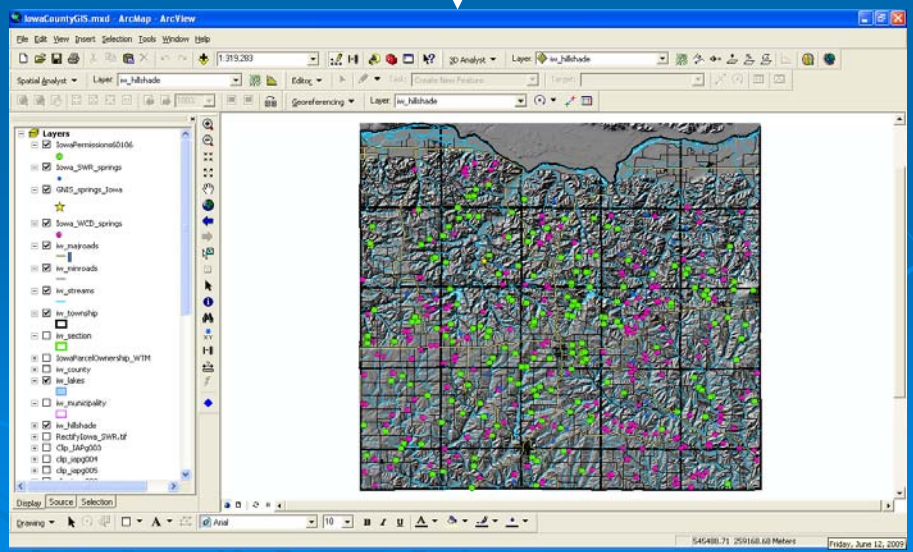
Initial Approach





Final Approach





GPS Pathfinder Office
(data dictionary design, differential correction)

TerraSync
(data collection, data viewing)

GPS Pathfinder Office

File Edit View Data Utilities Options Window Help

Map 1:8,777, <- 1,874 m ->

UTM, 16 North, NAD 1983 (Conus), EGM96 (Global)

SpringClassification.ddf - Data Dictionary Editor

File Edit Options Help

Name: SpringClassification

Comment:

Features:
- Spring

Attributes:
- Begin
- Site Code
- Date
- Start time
- SurveyorSITEDES
- SurveyorGEO/H20/CLIM
- SurveyorVEG
- SurveyorINVERTS
- Ownership
- Access Description
- Images Taken?
- Climate
- Wind Code
- Rain Code
- Cloud cover, %
- Air Temp 1, F
- Air Temp 2, F
- Air Temp 3, F
- Site Env Description
- Aspect, degrees
- Slope, degrees
- Slope Variability
- Site Area
- Another w/in 500m?
- Rip veg w/in 500m?
- Landscape Context
- Landform/Geo Surface
- Code 1
- Proportion 1, %
- Slope 1

Menu
- Private
- County
- State
- Federal

On Creation: Normal
On Update: Normal

New Attribute Type

Type
- Menu
- Numeric
- Text
- Date
- Time
- File Name
- Separator

Add
Cancel
Help

New Feature... F3
Edit Feature... F4
Delete Feature F5

New Attribute... F7
Edit Attribute... F8
Delete Attribute F9

Default Feature Settings:
- Min. Positions: 1
- Accuracy: Code
- Log Interval: 1 seconds
- Label 1: Site Code
- Label 2: SurveyorSITEDES

Press F1 for help

NUM

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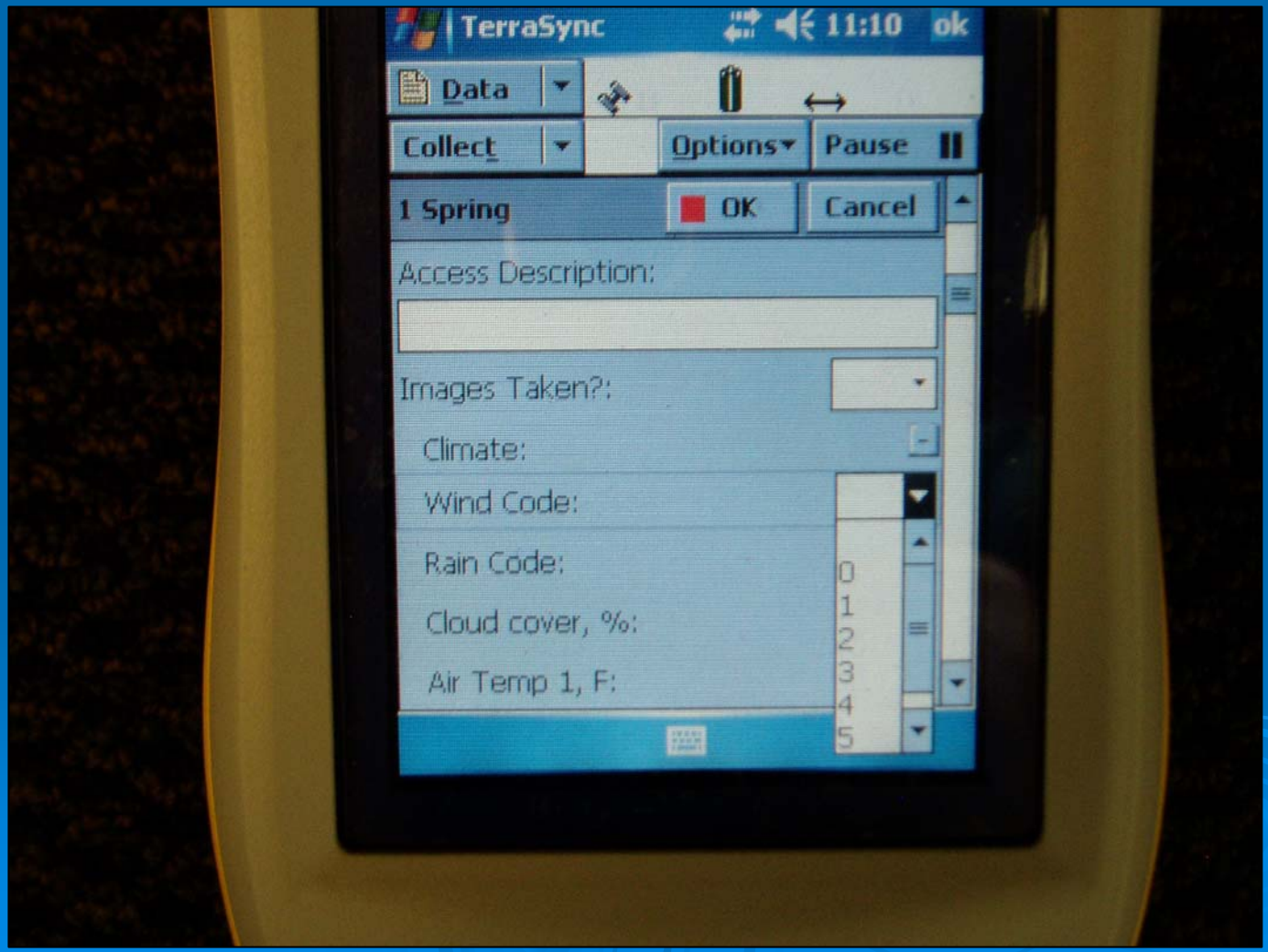

GPS Pathfinder Office
(data dictionary design, differential correction)

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Advantages:

- Data consistency in the field
  - Standardized terms/values
  - Fewer “missed” entries
- Position viewable in the field (small screen)
- Small size/Not heavy
- Reduced amount of manual data entry

Disadvantages:

- Need to create data dictionary (easy)
- Not all data sheets could be included in the data dictionary (could use Excel)
  - Vegetation surveys
  - Invertebrates
- Importing to database is not seamless (still better than manual data entry)

VEGETATION SURVEY FORM

SITE CODE : _____-- S_____ SITE NAME : _____ DATE : _____

VEG ETATI ON SP ECIES FO RM _____ OF _ _____ START TIME _ _____ END TIME ____ _____

Species Cover Cl ass: Starting with the uppermost stratum list all species with full scientific names, cover class for each species by geomorphic type. It may be helpful to group by lifeform, e.g. tree, shrub, graminoid, forbs, nonvascular. If the identification of a plant species is unknown please collect an ID sample and assign a unique unknown species code as described in the protocol. Use a check mark to indicate if ID collections or voucher collections were made.

Full Scientific Name	Unknown Species Code	Cover Class by geomorphic surface type (enter one value for each surface code)													Was Collection Made ?	
															Voucher ?	ID Coll?

Prominence scale for estimating vegetation and substrate cover					
Number	Class Name	Definition	Number	Class Name	Definition
6	Dominant	>95% cover	2	Uncommon	1-10% cover
5	Abundant	50-95% cover	1	Occasional	<1% cover
4	Common	25-50% cover	0	Rare	few individuals
3	Somewhat common	10-25% cover			

Geomorphic Surface Type Code			
Code	Name	Code	Name
BW	Backw all	SM	Spring Mound
SB	Slopping Bedrock	PL	Pool
CS	Colluvial Slope	TE	Terrace
C	Cave	TU	Tunnel
CH	Channel	MAD	Unfocused Madicolous Flow
HGC	High Gradient Cienega	OTH	Other
LGC	Low Gradient Cienega		

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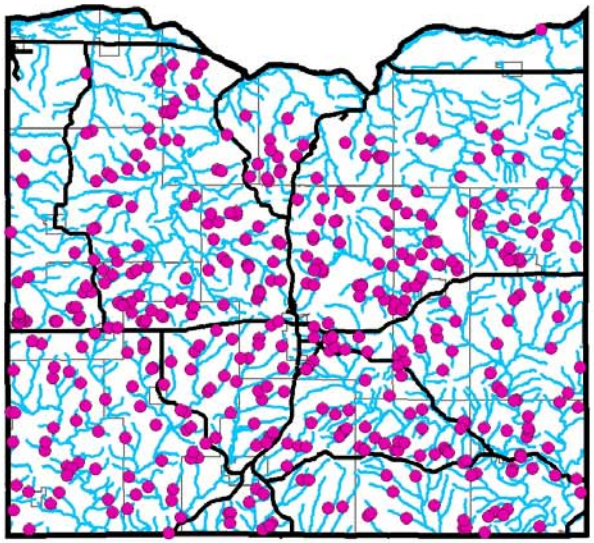
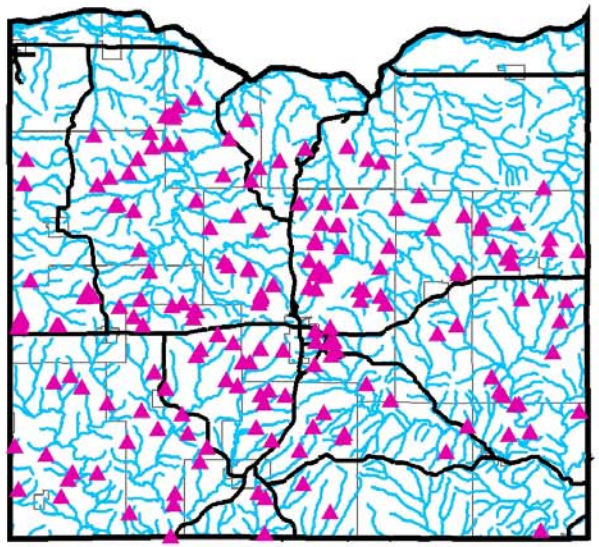
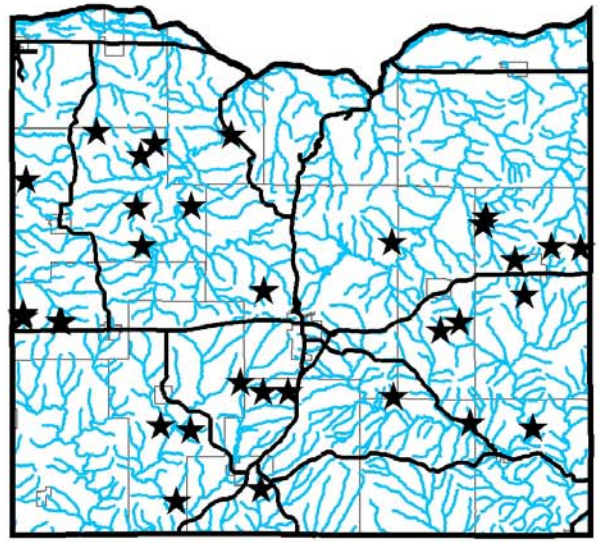
Disadvantages:

- Needed to create the data dictionary
- Not all data sheets could be included
  - Site sketch
  - Vegetation surveys
  - Invertebrates
- Importing to the database isn’t seamless (still better than manual data entry)

Iowa County







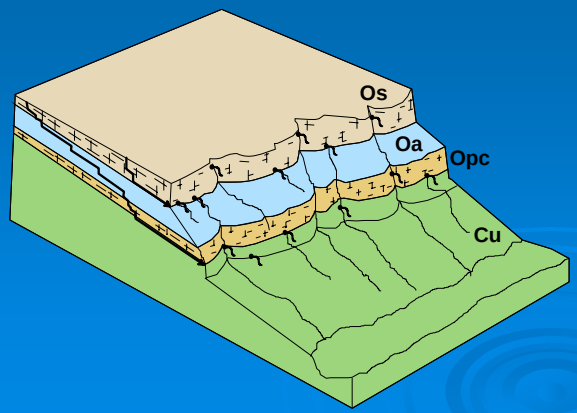
Legend

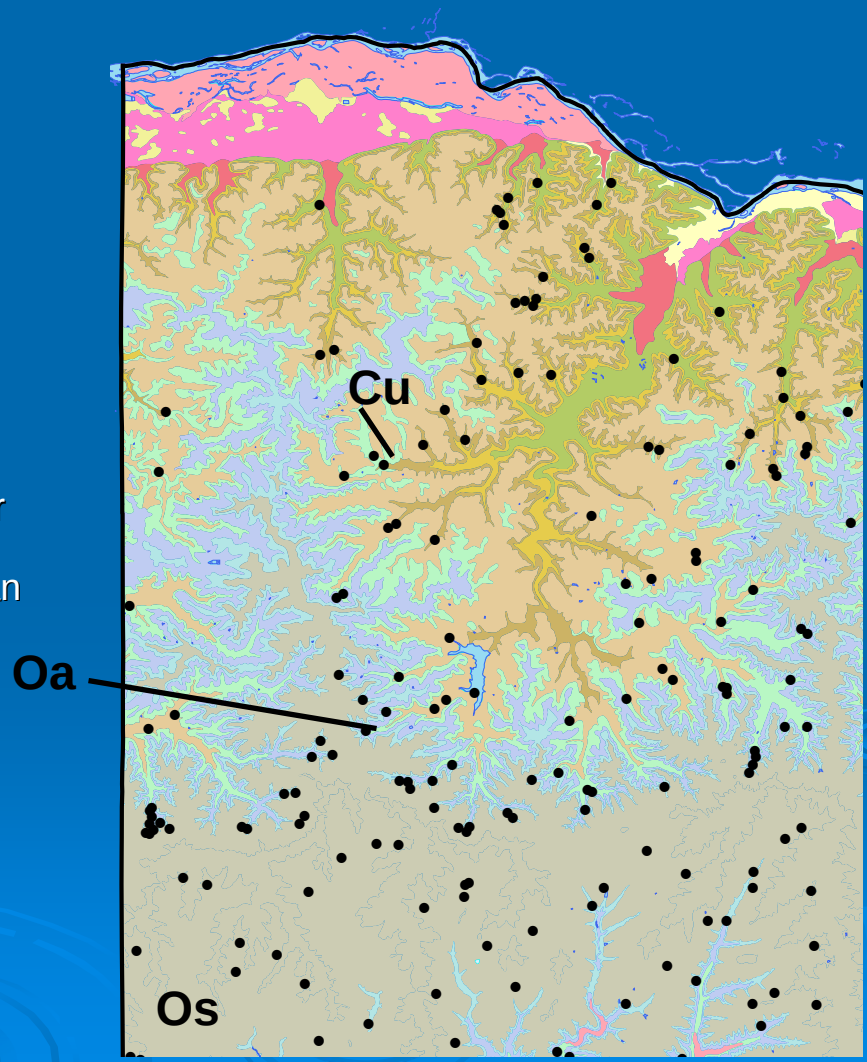
- Historical spring locations
- Spring location confirmed
- Springs surveyed in June and July 2006

Conceptual Models for Springs in Iowa County

- Confidence in the historical data sets
  - Spring positions are accurate.
  - Spring flow – useful in describing overall range of flow conditions.
- Simple overlays of regional data sets

- Springs are associated with every major stratigraphic unit
- Springs are most commonly found
  - In association with Sinnipee Group rocks
  - Near the upper contact of the St. Peter Formation
  - Near the upper contact of the Cambrian sandstones

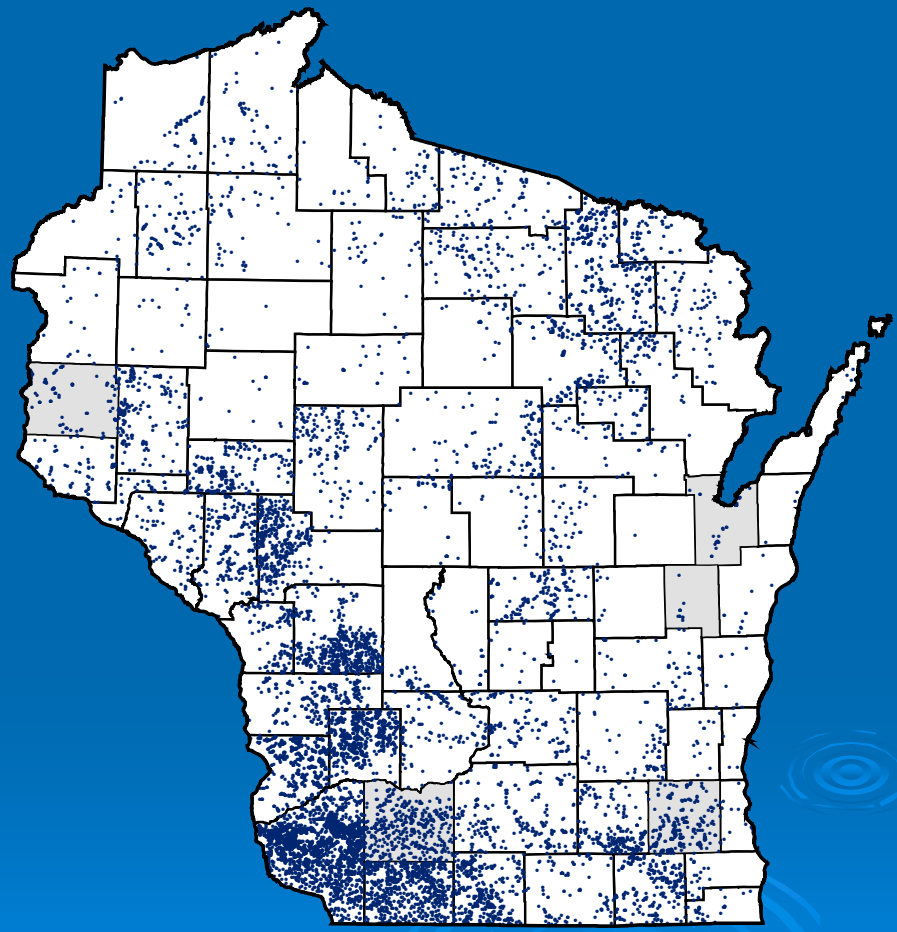




Source: Batten, in prep.

Conclusions: The range of Wisconsin's spring resources

- Historical, regional spring data set for Wisconsin can be used in association with regional data sets of topography and geology to reveal controls on groundwater flow.
- Complemented by data collected during site-specific spring surveys.
  - At least 20 springs were surveyed in each area.
- Approach provides sufficient data to develop conceptual models and preliminarily assess vulnerability to pumping.
- Overall approach may also be successful elsewhere in the state.



Source: Macholl, 2007 and Swanson et al., 2007