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## **Inventory of Wisconsin's Springs**

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2007

Open-File Report 2007-03

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Open File Report 2007-03

Jacob A. Macholl, Hydrogeologist  
Wisconsin Wildlife Federation  
August 2007

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## Table of Contents

<b>Title Page</b>	<b>1</b>
<b>Table of Contents</b>	<b>3</b>
<b>List of Figures</b>	<b>4</b>
<b>List of Tables</b>	<b>4</b>
<b>Introduction</b>	<b>5</b>
<b>Methods</b>	<b>7</b>
<i>Data Sources</i>	7
<i>Data Compilation</i>	10
<i>Field Exploration</i>	11
<b>Results</b>	<b>12</b>
<i>Spring Distribution</i>	12
<i>Flow Rates</i>	14
<i>Physicochemical Data</i>	14
<i>Biota</i>	14
<i>Springs Database and ArcGIS Coverage</i>	15
<b>Existing Protection of Springs</b>	<b>16</b>
<b>Potential Spring Protections</b>	<b>17</b>
<b>Conclusions</b>	<b>17</b>
<b>Recommendations</b>	<b>18</b>
<b>Acknowledgements</b>	<b>19</b>
<b>References Cited</b>	<b>20</b>
<b>Appendix A – Maps</b>	
<b>Appendix B – Springs Reporting Form</b>	
<b>Appendix C – Springs Working Group</b>	
<b>Appendix D – Springs Inventory Data CD</b>	

## List of Figures

<b>Figure 1.</b> Coverage of the 1956-1962 “Springs Survey.” .....	8
<b>Figure 2.</b> Photograph of a spring.....	11
<b>Figure 3.</b> a) Extent of glaciation in Wisconsin and b) known spring distribution... ..	12
<b>Figure 4.</b> A deteriorated springhouse.....	13
<b>Figure 5.</b> A screenshot of the ArcGIS coverage.....	15

## List of Tables

<b>Table 1.</b> Largest known springs in Wisconsin.....	13
<b>Table 2.</b> Flow rate and corresponding number of springs.....	14
<b>Table 3.</b> Springs not associated with trout streams and O/ERWs.....	16

## **Introduction**

Groundwater springs in Wisconsin are an important ecological, cultural and scientific resource. Historically, springs in Wisconsin were utilized as sources of water, both for humans and stock animals. Waukesha, WI gained fame in the early 20<sup>th</sup> century with its many spring spas and resorts. Though these uses have often been abandoned, springs remain a valuable resource. County and state parks feature springs for their scenic values. Springs provide windows to the groundwater, important points of groundwater discharge, sources for chemical analysis and points to measure groundwater elevation. Springs are valuable features of many ecosystems, supplying water for many diverse habitats including streams, fen-meadows and wetlands. These spring habitats often harbor endangered and threatened species, such as the Hine's emerald dragonfly (*Somatochlora hineana*), which are dependent on spring flows for survival (USFWS, 2006). Springs provide the necessary habitat of cool, oxygen-rich water essential for trout survival.

Human activities often threaten springs. The dewatering and filling of wetlands for road construction and housing development has dried up or severely altered the flow of springs. Drain tile installation and ditching practices alter groundwater flow and can affect nearby springs. Lowering of groundwater levels through high capacity well pumping has had a substantial impact on many lakes, streams and springs in Wisconsin. Some historic springs near Madison, WI are now dry, probably as a result of nearby high capacity well pumping. Spring-fed streams such as the Little Plover River and Bloody Run Creek in central Wisconsin occasionally go dry and have had flow regimes greatly reduced. The Little Plover River is "missing" approximately 4 cubic feet per second (CFS) of flow (average flow rate from 1959-1987 of approximately 10 CFS) suggesting municipal, industrial and agricultural high capacity wells in the vicinity are diverting a substantial quantity of the stream's base-flow (Kraft, 2007).

Recent legislation has attempted to address these impacts and the need for the protection of springs in Wisconsin. In 2004, WI Act 310, the groundwater quantity protection act, was signed into law. Prior to this law, high capacity well permits could be denied only if the pumping interfered with other public water supply wells. Act 310 sets aside ground water protection areas (GPAs) in which the Wisconsin Department of Natural Resources (DNR) may deny high

capacity well permits if the proposed well will cause a significant environmental impact. GPAs are defined as areas within 1200 feet of surface waters designated as trout streams and Outstanding or Exceptional Resource waters. Springs are currently afforded protection under Act 310 if they meet the definition of “an area of concentrated groundwater discharge occurring at the surface of the land that results in a flow of at least one cubic foot per second at least 80 percent of the time.” A proposed high capacity well “near” a spring meeting this definition may be denied if there is the potential for the well to cause a significant environmental impact on the spring. The only springs that are truly protected by Act 310 are those springs that are in excess of one CFS.

Though a first step, Act 310 was drafted with significant data deficiencies. The definition of a spring was written with limited information of the number and size of springs in the state. Due to this lack of information, policy makers were not in a position to create the necessary policy to protect the great majority of springs in the state.

The Legislature recognized this lack of information and created the Groundwater Advisory Committee (GAC) to provide the Legislature with recommendations on changes to Act 310, including the definition of a spring. The GAC is currently addressing many aspects of the definition. One point of debate is what constitutes “an area of concentrated groundwater discharge.” Spring complexes, where many springs discharge in an area, and seeps, areas where discrete groundwater discharge points don’t exist, are forms of groundwater discharge not fully addressed under the definition.

Another aspect of the definition being reviewed is the flow threshold of one CFS 80 percent of the time. A one CFS spring is rather large, approximately 450 gallons per minute or 7.5 gallons per second. This study has found that only 3% of Wisconsin’s roughly 10,851 known springs meet this criterion. Also, continuous monitoring of a spring to find its discharge rate for 80 percent of the time is impractical, time consuming, and rarely if ever done. Alternate methods of measuring flow duration are being investigated. Questions have arisen on the additional time needed to gather these measurements and the effect it will have on the high capacity well application review process.

The Wisconsin Wildlife Federation (WWF) recognized the importance of springs for fish and wildlife habitat and applied to the Joyce Foundation for a grant to inventory the current and historic data on springs in Wisconsin. The objectives of this study are to compile a centralized database of springs' information, to identify springs that are protected by Act 310 and to identify springs that fall outside the protections of Act 310. This information will be used to build a case for the protection of the many important springs with discharge rates below one CFS.

## **Methods**

The main charge of this study was to fill the springs' information data gap by creating the most up-to-date list of springs in the state, including their location and known physical characteristics. This inventory is in the form of an ArcGIS database and map. Prior to this study, a centralized database of Wisconsin's springs did not exist. The compilation was done using many resources, including historic and current federal and state databases and ongoing research.

During the study, there was much collaboration between academic and governmental staff. For this study, the Wisconsin Geological and Natural History Survey (WGNHS) in Madison, WI provided office space and general equipment, furnished field equipment (flow meter, pH meter, etc.) and provided additional expertise in hydrogeology and GIS database development. Also, housed at the WGNHS is extensive historic information on springs.

A "springs group" (Appendix C) was organized to facilitate data sharing and consistency. This working group included professionals from academia (University of Wisconsin schools, Beloit College), DNR, US Geological Survey, WGNHS, and the Wisconsin Wildlife Federation. Meetings were held to discuss and distribute current research and to assist in policy review.

## ***Data Sources***

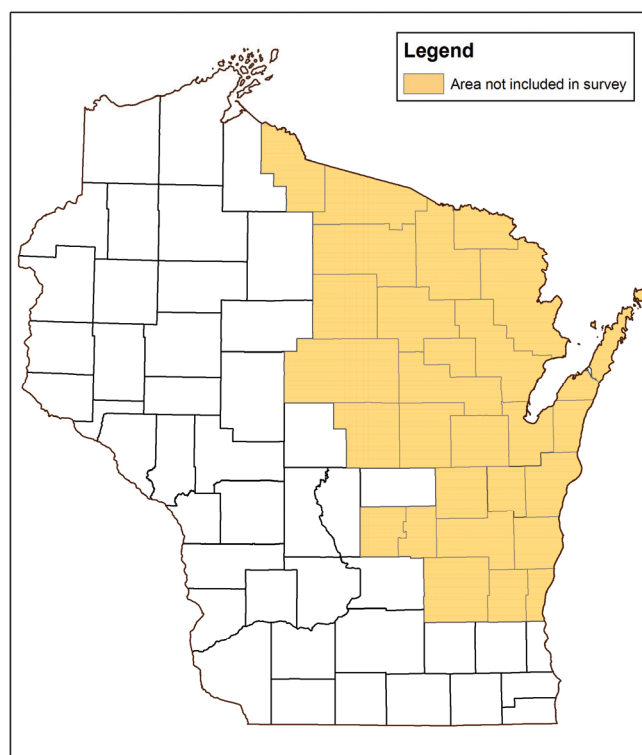
The earliest survey to include springs in the state was the original land survey of the Wisconsin Territory completed in 1834. The few springs that were recorded show up on later surveys. The Wisconsin Land Economic Inventory (1927-1947), or "Bordner Survey," after its director John Bordner, documented the current and potential land use in all parts of the state. One of the goals of the Bordner Survey was to set foot in every forty acre parcel in the state (Koch, 2006). Maps were not done for Lincoln, Manitowoc, Milwaukee and Sheboygan Counties, and some areas

covered by Native American reservations and national forests were not surveyed. Spring locations were marked on hand drawn, township-scale maps, which can be viewed online at the University of Wisconsin Digital Collections library. This survey provides the location of many springs, but does not include physicochemical characteristics.

The most extensive prior survey of Wisconsin's springs is the "Springs Survey" (1956-1962) housed at the WGNHS and available on CDROM. The survey was completed by the Wisconsin Conservation Department and covers the western and southern parts of the state (Figure 1). Funded by the Federal Aid in Sport Fish Restoration Act, it was conducted as a means to assess Wisconsin's potential for trout fishing and rearing opportunities focusing exclusively on springs. Surveys were completed on a county-by-county basis. Spring locations were found using previous land surveys and interviews with private landowners. Each spring includes a location marked on a plat book map, a flow measurement, temperature measurements, fish species present, land use data, and other information on the spring's physical characteristics and use.

Though the "Springs Survey" is fairly comprehensive and was completed by a professional natural resource agency, it has shortcomings. There was no established definition as to what was being called a spring during the survey. The

method of flow measurement was often not recorded and in some occasions flow was simply estimated. Counties that did report a method of flow measurement indicate the "stick-float" method (channel width multiplied by channel depth multiplied by the distance a stick floats in 5 or 10 seconds). Jefferson County reported using a V-notch weir and a rectangular weir with the stick-float method as a confirmation measurement. Only one flow measurement was reported for



**Figure 1.** Coverage of the 1956-1962 "Springs Survey."



each spring and the measurements were taken at various times of the year. This does not provide sufficient data to find a spring flow rate for 80 percent of the time. In spite of these shortcomings, the reported locations of springs have been found to be accurate during field investigations, and the “Springs Survey” remains a valuable data source.

The Surface Water Resources publications (1961-1985) by the DNR are another important source of spring data. The data are published by county and are available at the DNR offices in Madison, WI and at some DNR service centers. The primary focus is on streams and lakes, but springs are included when they significantly contribute to or affect surface waters (Margerum and Born, 1990). Although they do not include flow data, spring locations and comprehensive chemical analyses and water quality data are available.

Recent research on springs has provided updated flow data and chemical analyses to the Wisconsin springs inventory. Dr. Kevin Fermanich et al., of UW Green Bay, recently completed the study “Mapping and Characterization of Springs in Brown and Calumet Counties” (Fermanich et al., 2006). Of the 41 springs found, none would be protected under the current definition of a spring under Act 310. One spring did have flow rates above one CFS for a period of four months after 5+ inches of rain fell in early and mid-May (Fermanich et al., 2006). The discharge rate is not sufficient to provide legal protection under the flow duration clause of “at least 80 percent of the time.”

Also recently completed is a study by Dr. Katherine Grote of UW Eau Claire. The study “Identification and Characterization of Springs in West-Central Wisconsin” focused on St. Croix County (Grote, 2007). Of the 87 springs identified, 12 had a discharge rate of one CFS or greater, though flow rates of springs for 80 percent of the time were not identified.

Dr. Sue Swanson et al. completed the final study incorporated into this database, titled “Assessing the Ecological Status and Vulnerability of Springs in Wisconsin” (Swanson et al., 2007). This project describes and documents the physical, biological and socio-cultural characteristics of springs in Iowa and Waukesha Counties. Baseline data on physicochemical characteristics and biological communities of springs were collected using a comprehensive springs classification system in order to develop conceptual models to assess the impacts of

groundwater pumping on springs. The distribution and relationship of springs to major stratigraphic units was also examined. The study suggests the overall approach used may be successfully applied elsewhere in Wisconsin to preliminarily assess the vulnerability of springs to pumping.

A small number of other spring locations were obtained by personal communications with county conservationists and private landowners and from USGS topographic maps.

### ***Data Compilation***

An ArcGIS database of all known springs was compiled using the historic and recent research. The historic surveys were digitized as a Microsoft Excel document, with all reported physical and chemical data included. Each spring was assigned a unique six-digit number, the first two numbers being the county code of the county in which the spring is located and the final four numbers assigned in the order in which the data were entered into the database. To develop the database further into an ArcGIS map, the locational data was converted from township-range-section-quarter data to WTM91 x-y coordinates using a conversion program. The final Excel spreadsheet was saved as a Microsoft Access document, viewable as a geodatabase in ArcGIS. A shapefile of spring locations and attributes was created using the WTM91 x-y coordinates. The ArcGIS shapefile and database are available on a CD (Appendix D) with a data dictionary including descriptions of the data fields. The data will be put online by the Wisconsin Wildlife Federation ([www.wiwf.org](http://www.wiwf.org)) and also housed at the WGNHS.

The locations of the springs on the ArcGIS map were refined in a two-step process. Springs that had maps associated with them were moved to the proper location according to a georeferenced image of the map. Those without maps were refined to the quarter section resolution given. All spring locations were then overlain onto 2-meter resolution air photos from the National Agriculture Imagery Program's 2006 archives. The locations were further refined using the recent photographs as a base-map and using historic and current plat books to visually estimate the most likely location of the spring. If no discernible location could be found, preference was given to location provided in the survey or on the available maps. Almost all springs were located with high confidence, within a 40-acre area, with the exception of a few in western Waushara County.

The recently completed research projects were also developed as ArcGIS data sets, which allowed them to be incorporated into this statewide survey with relative ease.

### ***Field Exploration***

Field exploration was completed on a number of springs in order to verify the historic data and to update spring characteristics. Spring locations from historic surveys were found to be mostly accurate with the majority of current landowners contacted confirming the presence of a spring. The historic spring discharge measurements varied in accuracy. Generally, the earlier reported flow rates were higher than the flow rates observed during this investigation. This is possibly due to the methods used to measure spring flow or changes in the groundwater elevations and flow patterns over the 50-year period since measurements were taken. A reporting form was developed to streamline on-site data collection and used as a form for reporting new spring locations (Appendix B). The investigations focused on springs with a flow rate less than one CFS and located on private land. Landowners were identified using plat books and a phone call was placed to each. Of the 684 landowners contacted, 70% acknowledge a historic spring on the property. Less than 12% of the landowners granted access to the spring.

Data collected on-site included locational information, a description of the physical setting, spring characteristics, visible biota and a hand drawn map of the spring area. A photograph of the spring site and surrounding area was taken for future reference (Figure 2). A Garmin GPS 60cs was used to map the spring location. Large spring areas were delineated with multiple GPS points. When the information was added to the ArcGIS database, the center of the GPS delineation was used to represent the spring location. The land use and estimated distance to anthropogenic features were recorded to aid in future site identification and to identify any potential threats to water quality.

**Figure 2.** Photograph of a spring. At this spring site, viewing west, trampling by cattle has greatly degraded the spring area. A handheld GPS is used for scale (lower-right of figure).



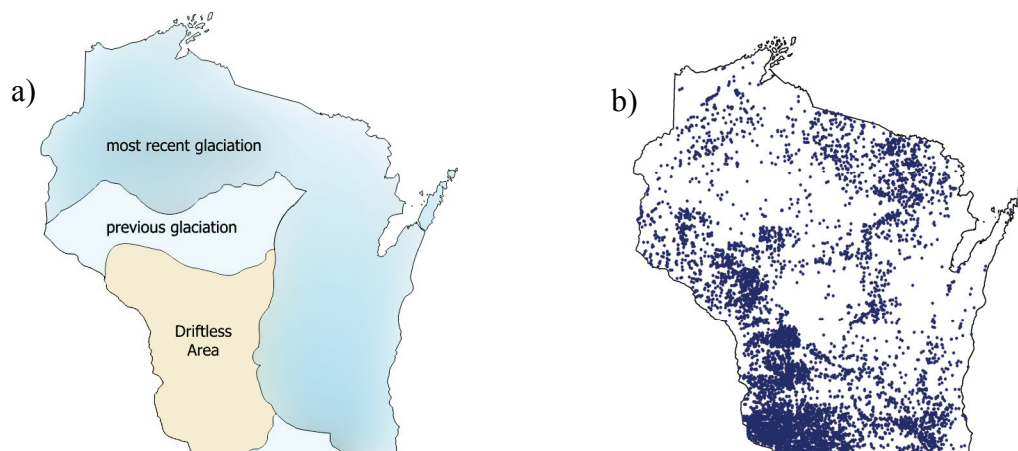
Water quality measurements were taken on-site using calibrated equipment. The measurements were acquired as near to the spring outlet or area of concentrated discharge as possible. Electrical conductivity and water temperature were taken using a Hach Conductivity/TDS meter. Measurements of pH were taken with an Orion Portable Meter. CHEMetrics test kits were used to find total alkalinity and dissolved oxygen. The kits allowed for immediate testing of the water at the source. Other spring characteristics recorded included the spring arrangement, number of discharge points and the spring type.

Spring flow rate was measured in the spring channel as near to the spring outlet or area of concentrated discharge as possible. The measurements were made using a Baski cutthroat flume or using a Flo-Mate model 2000 flow meter and the “6/10<sup>th</sup> depth” method of calculating discharge rates.

## Results

### *Spring Distribution*

A total of 10,851 springs were identified in this inventory. The distribution of springs in Wisconsin can be seen in Appendix A, Map 1. Spring locations are highly correlated to Wisconsin’s geology. The highest concentration of springs, in the southwest, unglaciated part of the state, is due to a large number of small springs (less than 0.02 CFS) originating from fractures in exposed or near surface bedrock (Figure 3). Grant County, in southwest-most Wisconsin, has 1.9 springs per square mile, the highest concentration of springs in the state. There is also a high concentration of springs along the edge of glacial lobe end moraines, those springs issuing from the base of the moraines as depression-type springs, where flow is due to the water table intersecting the land’s surface.



**Figure 3.** a) Extent of glaciation in Wisconsin and b) known spring distribution.

In general, the largest springs were found in the glaciated parts of the state, most being in the Northern Highland region of Wisconsin. The largest spring, Cedar Island Ponds, a spring complex occurring very near the Boise Brule River in Douglas County, has a flow rate of 40 CFS. An area with a low concentration of springs occurs in the Central Sands region of Wisconsin, which, during the last glaciation, was covered by Glacial Lake Wisconsin. Another area with a low concentration of springs is east-central Wisconsin, which was once beneath Glacial Lake Oshkosh. In this area, centered on Outagamie County, many of the springs are found discharging from the banks of rivers and streams.

County	Name	Approximate Discharge CFS
Douglas	Cedar Island Ponds	40
Waushara	Mecan Springs	22
Bayfield	Lake Two	15
Bayfield	Sajdak Springs	13.4
Washburn	Little McKay Spring	11.1
Grant	Unnamed	10.7
Bayfield	Louis Lake	10.4
Washburn	Crystal Brook Springs	10
Washburn	6-1	8.8
Washburn	5-6	8.7

**Table 1.** Largest known springs in Wisconsin.

On occasion, historic spring sites were found destroyed or severely altered, such as a new road or housing development on the spring site. This was most common in southwest and south-central Wisconsin. On rare occasions, springhouses and other developments were found in disrepair with no visible efforts to restore or remove the structure (Figure 4). The effects of these structures on flow rate, water quality, and the spring ecosystem are not known at this time.



**Figure 4.** A deteriorated springhouse. The spring beneath this structure, flowing at 120 gallons per minute (0.27 CFS), once supplied water to the inhabitants of a nearby farm.

### ***Flow Rates***

This study found the average flow rate of springs to be 0.2 CFS and a median flow rate of 0.03 CFS. Of the 10,851 springs in this inventory, 8088 had historic flow data ranging from an immeasurable “trickle” to 40 CFS. Also, 1,115 of the 10,851 springs were recorded not as a numeric measurement but as a flow note, such as “trickle” or “frozen at time of visit,” or by a range of discharge values.

<b>Flow Rate</b>	<b>Number of Springs</b>	<b>Cumulative Total</b>
1 CFS and greater	235	235
0.75 to <1 CFS	42	277
0.5 to <0.75 CFS	114	391
0.25 to <0.5 CFS	323	714
>0 to <0.25 CFS	7374	8088
Springs with a flow note	1115	9203
Springs with no flow data	1648	10851

**Table 2.** Flow rate and corresponding number of springs.

This data shows only a small percentage (3%) of the springs are covered under the current one CFS threshold. The distribution of known springs with a flow rate of one CFS or larger can be seen in Appendix A, Map 2. Applying this percentage to all known springs in Wisconsin, the estimated number of springs with a flow rate of at least 1 CFS is calculated to be 326.

### ***Physicochemical Characteristics***

Data was collected on site as a means to rapidly assess the quality of the water and the relative health of the spring area. Data values can be found in the ArcGIS coverage on the data CD included with this report (Appendix D).

### ***Biota***

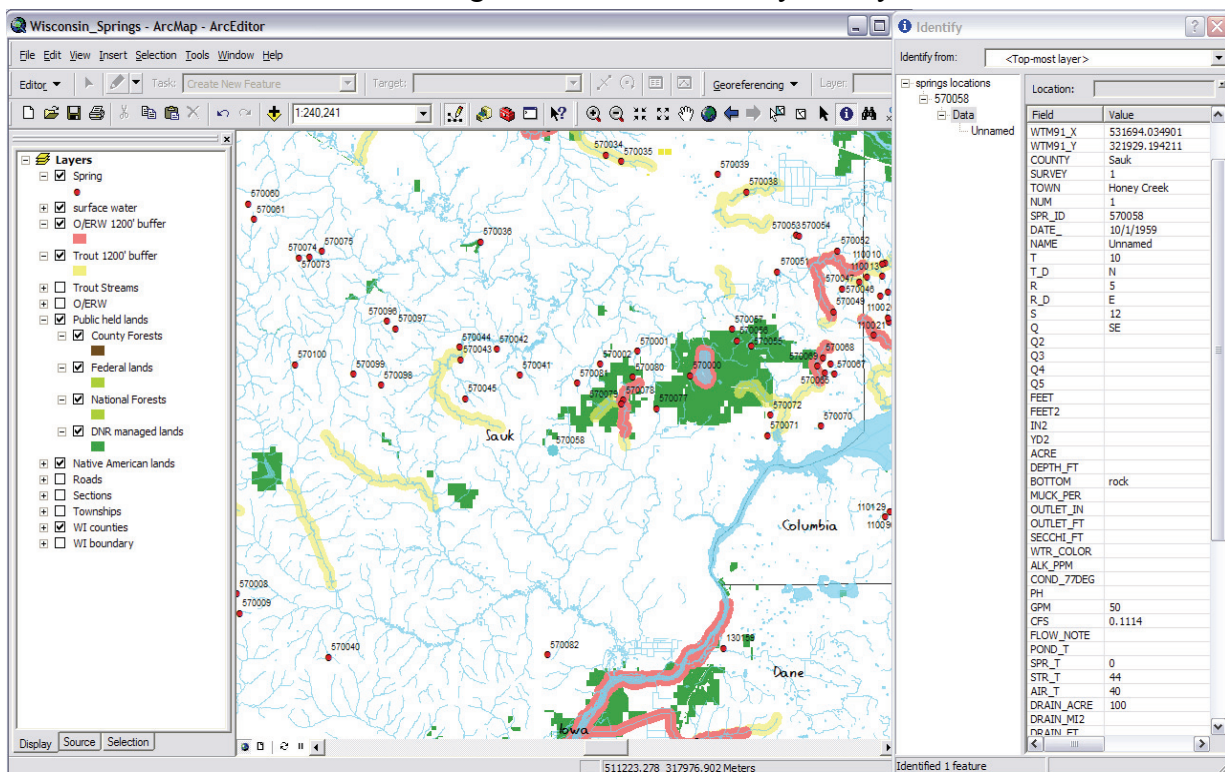
Flora and fauna observed at the spring site were also recorded, though not extensively surveyed. This was also done as a means to assess the relative health of the spring area. Common flora observed included watercress (*Nasturtium officinale*) and great angelica (*Angelica atropupurea*). The most common fauna observed was the freshwater shrimp or scud (Amphipoda). The diversity of biota varied greatly, from little to no flora and fauna to well developed spring ecosystems.



### ***Springs Database and ArcGIS Coverage***

This study developed the first and only comprehensive compilation of spring data in Wisconsin. The data are compiled using the ESRI geographic information system (GIS) and mapping software ArcGIS, which allows for quick editing and distribution of data.

Springs' locations and physicochemical data were formatted as an ArcGIS shapefile. This shapefile and other GIS datasets, such as 1200-foot buffer areas, public lands, political boundaries and other relative data, are compiled in a file geodatabase. The geodatabase is viewable as a layered map (Figure 5) that is interactive by turning datasets on or off, zooming and panning the map area, and by performing data queries and identifying relationships between the different datasets. Other datasets, such as surficial geology, can be added to the GIS coverage to identify other relationships. The ArcGIS database is available as a data CD with this report (Appendix D) and will be put online by the Wisconsin Wildlife Federation. The database is also available at the Wisconsin Geological and Natural History Survey.



**Figure 5.** A screenshot of the ArcGIS coverage.

## Existing Protection of Springs

Under the current legislation, springs are directly afforded protection based on flow rate. Some counties in Wisconsin, for example Eau Claire County, have no known springs with a flow of at least one CFS. Though the 210 historically known springs in Eau Claire County will not be protected by flow rate alone, the groundwater quantity act does provide some indirect protection of springs.

Springs with flow rates less than one CFS are afforded a very limited potential protection if they fall within the 1200-foot buffer adjacent to trout streams and Wisconsin's Outstanding or Exceptional Resource Waters (O/ERWs). In Eau Claire County, 43 springs are within these buffer areas. A high capacity well cannot be constructed within these buffer areas unless it is shown there will be no significant environmental impact on the surface water. A great majority (70%) of all springs fall outside this area of potential protection (Table 3). This protection favors springs with flow rates of  $\frac{1}{4}$  CFS or larger because these larger springs usually discharge enough water to create a trout stream. Of the larger springs, 63% are within these buffer areas and of the smaller springs, 29% are within these buffer areas (See Appendix A, Map 3 for distribution).

Flow Rate	Number of Springs Not Associated with Trout Streams and O/ERW Waters	Cumulative Total
1 CFS and greater	81	81
0.75 to 0.99 CFS	15	96
0.5 to 0.74 CFS	35	131
0.25 to 0.49 CFS	135	266
>0 to 0.24 CFS	5520	5786
Springs with no flow data	873	6659
Springs with a flow note	909	7568

**Table 3.** Springs not associated with trout streams and O/ERWs.

The 1200-foot buffer around valuable surface waters such as trout streams and O/ERWs provides very limited protection for springs and for the lakes and streams that the buffer was designed to protect. An arbitrary buffer distance does not consider the additional key factors that influence the possible impacts a high capacity well will have on surface waters. Subsurface geology and the density of surrounding high capacity wells in the vicinity of a proposed well are two important issues that are ignored by the arbitrary 1200-foot distance. Efforts are underway investigating alternative methods to approach protecting springs and other surface waters.



## **Potential Spring Protections**

Other potential protections investigated include whether the spring is located on public lands or Native American lands. Additional protection may exist for springs located in areas of the state with an aquitard separating shallow and deep aquifers. Protection of springs located on public lands is limited because a spring's recharge area may reach for miles from the point of discharge. Springs located on Native American lands will fall under treaty rights of the respective Native American tribes. Springs with source water originating from a shallow aquifer underlain by an extensive aquitard have the greatest potential of limited impact from a high capacity well. For this to be effective, the well must be constructed such that it penetrates a non-leaky aquitard and is cased below the aquitard therefore drawing water principally from the deep aquifer.

## **Conclusions**

This study provided the first comprehensive database of Wisconsin's springs and their characteristics. Data compiled from historic and recent surveys and studies produced a total of 10,851 springs in Wisconsin. These numerous springs have rates of discharge ranging in size from a small fraction of a cubic foot per second to tens of cubic feet per second. There are numerous smaller springs and springs feeding lakes and streams that are not accounted for in this survey. The confidence level for the historic locations of springs is high, with many of the current landowners contacted confirming the present or previous existence of a spring.

The distribution of springs in Wisconsin can be correlated to the geologic history of the state, most notably Wisconsin's glacial history (Figure 3). The most common spring types observed in this survey were depression springs in the glaciated areas of the state and fracture springs in the driftless area. Many larger springs (flow rates greater than 0.2 CFS) were found to have some sort of anthropogenic feature around or near the spring outlet including springhouses and developed ponds. In areas of the state undergoing rapid growth and development, such as southwest Wisconsin, springs are being lost to the filling and dewatering practices used during the construction of new roads and housing developments.

## **Recommendations**

This study creates the foundation for a comprehensive database of Wisconsin's springs and their attributes. The importance of this inventory has already been shown in the pre-publication distribution of data sets to various institutions including the DNR for high capacity well application reviews, research projects, and local and regional planning commissions. This project has been providing information to the Groundwater Advisory Committee to assist with developing potential recommendations to the Legislature for the creation of additional protection for Wisconsin's springs and in turn the ecosystems that depend on such springs. Recommendations for the future management of this database include:

- the completion of a new statewide survey of the physical and ecological characteristics of springs,
- maintenance and, on a regular basis, updating of a centralized, comprehensive database of springs' data,
- development of a monitoring and reporting system for springs.

A new statewide survey will likely have greater success accessing spring sites than this survey. Landowners expressed concern over granting land access because this project was being completed by a non-governmental organization. The centralized springs clearinghouse, such as the WGNHS in Madison, WI, should be established and funded with the purpose of acquiring new spring data and updating the database.

Springs in Wisconsin with a flow rate above one CFS are a small minority, making up 3% of the known springs in the state. Act 310, in protecting springs by a flow rate alone, ignores the other important ecological and physicochemical characteristics of springs. A definition designed to protect springs should:

- be qualitative and consider the important ecological, cultural and economic values of a spring,
- have a much lower flow rate threshold, such as 0.2 CFS, to include many of the important springs smaller than one CFS,
- not restrict springs from protection on the basis of a flow duration.

Springs with lower flow rates are likely to be affected more by groundwater withdrawal by high capacity wells than would larger springs. The loss of smaller springs due to the lowering of water tables or groundwater diversions by high capacity wells can have severe impacts on trout streams and other valuable water resources. Some trout streams obtain 34% of their total stream flow from the contribution of numerous springs with discharge rates of less than one CFS (Grote 2007).

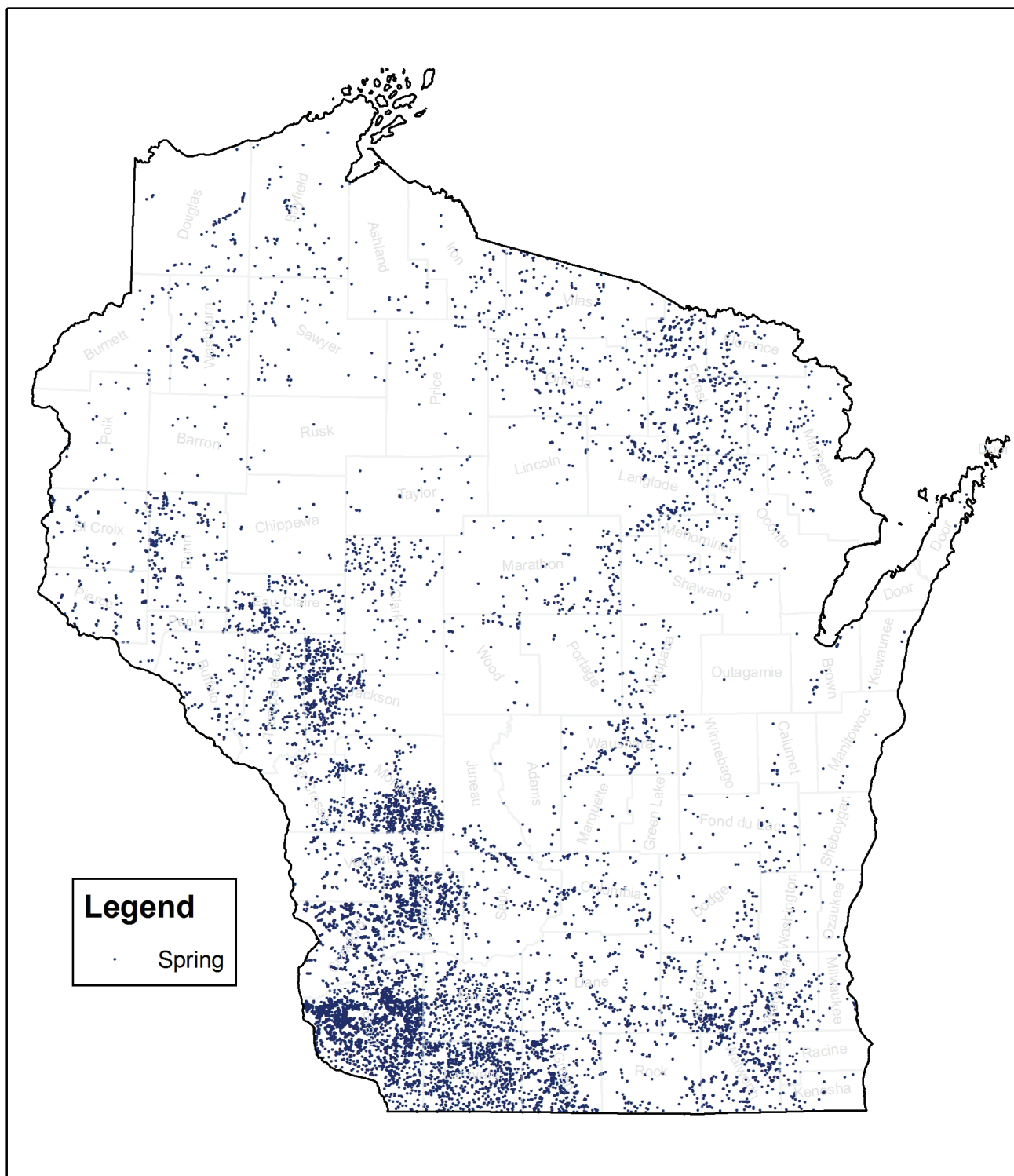
### **Acknowledgements**

A sincere thank you is extended to the Joyce Foundation of Chicago, IL for funding this project and to the Wisconsin Wildlife Federation for drafting the grant proposal and managing the funds. I would also like to thank the WGNHS for providing the office space, the use of field equipment and the additional expertise and guidance. A special thanks to Susan Hunt and Deb Patterson for providing figures and to Ken Bradbury for his many insights during this study. To the property owners who granted me access to springs and shared the histories of the springs and their importance to families, communities, and the environment, thank you.

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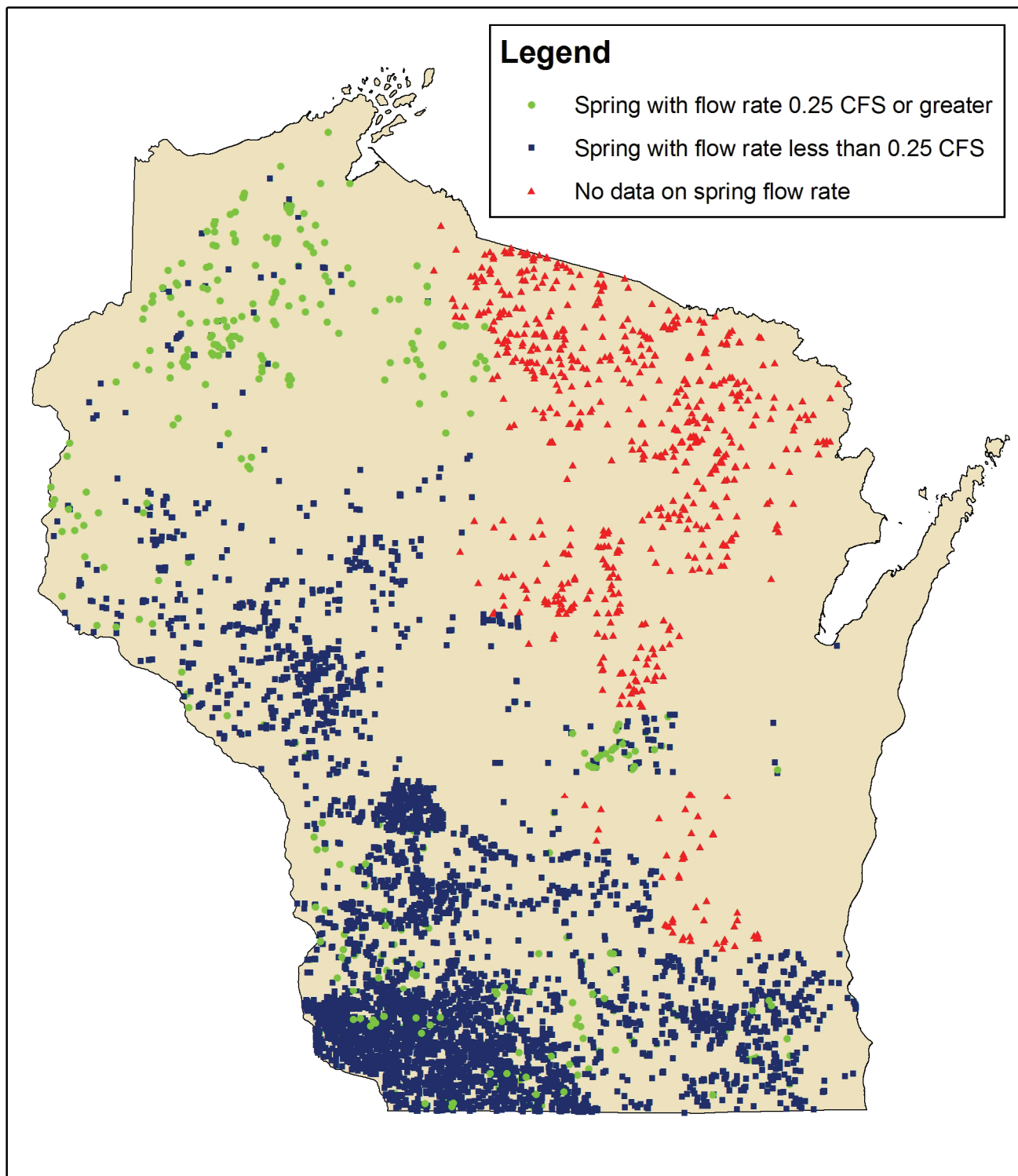
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## **Appendix A - Maps**



**Map 1.** The distribution of known springs in Wisconsin.





**Map 3.** Distribution of all springs not associated with trout streams and Outstanding/Exceptional Resource Waters.



## **Appendix B – Springs Reporting Form**

Rec'd: \_\_\_\_\_

Entered: \_\_\_\_\_

**Springs Reporting Form**

This form is used to report the locations of springs and artesian wells. Information collected this way will be used to inventory, characterize, and protect springs in Wisconsin. Please provide as much information as possible. Please mail or FAX completed form to: Wisconsin Geological and Natural History Survey, 3817 Mineral Point Road, Madison WI 53715; FAX (608) 262-8086

**Reporter** (Last, First): \_\_\_\_\_ Investigation Date: \_\_\_\_\_

Employer/Occupation: \_\_\_\_\_

Email: \_\_\_\_\_ Phone: \_\_\_\_\_

**Spring Identification and Location**

Spring ID (if known): \_\_\_\_\_ Spring Name: \_\_\_\_\_

Property Owners Name: \_\_\_\_\_ Phone: \_\_\_\_\_

Property Address: \_\_\_\_\_

County: \_\_\_\_\_ T. \_\_\_\_\_ N R. \_\_\_\_\_ E or W 1/4 of \_\_\_\_\_ 1/4 of \_\_\_\_\_ Sec. \_\_\_\_\_ Lot: \_\_\_\_\_

**If providing GPS data:** Feature mapped as point, line, or area? \_\_\_\_\_

X-Coordinates (Easting or Latitude): \_\_\_\_\_

Y-Coordinates (Northing or Longitude): \_\_\_\_\_

Referencing System: \_\_\_\_\_ (e.g. WTM, Lat/Long, State Plane, UTM, county system)

Datum (or Spheroid for Lat/Long): \_\_\_\_\_ (e.g. NAD91, NAD27, WGS84, GRS80)

Comments on location: \_\_\_\_\_

**Physical Setting**
Nearby Land Use & Estimated Distance (check all that apply, enter distance & measurement unit)

high capacity well – municipal: \_\_\_\_\_ potable well: \_\_\_\_\_ landfill: \_\_\_\_\_

high capacity well – ag/industrial: \_\_\_\_\_ building: \_\_\_\_\_ house: \_\_\_\_\_

high capacity well – other: \_\_\_\_\_ septic field: \_\_\_\_\_ farm field: \_\_\_\_\_

gasoline service station: \_\_\_\_\_ quarry: \_\_\_\_\_ livestock pen: \_\_\_\_\_

storm water detention pond: \_\_\_\_\_ gravel pit: \_\_\_\_\_ waste lagoon: \_\_\_\_\_

irrigation ditch: \_\_\_\_\_ other (describe): \_\_\_\_\_

Spring Arrangement

Isolated spring

Cluster of springs

Total # of outlets: \_\_\_\_\_

Largest outlet size (feet): \_\_\_\_\_

Type of Access: \_\_\_\_\_

Comment on physical setting: \_\_\_\_\_

Spring Type (may be multiple)

Rheocrene (flowing spring)

Limnocrene (emergence in lentic pool)

Helocrene (seep, indistinct/multiple sources)

Artesian Well other \_\_\_\_\_

Attach additional sheets or disk files as necessary.

## Springs Reporting Form

### Flow, Temperature and Chemistry

Estimated flow (GPM or CFS): \_\_\_\_\_ Comment: \_\_\_\_\_

Method of measuring flow: \_\_\_\_\_

Temperature °F / °C (*circle one, enter all that apply*)

Air: \_\_\_\_\_ Pond: \_\_\_\_\_ Spring: \_\_\_\_\_ Stream: \_\_\_\_\_

pH: \_\_\_\_\_ Total Alkalinity (meq/L): \_\_\_\_\_

Electrical Conductivity (µS/cm): \_\_\_\_\_ Dissolved Oxygen (mg/L): \_\_\_\_\_

Other Data Available: \_\_\_\_\_

Comments on flow, temperature and/or chemistry data: \_\_\_\_\_

### Biota

Flora: \_\_\_\_\_

Fauna: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Map:** *Plan view sketch should include: nearby landmarks (e.g., roads, fences, buildings), approximate scale, north arrow, cross-section (if appropriate). Attach photos or other reference maps as needed.*

**General Comments:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Attach additional sheets or disk files as necessary.

## **Appendix C – Springs Working Group**

Dr. Kenneth Bradbury, WGNHS

Mike Cobb, UW Madison

Dr. Kevin Fermanich, UW Green Bay

Dr. Katherine Grote, UW Eau Claire

Jeff Helmuth, WDNR Water Resources

Jim Krohelski, USGS emeritus

Jacob Macholl, Wisconsin Wildlife Federation

George Meyer, Wisconsin Wildlife Federation

Dr. Susan Swanson, Beloit College

Chris Waltman, UW Green Bay

Dave Zaber, UW Arboretum

## **Appendix D – Springs Inventory Data CD**