

# Integrated computerized mapping of point source contaminants and physical environmental characteristics to protect and manage groundwater quality in northeast Wisconsin. [DNR-105] 1993

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#### Integrated Computerized Mapping of Point Source Contaminants and Physical Environmental Characteristics to Protect and Manage Groundwater Quality in Northeast Wisconsin

#### **Principal Investigators**

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#### Funding

The Wisconsin Department of Natural Resources (WDNR) provided funding for this project through the Groundwater Management Practice monitoring Program which receives appropriations from the Groundwater account.

#### Introduction/Summary

A multitude of groundwater quality data, spill, and waste disposal practice information exists within WDNR. Since this information is in segregated hard copy files, it is relatively unretrievable by individuals outside the program of interest. This project addresses that massive information management problem with the design of a geographic information system for groundwater associated data in Lake Michigan District WDNR. The Lake Michigan District (LMD) is situated in northeast Wisconsin and consists of the following counties: Florence, Marinette, Oconto, Menominee, Shawano, Waushara, Waupaca, Outagamie, Brown, Door, Kewaunee, Manitowoc, Calumet and Winnebago.

Lake Michigan District WDNR has produced quality digitized groundwater information with a 36" X 48" digitizing table, 36" plotter, and 486 computer work station with PC ARC/INFO GIS software located in the office. This project has required the examination of numerous spill and groundwater quality monitoring files. Information retrieval was rather protracted since, generally, no single file contains all the District's groundwater information. As part of this project much of the WDNR Lake Michigan District spill and groundwater contamination information has been assembled into a relatively updated paper file also. These various updated information layers have been digitized to produce quality district-wide maps, which are variable by user request, and provide much improved groundwater resource management capability for district spills and groundwater management concerns.

This file of spill locations and associated groundwater quality information has been merged with other existing groundwater contamination susceptibility information for the Lake Michigan District. This includes:

- 1. All the karst geologic features mapped on the Groundwater Pollution Potential and Pollution Attenuation Potential Map for Door County, (1989 Door County Soil and Water Conservation);
- 2. All karst geologic features for the Branch River Priority Watershed in Manitowoc and Brown Counties;
- 3. Mapped locations of all current and past orchard and lead/arsenate pesticide mixing areas for Door County;
- 4. Potentiometric maps for Outagamie, Winnebago, Waushara and Waupaca Counties;
- 5. Pleistocene geology for Brown County;
- 6. Bedrock geology for Outagamie and Winnebago Counties.

PC ARC/INFO software was used to assemble the information at the District level for groundwater resource management and watershed decisions. The final product is a single file package of rapidly retrievable groundwater monitoring and groundwater contamination susceptibility information for the purposes of research, decision making, and comprehensive management. In addition to WDNR, information users now include Door County governmental agencies such as the Planning Department, Survey Department, and Soil & Water Conservation Department, other users may include WDILHR, WDATCP, WDHSS, University of Wisconsin researchers, environmental consultants, and realtors.

Individual spills or improperly located sites have been field identified with the use of a Trimble Transpac II GPS infield geographic location device with an estimated ground truth error of 100 feet. However, these point locations have been map verified to eliminate gross errors. Hard copy plots of potential groundwater contamination sources for each county in the Lake Michigan District WDNR exist at the LMD Water Supply office in Green Bay.

The mapping of potential groundwater contamination sources in the Lake Michigan District with GIS is very successful. The final digitized package is an integrated file of active groundwater contamination sources including contaminated soil areas potentially affecting groundwater. Maps and digital data can be viewed at the WDNR - LMD Office. Updating these maps can be simplified by accurate and systematic documentation of new potential sources as they occur. This point is paramount to maintaining the most complete and accurate mapping database. In LMD the following categories were selected as important to maintaining a file of potential groundwater contamination sources and receptors:

1) leaking underground storage tank (LUST) sites

2) environmental repair and restoration program (ERRP) sites

3) material spills

× 1

4) known groundwater contamination cases

5) active landfills

6) abandoned landfills

7) wastewater lagoons

8) general WPDES discharge sites for LUST/ERRP facilities

9) industrial and municipal WPDES discharge facilities

10) sludge application sites

11) septic spreading sites

12) wastewater land disposal areas

13) salvage yards

14) lead/arsenate pesticide mixing sites

15) pesticide storage and handling facilities

16) salt sheds

17) approximately 12,500 acres of apple and cherry orchards

18) special well casing requirement areas

19) municipal wells

20) other-than-municipal wells

21) non-transient non-community water wells

22) karst inventory for priority watershed areas

23) greater than 2000 water supply wells sampled for native arsenic

This list is a rather inclusive inventory of potential groundwater contamination sources. However some sources such as: salt sheds, land disposal of liquid waste and past or present septic waste spreading sites are not consistently maintained because they are very difficult to update. This list contains information that can be obtained in a reasonable period of time and has reliable accuracy to the data. Statewide lists are available and may be identified through the Groundwater Coordinating Councils "Directory of Groundwater Databases" (February 1994). However, for the most specific information, the WDNR District office files should be referred to.

This project was designed to create a complete contamination assessment/groundwater management package. The approach and methods of the project are independently useful and consistent with WDNR Bureau of Information Management (BIM) Geographic Information System (GIS) objectives. Attached with the final project submittal are several example map plots from selected areas of the project area consisting of:

- Figure 1) Door County Special Water Well Casing Map
- Figure 2) Northern Sturgeon Bay Environmental Summary
- Figure 3) Native Arsenic Contamination Trend
- Figure 4) Orthographic Photo of Chilton, WI and Environmental Summary
- Figure 5) Lower Oconto River Watershed Water Quality Sampling Locations

Plots are not limited to these example types only. Unlimited map versions, topics, scales and areas are obtainable from the digitized file that has been created. The ability to plot this information with GIS has greatly increased environmental information accessibility to other agencies and the private sector. Hopefully this greater information accessibility will further heighten the private sector's environmental consciousness and ultimately motivate it toward an even greater environmental responsibility.

#### **Objectives/Methods**

The principal objective of this project was to create a single useable computer file for retrieval of all groundwater contaminant source locations in the Lake Michigan District. This objective was accomplished in the following way.

- 1. Create computerized base maps for all 14 counties in the Lake Michigan District. This work was completed by the WDNR Bureau of Information Management (BIM) in Madison.
- 2. Update a complete hard copy repository file of all Lake Michigan District groundwater contamination sources (listed on page 3). This work was completed at LMD Headquarters.
- 3. Create a detailed dBase file of all groundwater contamination sources for the entire Lake Michigan District area. Pre-existing computerized program files were utilized when available (ie. LUST, ERRP). This was determined to be more accurate and would simplify the updating process since this primary file is managed on an ongoing basis by the respective program. This work was completed at the LMD Headquarters.

# Figure 1. Door County Well Casing Requirements



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## Figure 2. Northern Sturgeon Bay Environmental Hazards



# Figure 4. City of Chilton Environmental Summary





- 4. Digitize the thirty most affected private water supply wells from the lead/arsenate contamination study (Stoll, 1988) and key them to their well construction reports. This was completed at the LMD Headquarters.
- 5. Digitize the Door County soil and water conservation data file of 1,700 apple and cherry orchards totaling at least 12,500 acres, from the 1989 UWGB/Door County Soil and Water Conservation Department orchard/pesticide study. This was completed at LMD Headquarters.
- 6. Digitize all contamination points (#2 above and page 3 previously) along with municipal wells, OTM wells, special well casing areas and the Karst Geologic features identified on the Groundwater Pollution Potential and Pollution Attenuation Potential Maps. The digitizing software PC ARC/INFO was used and keyed for all of LMD counties to the dBase file referenced in #3 above. No quad sheets were left partially digitized. This work was completed at LMD Headquarters.
- 7. Digitize and maintain an ongoing file of all LMD naturally occurring arsenic in groundwater sample points and key them to respective well location and construction information when available.

All final maps were plotted with PC ARC/INFO software and an HP Draftmaster SX 36" plotter.

With the completion of this project scope and objectives a single comprehensive groundwater data package was created with visual outputs by subject or locale, for future and current users of data acquired through groundwater investigations within Lake Michigan District.

#### <u>Results</u>

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The completed products of this project include:

- A. Quality base maps with user control over scale, detail, and subject of each.
- B. A computerized, digitized, spill/groundwater contamination file that can be added to:
  - 1. new spills;
  - 2. newly contaminated wells;
  - 3. and new topics (soils, depths, lithology, etc.).

- C. Digital layers for specified areas identifying karst geology, orchard and pesticide mixing locations, potentiometric maps, Pleistocene and bedrock geology.
- D. An integrated computer format that allows groundwater quality data to be plotted, interfaced and retrieved with soil samples, sediment samples, surface water samples, geologic features, apple and cherry orchards, etc.
- E. A system that is additive and need not be bounded by the geography of the Lake Michigan District Project alone. Edge matching to adjacent counties will be simplified since all base maps and plotted points are relative to USGS 7½ minute quad sheets.

#### **Data Sources and Collection Techniques**

#### Bureau of Information Management GEO Section

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All potential groundwater contamination source maps for each county were produced using PC Arc/Info at the Lake Michigan District (LMD) Water Supply office. Base layers used on these maps were obtained from the WDNR Bureau of Information Management (BIM) Geo Section and consisted of:

- 1. Roads
- 2. Hydrology
- 3. Land Network
- 4. Municipal and Township Boundaries
- 5. County Boundaries
- 6. Geographic Names

These layers were obtained or created by the BIM GEO Section from various sources. The roads, hydrology, and land network layers were derived at a 1:100,000-scale from United States Geological Survey (USGS) Digital Line Graphs (DLG). These layers reflect the currency of USGS source maps dating from the early-to-middle 1980<sup>'s</sup>. Road network is periodically upgraded and new construction may not accurately represent what appears on the digital road network in a given area. Land network is based on the Public Land Survey System (PLSS). It should be noted that PLSS lines are added on the maps for cartographic reference purposes only, and are not intended to be official. The official land survey is the only legal

basis for determining land boundaries. County boundaries, municipal and township boundaries are derived from 1:100,000-scale U.S. Census Bureau Topologically Integrated Geographic Encoding and Referencing (TIGER) files. Geographic names are a digital collection of geographic features and associated locations of the USGS Geographic Names Information System (GNIS) at a scale of 1:24,000. All references made to the above digital layers were obtained from the BIM/GEO GIS Database User's Guide (1993). GIS allows the use of data to be combined that comes from many different scales, this can produce error if it is not recognized.

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The use of different scales produces various degrees of accuracy. For instance 1:100,000 base layers (roads, hydrology, etc...) have to meet accuracies to 149 feet and 1:24,000 base layers have to meet accuracies to 40 feet according to national standard mapping accuracies. LMD digitizes from 1:24,000 USGS topographic maps. The information digitized is therefore more accurate than the existing base road coverage. This can present a problem in certain instances. On some maps a LUST site which is located near a road and digitized from the 1:24,000 scale can sometimes appear on the wrong side of the road. In such instances we have kept all 1:24,000 digitized features in their original position to meet future road layers that will have a larger scale than 1:100,000. In the future base layers obtained from data sharing agreements with counties will have larger scale to coincide with the 1:24,000 scale we have currently digitized.

In addition to the data layers obtained from BIM GEO Section, this project team has cooperated with other agencies to obtain data that they possess in their collection.

#### Lake Michigan District and Door County Soil and Water Conservation Department

Several data layers created by this team within the LMD Water Supply office and in cooperation with the Door County Soil and Water Conservation Department were: Door County apple and cherry orchards, and karst features including fracture traces, caves, swallets, springs and crevices. Orchards were interpreted from historical air photos taken in 1938, 1954, 1961, and 1974 by the Door County Soil and Water Conservation Department. Field sheets were used as base maps and the orchards were outlined on translucent mylar film and subsequently digitized by LMD in 1992. Due to the age and nature of large scale black and white air photos, these source documents may incur some inaccuracies. Karst features were also transferred from air photos to mylar and subsequently digitized. Since, karst features have a very subtle appearance on air photos inaccuracies may also appear. Fracture traces are recognized on air photos where vegetation appears to be flourishing or abundant in a linear aspect. Digitized fracture traces are thus only identified at the surface and give no indication as to depth or width of fracture. This information has become extremely helpful to both agencies and environmental consultants. Currently maps are reproduced at a 1:24,000 scale at the LMD Water Supply office and at Door County Water and Conservation Department Sturgeon Bay, WI.

#### Lake Michigan District Water Supply Program and University of Wisconsin Green-Bay

In a cooperative effort the LMD and UWGB created a digitized layer of karst features for the Branch River Priority Watershed Project. UWGB students analyzed air photos and conducted subsequent field study to determine the location of karst features. These features were then reproduced on mylar that was subsequently digitized by LMD staff. Databases were connected to point and areal features, this information includes a description of the characteristics of the feature. This data layer was then distributed to the Brown and Manitowoc counties conservation departments, Bay Lakes Regional Planning Commission and WDNR Water Resources staff.

#### **INFORMATION LAYERS OVERVIEW**

#### Special Water Well Casing Areas

Special well casing areas of Door County were added to the base layers. This layer is often utilized by well drillers and LMD personnel. Door County has strict regulations concerning minimum casing depth throughout the county. The only map that depicted the regulations in the district was located at the Water Supply office and was created by pasting together ten 15 minute topographic maps of Door County. Well drillers phoned in requests for minimum casing requirements creating an inconvenience to them and Water Supply personnel. Several requests were made by well drillers to obtain copies of the map which was infeasible to reproduce without GIS technology because of the complexity and size of the original version.

Using PC ArcInfo the original map was traced onto separate topographic maps and digitized. Digitizing was done using the Door County hydrology and road layers when these layers acted as boundaries to the special well casing areas. The map was sent to a WDNR Water Supply Program Hydrogeologist and checked for accuracy. Several copies were then reproduced and sent to all well drillers in Door County consequently reducing the workload for all parties involved.

Well casing requirements are dispersed throughout the district and have also been digitized. These sites have a relational database joined to them that details the minimum well casing requirement and the type of contaminant that wells in the area are susceptible to.

#### Lead Arsenate Pesticide Mixing Sites

Historical Door County lead arsenate pesticide mixing and handling sites were also digitized. Lead arsenate was the staple pesticide used prior to 1960.

Investigations revealed that soils around the mixing sites were heavily contaminated with lead and arsenic and groundwater around the sites were often lead contaminated. Maps with the sites shown and a 1200' radius around the site were sent to all well drillers to inform them of areas possibly affected by high lead arsenate contamination.

#### LUST/ERRP Sites

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Leaking underground storage tanks (LUST) and Environmental Repair and Restoration Program (ERRP) sites were digitized from 1:24,000 7.5 minute USGS topographic maps. The location of the LUST or ERRP site was found by searching through the Solid and Hazardous Waste LUST and ERRP program files to obtain a site map. When a site map was not located, field investigation with a hand-held Global Positioning System (GPS) satellite based radio navigation system was used. GPS gives a latitude-longitude position on the location of the leaky tank or hazardous spill. These coordinates are downloaded into the computer with software that is purchased with the GPS unit. Accuracy of the GPS varies but all locations are checked with field maps to ensure correct location. LUST and ERRP locations in the WDNR files are not verified as to the accuracy of their original map, often a circle is drawn around a site that is bisected by a road and interpolation is required to find the most accurate location of the site. Since LUST and ERRP sites are continuously being added to the files, updates of these sites are suggested by LMD to occur every Currently LMD has located 1811 LUST sites and 574 ERRP sites. Each 3 months. LUST and ERRP site digitized is joined with the tabular database that the LUST and ERRP programs maintain. This allows a spatial assessment of all LUST and ERRP cases that have affected ground water or surface water and the type of contaminant involved along with locational information such as responsible party, address and consultant handling the case.

#### Municipal, Non-Transient Non-Community, and Other-than-Municipal Wells

Municipal, Other-than-Municipal and non-transient non-community wells were digitized from USGS 7.5 minute topographic maps. Locations of these wells were obtained from the WDNR Water Supply program's Well Vulnerability Assessment Project and direct field observations using GPS. This project aimed to locate most wells and photocopy topographic maps with their location. These site locations were subsequently transferred to the original 7.5 minute topographic map and digitized. Locations were also verified by Water Supply engineers who case manage the facilities. LMD has currently located 235 municipal wells, non-transient non-community wells, and 53 other-than-municipal wells. These locations were then used to assist Water Supply personnel with the 1995 Wellhead Vulnerability Assessment. ArcView maps were created and given to well system operators to aid in locating various potential groundwater contamination sources that had not been previously identified. Any new information once received could be added to the WDNR computerized map files. Each well location is also connected to the WDNR Groundwater Retreival Network (GRN) by the unique well identification number and to

its well construction report when it has been entered into the computerized well construction database using FilemakerPro software. GRN allows each municipal well site to be joined to water quality information and various information from its well construction report. The FilemakerPro software allows access to the entire well construction report.

#### Industrial, Municipal, and General Wastewater Discharge Sites

Industrial, municipal and general (treated groundwater) Wisconsin Pollution Discharge Elimination System (WPDES) permit sites were also digitized. These sites were digitized based on where they input into a surface water or seep into the groundwater. This discharge outfall may be at a different location than where the discharge water originated. All discharge locations were established by a record search of the Wastewater program files. Numerous sites have a map with the location while many sites have only a description of the location therefore requiring verification through field investigation. Site location maps for General discharge permits greatly outnumbered those for municipal and industrial permit locations. General discharge permit sites were joined to a tabular database located in the LMD Water Supply office and maintained by the District Hydrogeologist. Currently LMD has 135 general discharge permits located. This database contains various information about the discharge permitted such as the type of contamination. compliance status, receiving waters and other locational information such as responsible party name and address. Municipal and industrial permits were digitized but due to the nature of the Wastewater program files these sites could not be consistently linked to create an accurate tabular database.

Municipal and industrial sites may be point or areal discharges. Point discharges are more accurately determined than areal discharges. Landspreading operations which are areal discharges are located by the Public Land Survey System (PLSS) description and subsequently located to a 40 acre site. For example, the actual landspreading area may only occupy five acres on this 40 acre site. Consequently the location that is digitized on the map is only accurate to a 40 acre area in some locations. Also there is not a corresponding database that can accurately depict the type of contaminant discharge that is being allowed. Thus a hardcopy file must still be relied upon.

Wastewater land disposal sites consisting of agricultural and food processing wastes are included with WPDES industrial discharge permits. All land disposal sites are not currently required to be tracked, therefore the data is not inclusive of all occurrences of this activity. Sludge application sites and septic waste spreading sites are represented as municipal and industrial discharges. All municipal sludge application sites are currently in computer databases and have been added to the project. Currently computerized industrial sludge application sites are not inclusive, thus, can only be included when the information is available. The current computerized information is also not inclusive of septic spreading sites because many are not required to possess a permit.

#### Abandoned and Active Landfills

Abandoned and active landfills facilities were located using the <u>1993 Registry</u> of Waste Disposal Sites in Wisconsin. This list is a compilation of information regarding licensed landfills in the state and sites that obtained one-time demolition disposal permits. These sites are located using the PLSS within an accuracy of 40 acres. The nature of the registry does not provide an accurate description of the original facility type but does indicate if it is still operational. The site digitized by the LMD is chosen by interpolating the topographic map and file information as to the sites most representative location within the 40 acre area. Therefore the map has approximately a 40 acre accuracy for most sites. Although this is a very large error it is all that is available. In addition, locating these sites with GIS does save time when searching potential contamination source information with ArcView software. These sites are joined to a relational database that contains the same information as the 1993 Registry of Waste Disposal Sites in Wisconsin. This information consists of county, WDNR district, facility name, town/city, legal description, site address, ID number, and the status or information source. Currently LMD has digitized 804 abandoned landfills and 98 active landfills. LMD has included landfills labeled "transitional" with the active landfills. Landfills designated "transitional" have stopped receiving waste but have not been permanently closed. Most "transitional" landfills will be closed in the future and LMD's landfill coverages will reflect this change in the future.

#### Salvage Yards

Licensed automobile salvage yard dealer locations and historical salvage yard dealer locations have also been digitized. These sites are not as numerous as abandoned landfills and were field located without a great time expenditure. Upon field location the boundary was outlined on the 7.5 minute topographic map then digitized. These sites are located utilizing Wisconsin Department of Transportation, Division of Motor Vehicles (WDMV) Licensed Dealers, Wholesalers, Distributors & Manufacturers 1992 Edition book. The book provides basic information on every licensed motor vehicle, motorcycle, recreational vehicle and salvage dealer. Salvage dealers are given three types of licenses and are distinguished by their ranges and prefixes:

SL1 - SL699	Type 1 Salvage Dealers (Facilities conducted within a building)
SL700 - SL899	Type 2 Salvage Dealers (Business conducted within a building)
SL900 - SL999	Type 3 Salvage Dealers (Scrap metal recycling/shredding)
SL1000 - SL1250	Type 4 Salvage Dealers/"Scavengers" (Pick up and deliver to
	shredder)

LMD has located and digitized 141 salvage yards. Each digitized salvage yard was assigned its license number as an identification number in the GIS database which

represents the type of facility, name and address. All historical licensed salvage yard dealers no longer in operation were found through searches of files located at the WDNR Bureau of Solid and Hazardous Waste office.

#### Bulk Pesticide Storage and Handling Facilities

Pesticide storage and handling locations that have become a known spill have also been computerized. LMD has digitized 90 locations including the Door County lead/arsenate pesticide mixing sites. An important database that has not yet been attainable is the location of pesticide storage and handling operations where spills have not been reported. It is important that all pesticide storage and handling facility locations be identified regardless of known problems present. Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP) licenses these sites. Unfortunately a list of digital locations with correct addresses is not yet available. These sites are maintained in a system where the facilities name is accurate but the location of many sites are inaccurate because the address of the supplier to the facility has been used instead of the facility address. This list is currently being updated with WDATCP now using GIS to locate licensed pesticide facilities, pesticide mixing and loading areas, agrichemical spills, land spreading sites for agrichemically contaminated soils and similar features.

#### Other Contamination Sources

The following sources: material spills, salt sheds and wastewater lagoons do not have an associative database connected to the source. Material spills were digitized from existing information in the LMD Water Supply office. Often the spill site later became a LUST or ERRP site, thus, it has a database connected with this source. Material spills are collected on a phone-in basis from the public. These are numerous and may have only spilled a negligible amount of substance. It is time and cost prohibitive to locate most of these sites. Often the site location has no actual address location, therefore the correct site is hard to verify. In the future these sites having actual addresses may be located using address matching software.

Wastewater lagoons were located from WDNR Wastewater program files. Often these locations are existing on topographic maps allowing these features to be digitized directly from this source. Whenever the wastewater lagoon did not appear on the topographic map the feature was drawn on the topographic map and subsequently digitized.

Salt sheds were located from printouts obtained from the Wisconsin Department of Military Affairs Division of Emergency Government. This list is numerous because it consisted of all facility types regardless of the size of salt storage containers. A determination was made to gather information on where bulk county highway storage facilities were located and make an attempt at a later date to locate smaller facilities. A database of these sites exist with actual address locations that will enable an excellent chance to locate these facilities with address matching software.

#### LMD Applications and ArcView II

The Lake Michigan District uses this information frequently. Recently GIS has enabled the location of many files to be accessible to anyone with the knowledge of ArcView software. Arcview is a user-friendly software program that brings geographic information to the desktop. It creates the power to visualize, explore, guery and analyze data spatially. LMD has frequently used the district wide information and ArcView to analyze areas where potential for groundwater contamination can occur. Figure 6. is an example where the LMD GIS project enhances the WDNR wellhead vulnerability project to make an assessment on the Village of Birnamwood's vulnerability to contamination. The figure shows where municipal wells have been located and the calculated fixed radius (CFR) buffered around the well. The CFR is a radius specified around a certain well determined by DNR hydrogeologists working on wellhead vulnerability. Leaking underground storage tanks have been identified in this radius. The database that has been joined to the wells and LUST sites have also been extracted and a printout is located in Table 1. Analyzing the figure and table indicates that both wells have a possibility of being downgradient to the LUST sites. Well BG971 is of particular concern because it is a shallow well (35 feet deep) and has a casing depth of 20 feet.

Figure 7 and table 2 depict an example of how GIS can make assessments of areas at different scales. This figure is an area within the Branch River Priority Watershed. The figure locates two villages, Cato and Whitelaw, WI., potential groundwater contamination source information and karst geology. The table contains information about a variety of information on the map. Five abandoned landfills and one active landfill have been located. Two ERRP sites are located within two of the landfills both with a priority of one. Six LUST sites are depicted with two containing a priority score of one and one of these sites is located in the calculated fixed radius of well BG250. Well BG250 has a total depth of 495 feet and terminates in limestone with a casing depth of 130 feet. Fracture traces and other karst features have been identified with a description of the feature attached.

#### Updating and Other Locational Information Improvements

Lake Michigan District has realized the benefits of GIS throughout a variety of district projects. Each county has been digitized in regards to potential groundwater contamination sources. An updating schedule of approximately three month intervals is proposed. The reliable static information such as landfills and salvage yards have been located and only slight modifications will occur to this information. Thus considerable time can be saved with consistent updating of other source information

# Figure 6. Village of Birnamwood Wellhead Vulnerability





### TABLE 1. Village of Birnamwood Wellhead Vulnerability Environmental Summary

#### BIRNAMWOOD LEAKING UNDERGROUND STORAGE TANKS

UNIQUE_ID	SITE_NAME	ADDRESS	LEGAL_CITY	BEGIN_DATE	CLOSE_DATE		
1452	BIRNAMWOOD ELEM. SCHOOL/BUS GARAG	531 MAPLE STREET	BIRNAMWOOD	1993-04-26	_		
673	KERSTEN LUMBER COMPANY, INC.	HIGHWAY 45	BIRNAMWOOD	1990-10-10	1993-07-15		
424	SHAWANO CO HWY DEPT/TLC AUTO BODY	MAIN STREET	BIRNAMWOOD	1990-03-15			
BIRNAMWO	OD MUNICIPAL WELLS						

WINUM	CITY	COUNTY	WELL NUMBER	TOTAL DEPTH	CASING DEPTH	DRIFT	LIMESTONE	SANDSTONE	SHALE	GRANITE
BG970	BIRNAMWOOD	SHAWANO	3	35	20	0- 35				
BG971	BIRNAMWOOD	SHAWANO	4	55	35	0- 55				



## Figure 7. Whitelaw and Cato, WI Environmental Summary

#### TABLE 2. Cato and Whitelaw, WI Environmental Summary

ABANDONED LANDEILLS	

ADAIDONLD LA											
AREA	PERIMETER	LAN_LIST	DISTRICT	COUNTY	FACILITY_NAME	TOWN_CITY	LEGAL_DESC	SITE_ADDRE	ID_NUMBER	STATUS_INF	
124325.8	1417.5	16	LMD	MANITOWOC	FORMRITE TUBE CO./J. BIRKENSTOC	FRANKLIN	NE NW S27 20N 22E		POST-REG	SPEC. ORDER LM	D-88-17
395784.8	2587.375	17	LMD	MANITOWOC	WASTE MGMT. OF WIRIDGEVIEW	FRANKLIN	SW NW S26 20N 22E		2575	INACT 10/86	
185869.2	1724.75	15	LMD	MANITOWOC	LEMBERGER LDFL. (#753)	FRANKLIN	NE SE S27 20N 22E		WID056247208	ERRIS 10-20-83	
143346	1529 718	14	LMD	MANITOWOC	TRANSPORT RECYCLING INC	FRANKLIN	NE NE S34 20N 22E		WID980610364	ERRIS 10-20-83	
39819.02	864.4146	4	LMD	MANITOWOC	VIL WHITELAW	CATO	NW SW S02 19N 22E		513 TEMP	INACT. LOG 2/84	
ACTIVE LANDFIL	LLS										
AREA	PERIMETER	LAN_LIST	DISTRICT	COUNTY	FACILITY_NAME	TOWN_CITY	LEGAL_DESC	SITE_ADDRE	ID_NUMBER	STATUS_INF	
629299.1	4142.031	18	LMD	MANITOWOC	WASTE MGMT OF WIS-RIDGEVIEW LF	FRANKLIN	W NE S26 20N 22E	RT 1	3041	ACTIVE SITE	
ENVIRONMENTA	L REPAIR and RESTORATION SITE										
UNIQUE_ID	SITE_NAME	OTHER	ADDRESS	LEGAL_CITY	COUNTY	PROJ_MGR	BEGIN_DATE	CLOSE_DATE	PRIORITY	SCORE	
112	LEMBERGER FLY ASH LANDFILL			FRANKLIN	36	J. HUFFMAN			1 N	34.49	
113	LEMBERGER TRANSPORT & RECYCLI	LEMBERGER SITES		FRANKLIN	36	J. HUFFMAN			1	35.91	
	COOLIND STODAGE TANKE										
LEAKING UNDER	RGROUND STORAGE TANKS						BEONI DATE		BBIODITY/		
UNIQUE_ID	SITE_NAME			ADDRESS		LEGAL_CITY	BEGIN_DATE	CLOSE_DATE	PRIORITY	SCORE	
1974	GTE NORTH, INC.			383 MENASHA AV	ENUE	WHITELAW	12/05/94		4		
743	SEEFELD PROPERTY - FORMER GAS ST	ſN		13828 U.S. HIGHW	VAY 10	CATO	09/27/90	11/07/94	2		
1544	WDOT - CATO POST OFFICE			13806 U.S. HIGHW	VAY 10	CATO	07/29/93	08/09/94	2		
822	WHITELAW CONV. (FORMER GRALL'S)			138 MENASHA AV	'ENUE	WHITELAW	05/02/91		1	22	
1638	WDOT - PARCEL #15			13835 U.S. HIGHW	VAY 10	TOWN OF CATO	11/04/93	07/22/94	2		
1086	REITMEYER PROPERTY - WDOT			13732 U.S. HIGHV	VAY 10	TOWN OF CATO	12/17/91		1	28	
WPDES - GENER	RAL DISCHARGE (TREATED GROUNDWAT	TER)									
CASE_ID	GW_CASE_NM			CONSULT	CONTAMINANT	GPM	ADDRESS	SURVEY_ID	RECEIVE WATER	ISSUE	COMMENTS
L-1133	George Reitmeyer (Tavern)			ECCI	BZN, TLN, XLN, EBZN, 1,2 DCA, NPLN	3	Comer CTH J & US HWY 10	nw/sw/sec3/t19n/r22e	GW via HWY 10 roadside ditch	7/19/94	air stripping tower
		COLINITY		TOTAL DEPTH		ODIET	IMESTONE	SANDSTONE	SUALE	CRANITE	
DODED		MANUTOWOO	MELL_NO	ADE DEPTH	420	70	405	SANDSTONE	STALE	GROANITE	
BG250	WHITELAW	MANITOWOC	1	495	130	70	490				

DESCRIPTION

 KARST FEATURES

 UNIQUE\_ID
 DE

 62
 Ab

 69
 Po

 77
 Sp

 79
 Po

 83
 Se

 84
 Ab

DESCRIPTION Abandoned well; 75 feet N of Rief Mills Rd.; old wind mill frame with pump assembly at base, pump attached to 4 inch dia. pipe; med. topo Possible filled sinkhole; NE of old shed is 15 x 20 foot depression filled level to surface with rocks; drainage from perimeter and W woodlot evident Spring; W side of exposed bedrock hill and W of driveway is depression supported by rocks; no water flowing W into marshy area on 10-1-94, but centralized flow evident; slab Possible point source; manhole cover with brick-lined manhole below in middle of farm field; tiled inlet observed and possibly connected to cement seep tank on W side of Preston Rd. Seep; 40 foot dia. area containing tall grass and cattalis; owner states that area is always wet and drains into ditch; site was not wet on 10-1-94, Abandoned well; 20 feet S of San Rd.; windmill frame with hand pump connected to 4 inch dia. pipe, cement slab at base; low/med. topo

#### Table 3. Calendar of Updates for Potential Groundwater Contamination Sources.

LMD COUNTY POTENTIAL GROUNDWATER CONTAMINATION SOURCE or RECEPTOR														
	LUST Site	ERRP Site	Municipal Well	OTM Well	Abandoned Landfill	Active Landfill	Salvage Yard	Salt Shed	WPDES Treated GW	WPDES Municipal	WPDES Industrial	Pesticide Storage Handling	Special Well Casing Area	Other Available Layers
Brown Co.	4/25/95	4/25/95	3/30/95	9/30/92	9/30/92	9/30/92	9/30/92	9/30/92	4/24/95	9/30/92	9/30/92	9/30/92	9/30/92	Glacial Geology,
Calumet Co.	4/25/95	4/25/95	3/30/95	5/25/94	5/25/94	5/25/94	5/25/94	5/25/94	4/24/95	5/25/94	5/25/94	5/25/94	5/25/94	Branch River Priority watersned Karst Inventory
Door Co.	9/4/94	9/4/94	3/30/95	9/30/92	9/30/92	9/30/92	9/30/92	9/30/92	4/25/95	9/30/92	9/30/92	9/30/92	9/30/92	Orchards, Karst Inventory, Lead Arsenate Mixing Site
Florence Co.	3/1/95	3/1/95	3/30/95	3/1/95	3/1/95	3/1/95	3/1/95	3/1/95	4/25/95	3/1/95	3/1/95	3/1/95	3/1/95	
Kewaunee Co.	3/1/ <b>95</b>	3/1/95	3/30/95	3/1/95	3/1/95	3/1/95	3/1/95	3/1/95	4/25/95	3/1/95	3/1/95	3/1/95	3/1/95	
Manitowoc Co.	9/4/94	9/4/94	3/30/95	5/25/94	5/25/94	5/25/94	5/25/94	5/25/94	4/26/95	5/25/94	5/25/94	5/25/94	5/25/94	Branch River Priority Watershed Karst Inventory
Marinette Co.	3/1/95	3/1/95	3/30/95	3/1/95	3/1/95	3/1/95	3/1/95	3/1/95	4/26/95	3/1/95	3/1/95	3/1/95	3/1/95	
Oconto Co.	3/1/95	3/1/95	3/30/95	3/1/95	3/1/95	3/1/95	3/1/95	3/1/95	4/26/95	3/1/95	3/1/95	3/1/95	3/1/95	
Outagamie Co.	4/25/95	4/25/95	3/30/95	9/5/93	9/5/93	9/5/93	9/5/93	9/5/93	4/26/95	9/5/93	9/5/93	9/5/93	9/5/93	
Shawano Co.	9/ <b>25/9</b> 4	9/25/94	3/30/95	9/25/94	9/25/94	9/25/94	9/25/94	9/25/94	4/27/95	9/25/94	9/25/94	9/25/94	9/25/94	
Waupaca Co.	9/25/ <b>9</b> 4	9/25/94	3/30/95	9/25/94	9/25/94	9/25/94	9/25/94	9/25/94	4/27/95	9/25/94	9/25/94	9/25/94	9/25/94	Potentiometric Surface Maps
Waushara Co.	5/25/94	5/25/94	3/30/95	5/25/94	5/25/94	5/25/94	5/25/94	5/25/94	4/27/95	5/25/94	5/25/94	5/25/94	5/25/94	Potentiometric Surface Maps
Winnebago Co.	4/25/95	4/25/95	3/30/95	9/5/93	9/5/93	9/5/93	9/5/93	9/5/93	4/27/95	9/5/93	9/5/93	9/5/93	9/5/93	

as it increases over time. LMD records the date that information has been updated (Table 3.). Table 3. tracks all potential groundwater contamination sources digitzed by county and notes the period of last update. Each county will be assigned different updating periods based on the population of the county. Population is a sound method since it usually most directly affects environmental changes. Therefore changes to the tracked information occurs most frequently near large industrial bases. As this data source continually grows LMD requests that information currently unable to be added to this project due to poor location attributes and unreliable formats be structured for relaying and computer entry.

This project tracks information that can be obtained in a relatively short period of time with reliable accuracy. The project authors assert that important information is left off this project because it lacks credible locational information. Individual WDNR environmental and resource programs should require exact site maps be placed into all permit and case reports to aid future updating with precise locations for mapping of all potential groundwater contamination sources. Consultants that submit various reports should be encouraged to include diskettes that supply the information contained in charts and tables and identify the software used. Downloading this information could also be utilized with GIS to further enhance its capabilities with site specific data without the need for an intermediary data entry person.

#### **INHERENT PROBLEMS**

#### <u>Scale</u>

ArcInfo allows the functionality of many different scales, but this can present a problem in the final result. As discussed on page twelve digitized site information can often be more accurate than the base layers it is overlaid upon. Therefore users of GIS produced information must consider scale of the original data when evaluating site specific problems.

#### Equipment Inadequacies

This project originated using an ALR 486 computer with 100 megabytes of hard drive memory and 4 megabytes of RAM. Through a series of upgrades along the course of the project LMD now operates two Compaq 486 computers with 575 megabytes of hard drive and 16 megabytes of RAM. For additional data storage and backup one 150 Iomega Bernoulli machine with four 150 megabyte disks and one 90 Iomega Benoulli machine with seven 90 megabyte disks have also been purchased. Bernoulli disks allow efficient and economical data storage and retrieval. Serious shortcomings occur with the computers RAM memory. Many programs designed use exorbitant amounts of RAM memory. ArcView II allows many data queries to be obtained but its use is severely inhibited on these computers. Response lag time and computer failure are common inconveniences during queries. Other machines in the District commonly have 4 megabytes of RAM. It is recommended that each agency program upgrade or purchase at least one computer that can operate ArcView II efficiently. BIM-GEO recommends for minimum requirements a Pentium-chip computer with a minimum of 32 megabytes of RAM while using ArcView II. Fiscal restraints restrict the purchase of computers with this capability therefore ArcView II and data queries are not used to their full capabilities.

For large size (36x48) hard-copy maps a Hewlett Packard Draftmaster SX/RX pen plotter has been used. This allows a combination of 10 different colors to be utilized. This is many times an insufficient amount of color variation on complex maps. Pen plotters also operate at very slow speeds on intricate maps, which at times may exceed five hours. To alleviate this problem of color and speed the purchase of an inkjet plotter is recommended.

#### FEES

Contamination maps are frequently requested by other government agencies and environmental consulting firms. To recuperate the cost of production of maps LMD should initiate a chargeback policy for the type of request. For example large-scale hard-copy maps could be produced for a charge of \$50.00 for each map. LMD has prepared map compositions of contamination maps for each county in its district. For special maps such as large scale contamination maps of a specific area produced with ArcView the charge could be \$20.00 per map. These maps would contain the site specific identification number of the contamination incident which could then be found in files located throughout the WDNR. However due to fiscal policy cost recovery for map production is not available at the district level. Without the ability to capture the costs of map production it is not possible to support the personnel required to produce the maps. Therefore such maps are not available to fulfill potential public requests. It is also recommended that a dedicated computer terminal be set-up to allow queries to be made on a walk-in basis by the public. This can be set-up to access in a read-only environment where none of the information could be accidently erased or altered. Currently there is nothing like this available for public inquiry. This should eventually become a goal for all WDNR district offices.

#### GIS Activity in LMD

Throughout the progress of this project many requests from other LMD programs about the capabilities of GIS and costs associated with implementation have been fulfilled by this staff. GIS has become increasingly popular in LMD as evidenced by the purchase of additional GPS units and ArcView for LMD programs. The WDNR Water Resources program has begun locating all storet station sites with GPS and have been converting them into GIS. Fisheries has identified all trout streams and regulations pertaining to them through GIS. Numerous projects such as these have brought about the need for funding of GIS at the district level. It is at the district level where local information can be most accurately transferred into GIS with the least chance for error due to communication. With a commitment to GIS at the district an increased level of participation from most programs would be assured. Direct response to questions regarding GIS could be handled and a system of District GIS priorities could also be implemented. In addition response time to ArcInfo and ArcView inquiries would be minimal with personnel funded at the district.

#### **CONCLUSIONS**

The LMD geographic information system has proven to be a benefit to many WDNR programs throughout the district. It has taken information used by various programs, state agencies, county offices, consultants and realtors and conveniently put it on a desktop. However, the district use of GIS has not yet become funded on a permanent basis even though its utility is proven to be paramount to improved operational quality and efficient district function. As WDNR program budgets are revised and the agency is reorganized efforts should be made to permanently fund GIS operations in LMD and to provide avenues to fulfill public inquiries such as public dedicated read-only computer terminals and program recuperation of map production charges.