# Chapter 5: Inventory of Potential Pollution Sources

A wide array of human activities may potentially have an adverse impact on groundwater quality. Examples of such activities include the disposal of municipal and industrial waste, storage of petroleum products, and agricultural practices such as pesticide and fertilizer applications.

Many of the activities and land use practices that can impact groundwater are basic to our way of life; however, adequate safeguards can and should be placed on these practices to minimize detrimental water quality effects. The necessary safeguards may range from minor modifications of existing practices to active regulatory controls and siting requirements.

The key to groundwater protection is prevention, because groundwater pollution is extremely difficult to correct or reverse. Knowing what to emphasize in the prevention of groundwater pollution is important to maximize available financial and human resources. In order to determine this, an inventory of land use trends and potential pollution sources are included as a part of this plan.

## Land Use

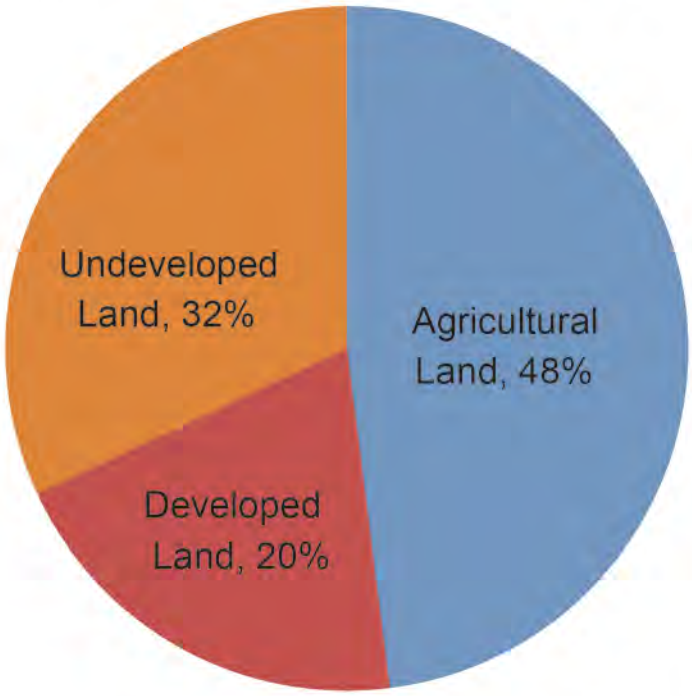
Groundwater quality and consumption can be related to land use patterns. Dense populations in urbanized areas, for example, use large quantities of groundwater, and activities in these areas can pose significant threats to groundwater quality. Such activities include industrial and municipal waste disposal, deicing, storage of petroleum products and other hazardous materials, lawn care, automobile maintenance, etc. In rural areas, less groundwater is used and different threats to groundwater quality exist. Animal waste storage, on-site wastewater disposal, and fertilizer and pesticide applications are the primary potential pollution sources in these areas.

Agriculture is the predominant land use in Dane County (**Reference Map 8 and Figure 30**). In 2010 nearly 50 percent (384,634 acres) of the total area of the county was devoted to crop and pastureland. An additional 32 percent (249,724 acres) was categorized as woodland, water, vacant, or open land). Total developed area in the county comprised about 158,297 acres, or 20 percent of the total area of the county.

**Table 21** summarizes land use by category in Dane County, comparing the results of land use inventories conducted from 1990 to 2010. The figures indicate that the total developed area of the county increased by about 25 percent between 2000 and 2010 at a rate of about 3,124 acres per year. This is almost double the rate for growth compared to the decade of 1990 to 2000 when 1,439 acres per year was developed in Dane County. Residential land use grew by 26 percent between 2000 and 2010, an increase of 12,785 acres. Most of this residential land use increase occurred in cities and villages where public sanitary sewers are available. Although some of the development in towns is served by public sanitary sewers, 1,564 single-family dwelling units with on-site wastewater systems were constructed between 2000 and 2010, totaling 21,916 dwelling units. Between 2000 and 2010 the number of on-site systems in cities and villages decreased by 117, totaling 1183 dwelling units (**Reference Table 23**).[1]

[1] Capital Area Regional Planning Commission. 2013. *Private On-Site Wastewater Treatment* Systems Management. Appendix I of the Dane County Water Quality Plan.

## Figure 30
## Distribution of Land Use in Dane County in 2010




Source: Capital Area Regional Planning Commission

### Table 21: Land Use in Dane County: 1990-2010

| | 1990 | | | 2000 | | | 2010 | | |
|---|---|---|---|---|---|---|---|---|---|
| **Land Use** | acres | % Total | % Dev'd | acres | % Total | % Dev'd | Acres | % Total | % Dev'd |
| Residential | 48,002 | 6.1% | 42.6% | 49,194 | 6.2% | 38.7% | 61,979 | 7.8% | 39.2% |
| Industrial | 5,190 | 0.7% | 4.6% | 7,362 | 0.9% | 5.8% | 7,054 | 0.9% | 4.5% |
| Transportation | 37,418 | 4.8% | 33.2% | 43,842 | 5.5% | 34.5% | 47,286 | 6.0% | 29.9% |
| Communication/ Utilities | 1,515 | 0.2% | 1.3% | 1,778 | 0.2% | 1.4% | 2,232 | 0.3% | 1.4% |
| Commercial Retail | 2,522 | 0.3% | 2.2% | 3,009 | 0.4% | 2.4% | 3,771 | 0.5% | 2.4% |
| Commercial Services | 2,203 | 0.3% | 2.0% | 3,655 | 0.5% | 2.9% | 4,855 | 0.6% | 3.1% |
| Institutional/ Governmental | 4,707 | 0.6% | 4.2% | 5,083 | 0.6% | 4.0% | 5,994 | 0.8% | 3.8% |
| Outdoor Recreation | 11,103 | 1.4% | 9.9% | 13,133 | 1.7% | 10.3% | 25,011 | 3.2% | 15.8% |
| Under Construction | na | na | na | na | na | na | 115 | 0% | .1% |
| Agriculture & Undeveloped | 674,161 | 85.7% | -- | 666,280 | 84% | -- | 634,358 | 80% | 400.7% |
| Total Developed Area | 112,660 | 14.3% | 100% | 127,055 | 16% | 100% | 158,297 | 20% | 100% |
| **Total Area*** | **786,821** | **100**% | -- | **793,335** | **100**% | -- | **792,655** | **100**% | -- |

*Differences in total area results from improved methods and source data
Source: Capital Area Regional Planning Commission

In rural areas, although the number of farms and farmers has been declining, the average farm size has increased. Also, many farmers have switched from dairying and livestock operations to cash crops, especially corn. Cash crop agriculture is concentrated in the eastern and central portions of the county due to the prevailing soils and topography. Dairy and livestock operations are more common in the western, driftless area.

If present trends continue, most of the land in Dane County will remain in agriculture over the next 75 years. Population growth and development will continue in the towns, villages and small cities adjacent to the City of Madison, in the outlying cities and villages, and in Madison itself. Groundwater consumption will increase with population growth, and new development (both urban and rural) may present additional threats to groundwater supplies.

## Dane County Sources

The inventory of potential pollution sources in Dane County is a major element in determining subsequent groundwater protection strategies. The following inventory provides a brief description of each pollution source; a list of common pollutants that result from the source; specific data regarding the pollution source in Dane County; and, in many instances, estimates of the relative significance of the source. Such estimates represent judgments based on the likelihood of groundwater quality degradation and the size of the population that may be at risk. Although general estimates of pollution significance are stated, it should be kept in mind that pollution hazards are site-specific and very dependent on source use. For example, an old, poorly designed landfill containing hazardous chemicals represents a greater groundwater threat than a recently designed sanitary landfill which does not receive hazardous chemicals. Thus, a particular source causing a groundwater quality problem in one area may not be a threat in another. Also, while this inventory lists the major potential sources of groundwater pollution in the county, it is not comprehensive in addressing every possible source.

Ideally in preparing the inventory, information on the location, size, design, etc. for all potential sources of pollution should be available. In reality, data availability varies with each source. Potential pollution sources are presented in the inventory according to their occurrence relative to the land surface, rather than in order of importance (**Table 22**). This was done because the approach in the plan to evaluate groundwater pollution hazards is based upon effects of pollution sources located at the land surface, and below the land surface. This is reflected in the use of groundwater contamination risk maps which are presented later in this report.

## Subsurface Pollution Sources

### Land Disposal of Solid Waste

Solid waste disposal sites are important potential sources of groundwater pollution. Contact between water and refuse in the disposal site and subsequent decomposition produces a polluted liquid called leachate. If not adequately contained and collected, this liquid can seep into the groundwater.

Groundwater pollution hazards are dependent upon the type and amount of leachate produced in waste disposal sites (primarily landfills) and how well leachate is eventually collected and treated. Leachate composition is extremely variable and is a function of refuse composition and volume of water in the landfill. Landfills containing only domestic waste and a minimal amount of water pose a lower pollution risk than landfills having more toxic industrial or commercial chemicals and a greater volume of water. Most landfills in Dane County will produce at least some leachate due to humid climatic conditions. Movement of groundwater, though, is usually very slow, both vertically and laterally. In Dane County,

vertical migration is typically less than 1 foot/year and lateral movement ranges from less than 1 foot to 100 feet/year.[2]

## Table 22

Potential Groundwater Pollution Sources

| Potential Pollution Sources | Waste-Related | | | | Non-Waste | | | |
|---|---|---|---|---|---|---|---|---|
| Place of Origin | Municipal | Industrial | Agricultural | Other | Municipal | Industrial | Agricultural | Other |
| At or near the land surface | Sludge or biosolids landspreading | | Feedlots | Septage landspreading | Roadway deicing | Above and on-the-ground storage of chemicals | | |
| (Use Surface Contamination Risk Map) | | Wastewater irrigation & landspreading | Manure storage & spreading | Junkyards & salvage yards | Salt Piles<br>Snow Piles | Stockpiles<br>Spills | Irrigation<br>Fertilizers<br>Pesticides<br>Silage | Lawn fertilizers, pesticides |
| | | | | | Contaminated Stormwater Infiltration | | | |
| Below the Land Surface | Landfills | | Manure pits | On-site wastewater systems | | Underground tanks | | Improperly constructed & abandoned wells |
| (Use Subsurface Contamination Risk Map) | Wastewater impoundments or infiltration ponds | | | | | Pipelines | | |
| | Sanitary sewers | | | | | | | |

Adapted from: *Groundwater Protection Principles and Alternatives for Rock County, Wisconsin* (1985). A. Zaporozec, editor. Wisconsin Geological and Natural History Survey. Special Report 8.

The problem of solid waste disposal reached enormous proportions in this country in the 1960s. Federal legislation was enacted to charge the states with responsibility for dealing with this problem. As early as 1970 Dane County made a commitment to develop a countywide solid waste management program. This commitment was confirmed when Dane County adopted a comprehensive *Solid Waste Management Plan* in 1976 and opened its first sanitary landfill in 1977. The comprehensive solid waste management plan adopted by the RPC and the County as a specific element of the *Dane County Water Quality Plan*, sets the policy framework for every segment of the solid waste system including storage, collection, transportation processing, recycling, and disposal. In 1980 the *Dane County Solid Waste Plan* was updated and adopted by the Dane County and the RPC. The plan contained significant new information on sanitary landfill siting and recycling. Most of the major proposed programs and recommendations contained in the Solid Waste Plan and its update have been implemented. In 1988 Dane County and the RPC adopted the *Dane County Recycling Plan* as a supplement to the 1980 Solid Waste Plan. Many of the Recycling Plan recommendations have been implemented, promoting recommended strategies of waste reduction, recovery of organic wastes, and waste-to-energy alternatives.

In addition, landfills are now developed according to stricter siting and design standards than those constructed in the past; thus they have less potential for degrading groundwater quality. (Since the 1980s landfills must be lined and equipped with leachate collection systems.) However, many landfills were developed before the stricter regulatory standards were adopted. These older landfills were sometimes located in worked-out sand and gravel pits, or in low-lying wetland areas. Such landfills pose a much greater risk to local groundwater quality than modern sanitary landfills because of poor location and absence of liners or leachate collection systems. As time progresses, leachate can move farther off-site from unprotected landfills. Groundwater monitoring is important to detect the presence and movement of leachate near these landfills to determine if problem areas exist.

[2] Dane County Regional Planning Commission. 1988. *Residual and Solid Waste Disposal.*

Wisconsin's solid waste management program has been in place for over 30 years. In the first two decades of the program, efforts were primarily directed toward licensing existing solid waste facilities; closing poorly located or operated facilities; and ensuring that new solid waste facilities were properly located, designed, constructed, operated, closed, and maintained. During this period, the vast majority of municipal and industrial solid waste generated was landfilled.

In the 1990s, things began to change. Wisconsin's Recycling Law was passed in 1990, with most of the requirements taking effect in 1995. In 1997 NR 538, Wis. Adm. Code was promulgated, facilitating the beneficial use of industrial byproducts. These two milestones resulted in significant and still-increasing quantities of waste being diverted from landfills.

Today, the primary source of information about properties where solid waste has been disposed in Wisconsin is the Solid & Hazardous Waste Information Management System (SHWIMS). This on-line database includes locations and facilities regulated by WDNR's Waste and Materials Management program, including:

- engineered and licensed solid waste disposal facilities;
- older unlicensed waste disposal sites (e.g. town dumps);
- licensed waste transporters;
- hazardous waste generators;
- composting sites, wood-burning sites, waste processing facilities and more.

A casual search of the database indicated over 2,100 businesses or facilities listed in Dane County as either operating or closed.

The Contaminated Lands Environmental Action Network (CLEAN) is an inter-linked system providing information on different contaminated land activities in Wisconsin, to assist with the investigation, cleanup and eventual re-use of those lands.

There are two main ways to view information about contaminated land activities.

- BRRTS on the Web - **http://dnr.wi.gov/botw/SetUpBasicSearchForm.do**
- RR Sites Map - **http://dnr.wi.gov/topic/Brownfields/rrsm.html**

The Bureau for Remediation and Redevelopment Tracking System (BRRTS) on the Web (BOTW) is WDNR's on-line database that provides information about contaminated properties and other activities related to the investigation and cleanup of contaminated soil or groundwater in Wisconsin. The database includes (but is not limited to) the following contamination data:

- Emergency spills
- Investigations and cleanups of contaminated soil and/or groundwater
- Cleanup of sites under the federal Superfund (CERCLA) statute
- Sites where WDNR has determined no cleanup action is required
- Properties identified by street address

The Remediation & Redevelopment (RR) Sites Map is the WDNR's web-based mapping system that also provides information about contaminated properties and associated activities. The RR Sites Map is a spatial view linked to BRRTS through the web.

Either system may be used to find the following information:

- Completed and ongoing investigations and cleanups of contaminated soil and/or groundwater;
- Public registry of sites with residual soil or groundwater contamination, or where continuing obligations have been put in place;
- Liability exemptions and clarifications at contaminated properties (i.e., brownfields); and
- WDNR funding assistance.

Prior to development of on-line databases, WDNR provided public information about old waste disposal facilities in a printed publication called the Historic Registry of Waste Disposal Sites (the "Registry"). The department now provides searchable on-line databases that include this type of information (above). Because some information in the Registry has not yet been reviewed and incorporated into other databases, the agency has posted the Registry spreadsheet on-line: **http://dnr.wi.gov/topic/Landfills/Registry.html**

The Registry of Waste Disposal Sites includes active, inactive, and abandoned sites where solid or hazardous wastes were known, or were likely, to have been disposed. The inclusion of a site on the Registry does not mean that environmental contamination has occurred, is occurring, or will occur in the future. The Registry is intended to serve as a general informational source for the public, and State and local officials, as to the location of waste disposal sites in Wisconsin. For example, while there are only two active licensed landfills in Dane County (WMWI Madison-Prairie and Dane County Rodefeld landfills), there are approximately 200 closed waste disposal sites listed in the Registry. These are displayed on **Map 43** and included in Attachment C.

## On-Site Wastewater Management

The disposal of domestic and commercial wastewater in rural areas outside of urban service areas is handled through the use of individual on-site wastewater disposal systems, primarily septic tanks discharging to subsurface tile disposal fields. The primary pollutants potentially released by on-site wastewater systems include nitrogen, phosphorus, bacteria, viruses, and hazardous materials from septic tank cleaning agents or inappropriate disposal of household chemicals into septic systems. Most of these pollutants are captured and neutralized in the soil; however, even in properly functioning septic systems, some pollutants may leach to the groundwater. For example, where high septic system densities exist, nitrate concentrations in excess of the recommended drinking water standard (10 mg/L) may be present in local groundwater. In Dane County, sufficiently high densities and clusters of residential on-site systems may exist in some rural subdivisions and hamlets which rely on these systems.

Private on-site wastewater treatment systems currently serve over 23,000 households in Dane County. This is about 11 percent of the total 216,022 housing units in the county according to the 2010 Census. It is expected that the number of on-site wastewater systems will increase to over 28,000 by the year 2030 serving about 73,000 people. **Map 44** shows residential on-site wastewater units in Dane County in 2010. **Map 45** shows subdivisions with on-site systems and their location with respect to subsurface contamination risk areas. **Table 23** shows data on the dwelling units in Dane County served by on-site wastewater systems. The five towns of Middleton, Cottage Grove, Bristol, Oregon, and Burke contained over 30 percent of the total number of on-site systems in Dane County in 2010. Onsite systems represent an important segment of the wastewater management and water quality planning programs in the region. Appendix I of the Dane County Water Quality Plan provides more detailed information concerning on-site wastewater management in Dane County, summarized here.[3]

The primary concern regarding on-site wastewater systems is their effect on nitrate levels in groundwater. Excessive nitrate levels in shallow groundwater and private wells are a problem throughout

[3] Capital Area Regional Planning Commission. 2013. *Private* On-Site Wastewater Treatment Systems Management. Appendix I of the Dane County Water Quality Plan.

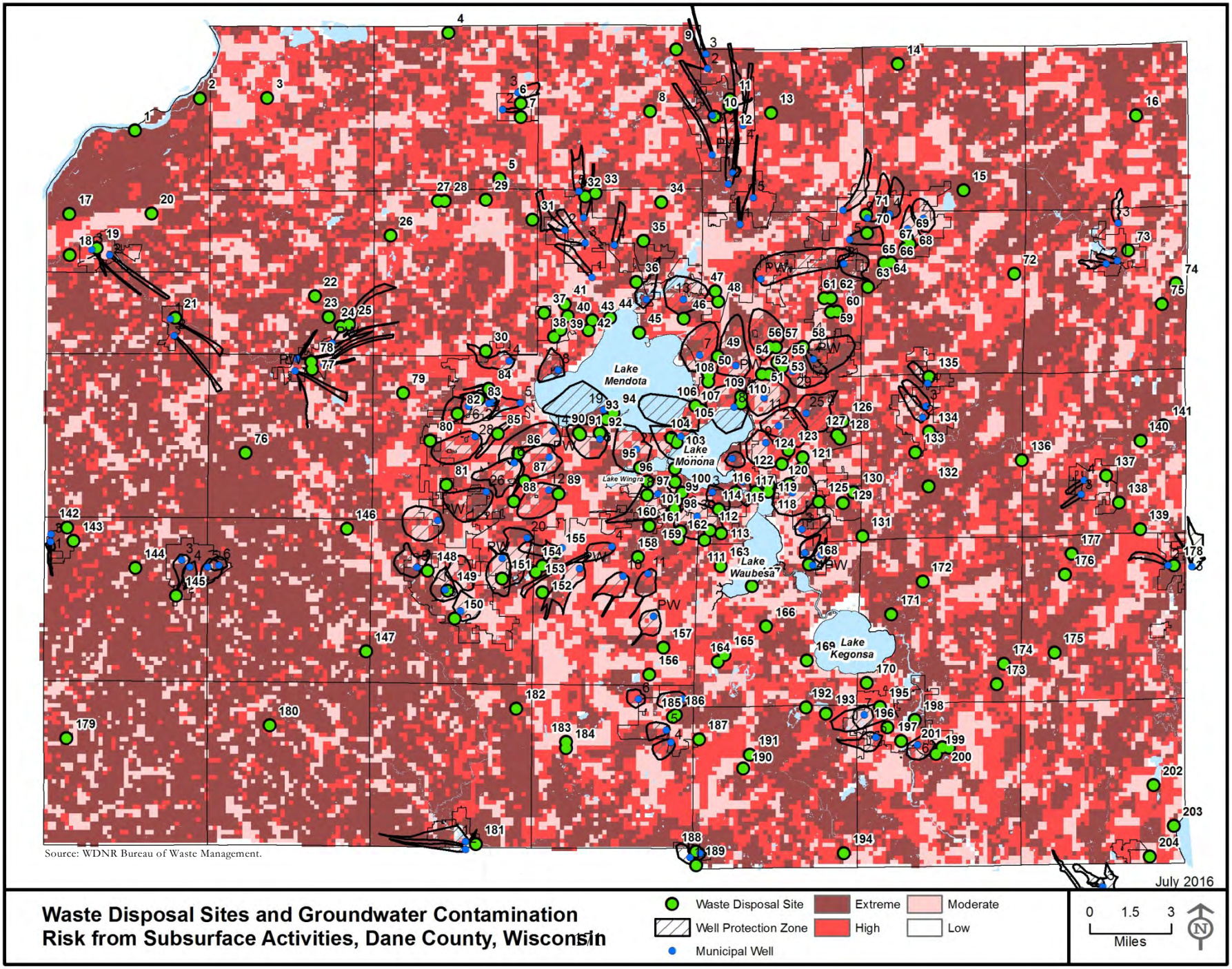
Dane County. A significant percentage (18 percent) of private wells tested in Dane County exceed the 10 mg/L enforcement standard for nitrate in drinking water. An additional 52 percent of private wells tested in Dane County exceed the 2 mg/L preventative action limit for nitrate in drinking water. While nitrate levels in groundwater have generally been increasing over the last half century, there is recent evidence that nitrate levels in groundwater may be decreasing due to nutrient management and other conservation practices being employed.

It is difficult to determine the relative contribution to the nitrate problem from past and present agricultural practices versus on-site wastewater treatment systems. It is not likely that scattered on-site systems contribute significantly to the overall problem, but they can be a source of local nitrate contamination of nearby shallow wells. There is some concern that large on-site systems or clusters of systems (such as in rural subdivisions or hamlets) can, when added to background nitrate levels in groundwater, result in raising nitrate levels in nearby shallow wells to above drinking water standards if the density or loading of on-site systems is too high.

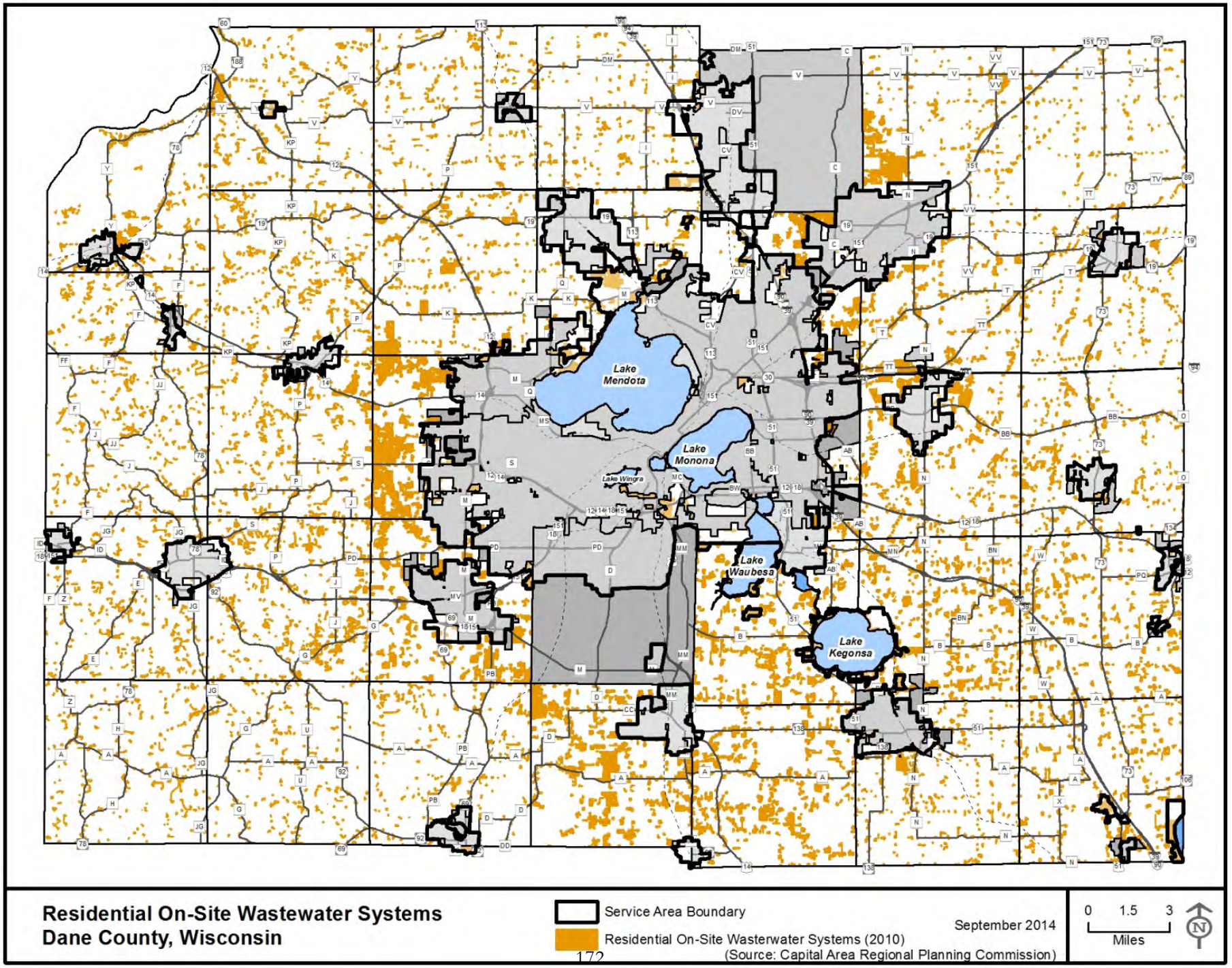
The potential impacts of nitrate contamination resulting from large on-site systems or clusters of on-site systems can be addressed by review and evaluation of specific proposals (permit applications, subdivision plat reviews, etc.) to determine if there is likelihood that waste disposal practices will affect nitrate levels in nearby water supply wells. Because dilution in the groundwater is the primary mechanism of controlling nitrate levels in the groundwater once introduced, it is prudent to evaluate the groundwater impact of proposed development at densities greater than one house per 2 acres. Limited national and state/local information suggests that it is not likely that localized groundwater nitrate contamination will be caused by on-site systems at a lower density than one system per two acres, but that there is a greater potential for contamination where systems exceed a density of one per acre.

Based on this information, the planning of rural subdivisions or developments that include large on-site systems or clusters (more than 20) of on-site systems with an average density of one house per 1-1.5 acres (based on the gross acreage of the development) should include an evaluation to ensure that drinking water supplies are protected. If the evaluation indicates a risk for nitrate levels above 10 mg/L, alternatives such as protected water supplies (well location and depth), utilizing nitrogen-reducing wastewater treatment systems, or community scale water supply and wastewater treatment systems should be explored. The US EPA recommends that private on-site wastewater treatment systems sited in drinking water aquifers or near sensitive aquatic areas incorporate additional nitrogen removal technologies prior to final soil discharge. However, very few of these systems are currently in use in Dane County. The Wisconsin Administrative Code exempts private sewage systems from having to meet groundwater nitrate standards.

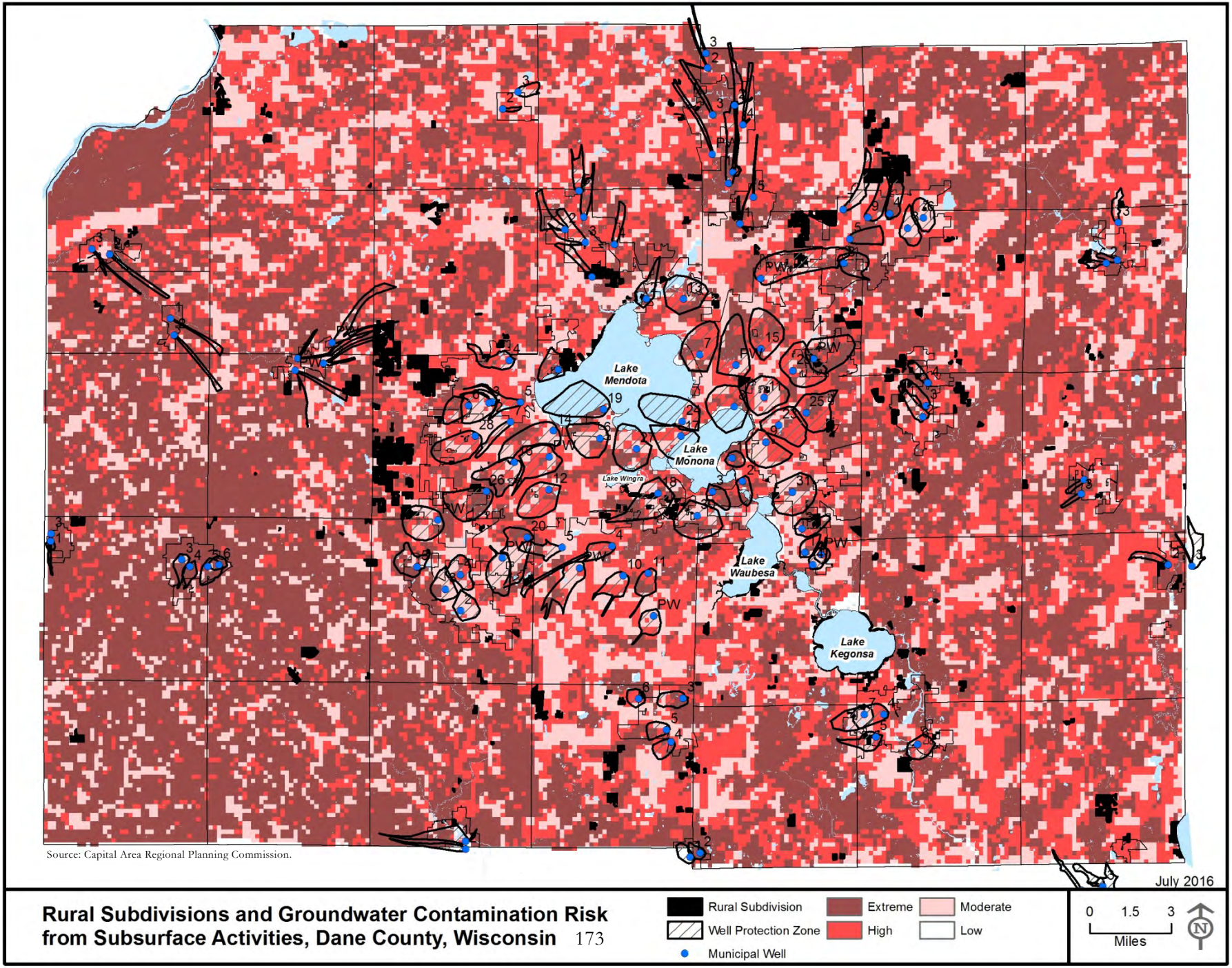
# Map 43


Lake Mendota
Lake Monona
Lake Wingra
Lake Waubesa
Lake Kegonsa
PW
Source: WDNR Bureau of Waste Management.
July 2016
Waste Disposal Sites and Groundwater Contamination Risk from Subsurface Activities, Dane County, Wisconsin
Waste Disposal Site
Well Protection Zone
Municipal Well
Extreme
High
Moderate
Low
0 1.5 3
Miles
N

# Map 44


Lake Mendota
Lake Monona
Lake Wingra
Lake Waubesa
Lake Kegonsa
Residential On-Site Wastewater Systems
Dane County, Wisconsin
Service Area Boundary
Residential On-Site Wasterwater Systems (2010)
(Source: Capital Area Regional Planning Commission)
September 2014
0 1.5 3
Miles
N

# Map 45




**Rural Subdivisions and Groundwater Contamination Risk from Subsurface Activities, Dane County, Wisconsin** 173

## Table 23.
## Dwelling Units with On-Site Wastewater Systems in Dane County

| | 1970 | 1980 | 1990 | 2000 | 2010 |
|---|---|---|---|---|---|
| *Towns* | | | | | |
| Albion | 566 | 503 | 549 | 643 | 493 |
| Berry | 229 | 345 | 365 | 428 | 489 |
| Black Earth | 99 | 132 | 136 | 149 | 205 |
| Blooming Grove | 180 | 350 | 379 | 372 | 375 |
| Blue Mounds | 197 | 229 | 226 | 309 | 321 |
| Bristol | 369 | 518 | 595 | 956 | 1,278 |
| Burke | 476 | 816 | 886 | 968 | 1,130 |
| Christiana | 358 | 393 | 397 | 480 | 486 |
| Cottage Grove | 458 | 910 | 1,120 | 1,473 | 1,433 |
| Cross Plains | 237 | 317 | 416 | 526 | 571 |
| Dane | 196 | 258 | 292 | 371 | 357 |
| Deerfield | 220 | 353 | 371 | 466 | 550 |
| Dunkirk | 605 | 688 | 691 | 738 | 778 |
| Dunn | 1,021 | 1,107 | 678 | 657 | 670 |
| Fitchburg[4] | 876 | 1,063 | | | |
| Madison | 147 | 56 | 45 | 54 | 56 |
| Mazomanie | 235 | 316 | 392 | 493 | 437 |
| Medina | 292 | 334 | 397 | 445 | 492 |
| Middleton | 451 | 786 | 1,142 | 1,593 | 2,063 |
| Montrose | 262 | 343 | 377 | 447 | 436 |
| Oregon | 274 | 559 | 789 | 1,113 | 1,167 |
| Perry | 212 | 206 | 229 | 270 | 280 |
| Pleasant Springs | 580 | 828 | 1,031 | 780 | 851 |
| Primrose | 169 | 207 | 205 | 247 | 281 |
| Roxbury | 280 | 390 | 467 | 547 | 558 |
| Rutland | 336 | 485 | 550 | 700 | 786 |
| Springdale | 308 | 402 | 456 | 584 | 724 |
| Springfield | 459 | 677 | 857 | 1,013 | 943 |
| Sun Prairie | 386 | 583 | 629 | 742 | 839 |
| Vermont | 156 | 229 | 260 | 302 | 331 |
| Verona | 395 | 503 | 529 | 673 | 608 |
| Vienna | 288 | 398 | 422 | 401 | 363 |
| Westport | 538 | 540 | 443 | 395 | 410 |
| Windsor | 376 | 450 | 707 | 749 | 890 |
| York | 194 | 215 | 212 | 268 | 265 |
| Subtotal | 12,425 | 16,489 | 17,240 | 20,352 | 21,916 |
| *Cities and Villages* | 1,009 | 749 | 1,479 | 1,300 | 1,183 |
| | 13,434 | 17,238 | 18,719 | 21,652 | 23,099 |

Sources: 1970 – 1990 US Census data
2000 Estimated from US Census data, DCRPC USA and LSA data, and Department of Public Health Madison & Dane County records
2010 Department of Public Health Madison & Dane County records
[1] The Town of Fitchburg incorporated as a city on April 26, 1983.

The problems and impacts associated with excessive nitrate concentrations near some existing rural subdivisions need to be evaluated and solutions to any significant problems assessed and pursued. The Towns of Bristol, Burke, Middleton and Windsor, in particular, appear to have some significant nitrate contamination issues. Appropriate solutions to the problems can range from on-site improvement or replacement of individual systems to providing centralized sewerage collection and treatment systems, depending on the magnitude and scale of the problem. In other cases, providing a protected water supply may be the best solution.

Many existing on-site wastewater disposal systems were installed before modern wastewater codes were enacted. Some of these older systems may fail or function poorly because of inadequate design and construction standards in effect at the time they were built, unsuitable site conditions, or lack of proper maintenance. Septic systems should be inspected at least every three years and pumped when the tank is 1/3rd full of scum or sludge to prevent clogging and failure. Although proper maintenance and servicing is not costly, it is sometimes postponed or neglected until a serious problem or failure occurs.

Since 1998, Dane County has required periodic evidence of adequate maintenance and servicing for all on-site systems. Revisions to Chapter Comm 83 of the Wisconsin Administrative Code (now SPS 383) in 2000 also required that maintenance plans be submitted with every application for an on-site system. Regular inspection and pumping are the most important aspects of an on-site system maintenance program. SPS 383.54 and Dane County Chapter 46 require all private sewage systems to be inspected at least every 3 years, or more frequently if required for aerobic treatment units or other alternative systems. These changes have dramatically improved system performance, reduced system failures, and increased the prompt replacement of failed systems.

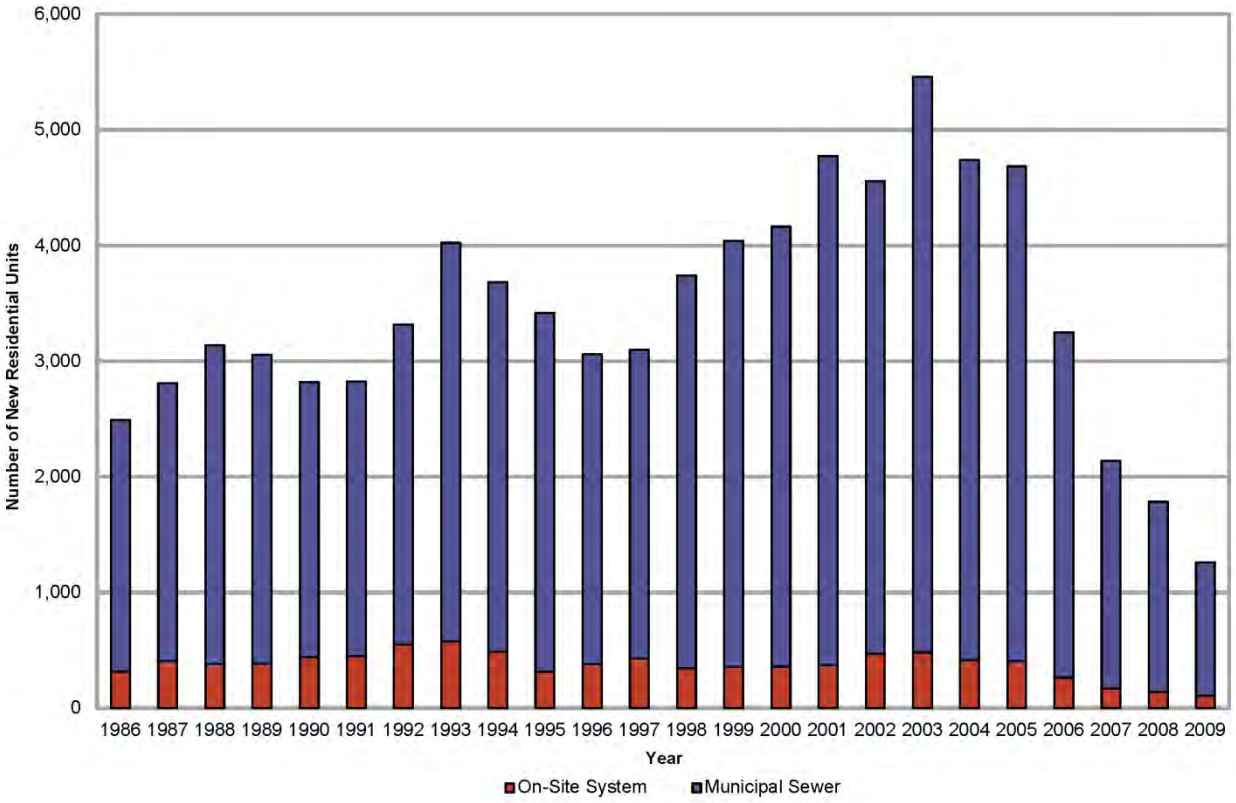
When the revisions to Comm 83 were promulgated in 2000, a major concern of several municipal and environmental groups was that the new regulations would cause an increase in rural development because they allowed alternative technology systems to be used in areas that were previously undevelopable with on-site systems due to restrictive soil conditions. Thus far, however, the data does not substantiate this concern (**Fig 31)**.[5] From 1986 to 2000 the number of new residential units with on-site wastewater systems was 12.9 percent of the total new units on average. Since 2000, it has been 8.5 percent on average.

In general, the current siting, design, construction and maintenance standards for on-site wastewater disposal systems result in systems that are reliable and have minimal environmental impact. Test results suggest that that the nitrate loading from modern subdivisions can actually be equal to or less than the agricultural production activities preceding the development.[6] On-site systems also have the beneficial effect of replenishing groundwater supplies and avoiding the impacts of groundwater pumping and diversion through the sewer system. Other designs, including mound systems, are available to replace failing systems where site conditions do not permit in-ground system replacement.

[5] Capital Area Regional Planning Commission. 2013. *Private* On-Site Wastewater Treatment Systems Management. Appendix I of the Dane County Water Quality Plan.

[6] Bradbury, K. et al. 2005. *Monitoring and Predictive Modeling o f Subdivision Impacts on Groundwater in Wisconsin.*

## Figure 31. Residential Development Trends in Dane County




Current regulations and inspection programs are generally ensuring the level of maintenance and servicing of on-site systems necessary to reduce failures, ensure continued functioning, and provide a long system life. According to the Department of Public Health for Madison & Dane County records, 89 percent of the on-site wastewater treatment systems in Dane County were operating in full compliance in 2010. The majority of those systems issued corrective action notices were due to failure of the owner to submit the required system maintenance reports. Only 14 systems (less than 0.1 percent) were identified with a failure or other maintenance problem requiring system modification. There is a system in place to refer problem property owners to Dane County's Corporation Counsel for legal action if they do not comply with a citation issued by the Department of Public Health.

Daily care in the use of an on-site system also contributes to its proper functioning. Such care would include avoiding the installation of garbage disposals in the house, because they contribute high per capita loads of organic matter and suspended solids (higher than even toilets), and are therefore not suited for use with septic systems. Large inorganic solids and toxic materials should also be kept out of the plumbing system. Local contamination of the groundwater by inappropriate disposal or use of toxic chemicals in septic systems can pose health and environmental threats, especially considering the relatively short distances the pollutants would have to travel to contaminate nearby private wells in rural subdivisions. In addition, water conservation measures such as using dishwashers and washing machines only for full loads, taking shorter showers, fixing leaks in the water system, using front loading washers, low flow or dual flush toilets and water conserving fixtures can all help to reduce the hydraulic load placed on an on- site system. This information should be included as part of an effective public information and education campaign regarding the proper use and maintenance of on-site systems, including emphasis on the vulnerability of groundwater to contamination and the difficulty and expense of restoring drinking water supplies. Information should also be provided which provides guidance for

testing private wells for homeowners concerned about their drinking water quality. Overall, proper siting, appropriate choice of technology, good design and installation practices, and adequate operation and maintenance are crucial in assuring proper treatment of wastewater and the protection of the groundwater from contamination.

**Disposal of Emerging and Unregulated Contaminants**

Water quality contaminants of emerging concern include pharmaceuticals, personal care products, and endocrine disrupting compounds. Research indicates that these contaminants are entering surface and groundwater and may be producing adverse effects on fish and other aquatic organisms.[7] The extent of the threat posed to human health and to the integrity of surface waters and groundwater by the presence of these compounds is not currently known. Several factors account for this lack of knowledge. These categories represent a large number of chemical compounds. The concentrations of most of these compounds in surface waters and groundwater have not been determined. The biological and toxicological effects of many of these compounds on human health have not been characterized, especially at environmentally relevant concentrations and under long-term conditions. Few data are available on the fate of these compounds in the environment. Studies examining the presence of these compounds in the environment and the toxicological properties of these compounds have generally not examined their metabolites and transformation products, which may be biologically active.

In view of the potential risks posed by the release of pharmaceuticals and personal care products into the environment, it would be prudent and protective of human health and the integrity of surface waters and groundwater to reduce inputs of these materials into the environment. Therefore, it is recommended that public informational and educational programs be carried out to encourage the use of the collection sites available for expired and unused medications. The WDNR has issued guidance on regulatory aspects of collecting unwanted household pharmaceuticals. Communities should continue to support the collection of pharmaceuticals through the MedDrop program. Because some of these compounds are considered controlled substances and are strictly regulated by the U.S. Drug Enforcement Administration, such collections require the participation of local law enforcement agencies. In addition, Wisconsin allows some unused cancer and chronic disease drugs and supplies to be donated to participating pharmacies or medical facilities for use by other patients. Rules governing these donations are set forth in Chapter HFS 148 of the *Wisconsin Administrative Code*.

## Wastewater Infiltration Ponds

Infiltration ponds or seepage cells are used at some wastewater treatment plants to absorb treated wastewater, and are often preceded by stabilization lagoons for the settling of solids. Wastewater varies according to water sources, but often contains pollutants such as nitrogen, chlorides, dissolved solids, and oxygen-demanding material. If infiltration ponds are properly sited and operated, many pollutants in the wastewater will be biologically degraded or attenuated while percolating through the ground and pose a limited threat to water quality. The possibility of groundwater pollution exists, however, particularly from nitrogen, chlorides or other pollutants, which are less attenuated by the soil.

Dane County no longer has any municipal wastewater treatment plants discharging to groundwater. The Village of Dane and the unincorporated community of Morrisonville have connected to MMSD, and Roxbury has converted to a surface discharge.

[7] http://dnr.wi.gov/topic/HealthWaste/Pharm.html

## Sanitary Sewers

Recently, viruses and other microbial pathogens have been found in deep municipal wells, challenging previous assumptions about their occurrence. Public water systems that supply groundwater in Wisconsin are not required to disinfect their drinking water (although municipal water utilities in Dane County do). Public and private water samples are also not regularly tested for viruses. Viral testing is expensive and very few labs are capable of conducting the test. The presence of coliform bacteria has historically been used to indicate the water supply is not safe for human consumption. However, virus data complicates this interpretation since the presence of coliform (and other indicators as well) do not always correlate with the presence of human viruses. These indicators have a high positive predictive value but a low negative predictive value for pathogen occurrence. In other words, when an indicator is present in drinking water there is a high probability that particular water source will be contaminated. However, if an indicator is absent, no inferences can be made about pathogen occurrence.

In a novel study, researchers discovered human viruses in the confined aquifer supplying Madison's drinking water.[8] This finding was completely unexpected because it was believed the 3 to 9 meter shale confining layer protected the aquifer from microbial contamination. Water isotope analyses indicated surface water (the Yahara Lakes) to be an unlikely source of viruses. The most likely source of the viruses in the wells was traced to leakage of untreated sewage from the Madison sewer system, which contains a large number of clay pipes installed before 1950. Additional research has shown virus transport from leaking sanitary sewers to the wells can be very rapid, on the order of weeks to months instead of years.[9] The virus transport and contamination levels were particularly high after extreme rainfall events or rapid snowmelt. From a public health standpoint, the lesson learned is that all aquifers are potentially vulnerable to microbial contamination and require a similar level of disinfection for drinking water purposes.

Because sanitary sewers are commonly located near municipal wells and can carry very high numbers of infectious viruses, and very small numbers of infectious viruses in water can constitute a health risk, drinking water wells can be considered vulnerable to fast groundwater flow paths even though they may only contribute a very small amount of virus-laden water to a well. Thus, these results suggest that evaluations of drinking well vulnerability should include low yield-fast transport pathways in wellhead protection – especially in communities that do not disinfect their water supplies.

Until recently, few water utilities or researchers were aware of possible viruses in water from deep wells in Madison. Because of their small size, viruses have a high potential to move deeply through the subsurface environment, penetrate aquitards, and reach confined aquifers. During 2008 and 2009 researchers collected a time series of 26 monthly virus samples from six deep municipal water supply wells in Madison. Viruses were detected in at least eight samples from each of the six municipal wells chosen for long-term sampling, and the percentages of samples testing positive for viruses ranged from 31 to 61 percent. These findings are consistent with previous work and show that even deeply cased municipal wells in confined aquifer settings can be susceptible to pathogen contamination.

It is clear from these results that casing these deep wells across a regional aquitard (such as the Eau Clair formation) does not prevent virus contamination, or even significantly reduce the percentage of virus detections (although the absolute concentrations of viruses were appreciably lower in two of the deeply cased wells, indicating larger casing depth appears to be correlated with lower virus concentrations). In addition, multiple samples from each well tested positive for infectivity, showing that these viruses can represent a public health threat if the water is not disinfected by chlorination or other means. The simultaneous detection of viruses in multiple wells miles apart shows that virus presence cannot be attributed to a single surface source or a single defective well. Instead, these detections suggest widely distributed or multiple virus sources and multiple pathways from the virus source to the wells.

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[8] Borchardt, M. et al. 2007 *Human Enteric Viruses in Groundwater from a Confined Bedrock Aquifer.*

[9] Bradbury, K. 2013. *Source and Transport of Human Enteric Viruses in Deep Municipal Water Supply Wells.*

Virus detections were correlated with recharge events when sewers are often surcharged with water and increased leakage from sewers is very likely. Leakage from urban sewers beneath Madison is the most likely source of the viruses detected in in municipal wells as supported by several lines of evidence. First, the raw sewage carries a very high virus load, and both the physical characteristics of the sewers (age, location) and visual inspections (video logs showing breaks and root invasions) suggest they leak. Second, with one exception, all viruses detected in well water were also detected in untreated sewage. Third, variations in virus serotypes identified in the sewage also appear in well water, with significant temporal correlation. Fourth, the hydraulic gradients beneath Madison are strongly downward, which would transport viruses downward from the near-surface toward the deep aquifer.

One of the most intriguing findings of this work is the temporal variation and correlation between virus serotypes in sewage and groundwater. In several instances an occurrence of a "new" virus in sewage is followed within weeks by detection of the same virus in water produced from municipal wells. The implied transport from the sewers to the wells occurs much more rapidly than previous porous- media calculations or modeling have suggested. Transport along preferential pathways such as fractures or poorly-grouted well casings is required to explain the virus occurrence. If such rapid transport exists, then deeply-cased municipal wells may be much more vulnerable to shallow contamination than previously assumed. By the same token, this work supports the concept of viruses as potentially excellent groundwater tracers. Viruses have the desirable tracer properties of mobility, unique identification and, most importantly, quantification over a broad concentration range. Further research on viruses as tracers is needed.

The high rates of detection of human intestinal viruses in groundwater sampled during this study suggests that exfiltration from sanitary sewers has a significant impact on groundwater quality. Sanitary sewers are a major part of civic infrastructure in urban settings and represent a significant potential source of groundwater contamination. Sewer exfiltration or outward leakage of sewage wastes, represents a potential source of pathogens, toxic chemicals, pharmaceutical compounds and other materials to the subsurface environment.[10] There have been two schools of thought on the significance of sewer exfiltration. Some investigators argue that the overall impact of sewer exfiltration is insignificant due to the small volumes of leakage and to biodegradation and sorption of contaminants in the soil zone.[11] Others believe that exfiltration can be a major source of groundwater contamination. [12, 13] Most studies conclude that the impact of sewage exfiltration on groundwater is quite variable in time and space and there is currently a lack of knowledge about both the quantity of leakage and its consequences for the environment. While similar studies have not been conducted in deep wells in other Wisconsin or Midwestern cities it seems likely that other municipalities might have similar virus occurrences. Many of the viruses detected in this study were shown to be infective. Therefore it is important that municipal water systems using groundwater as a source disinfect the water to deactivate viruses.

## Underground Storage Tanks

Tanks are commonly used for storing various substances such as petroleum, fertilizers, pesticides and industrial chemicals. Petroleum is stored in both aboveground and underground tanks, while fertilizers, pesticides and industrial chemicals are usually stored in aboveground tanks. There are many of these tanks located throughout the county, being particularly common in urban areas. Although aboveground and underground chemical storage tanks are both of concern; underground tanks often represent a greater hazard, since leaks are more difficult to detect and the tanks are located closer to the groundwater table. Leaking underground tanks also have greater potential to contaminate groundwater and threaten municipal and private water supplies.

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[10] Bishop, P. et al. 1998. *Impacts of Sewers on Groundwater Quality.*

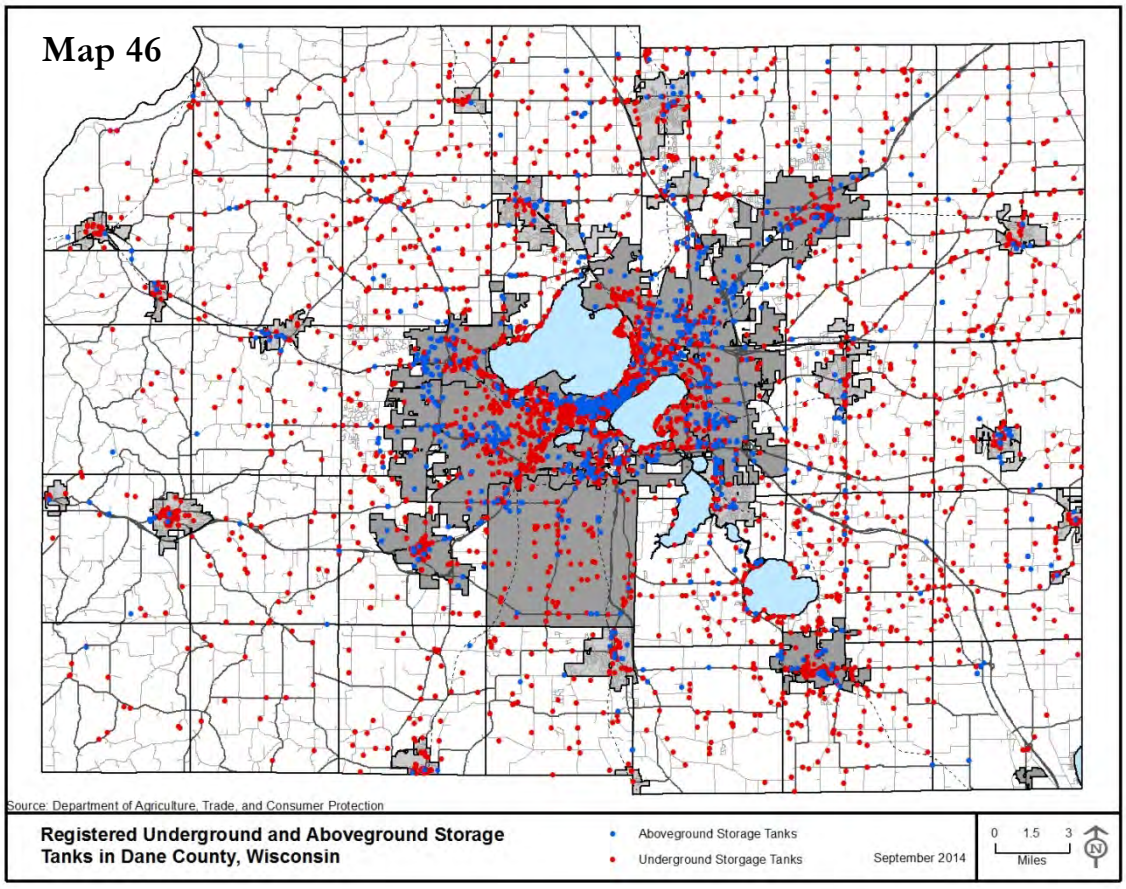
[11] Rutsch, M. et al. 2008. *Towards a Better Understanding of Sewer Exfiltration.*

[12] Wolf, L. et al. 2004. *Impact of Leaky Sewers on Groundwater Quality.*

[13] Osenbrück, K. et al. 2007. *Sources and Transport of Selected Organic Micropollutants in Urban Groundwater Underlying the City of Halle (Saale), Germany*

Wisconsin requires underground storage tanks (USTS) with a capacity of 60 gallons or greater and above ground storage tanks (ASTs) with a capacity of 110 gallons or greater to be registered with DATCP. Exempt tanks include: farm or residential tanks of 1,100 gallons or less; tanks storing heating oil for consumptive use on the premises; septic tanks; and storage tanks situated on or above the floor of underground areas, such as basements and cellars.

DATCP's inventory reveals there are 8597 USTs and 2641 ASTs registered in Dane County. These sites are shown on **Map 47.** The Petroleum Environmental Cleanup Fund Award (PECFA) program was created in the late 1980s in response to enactment of federal regulations requiring release prevention from underground storage tanks and cleanup of existing contamination from those tanks. It is funded by a tax added to all petroleum products sold. PECFA was a reimbursement program returning a portion of incurred remedial cleanup costs to owners of eligible petroleum product systems, including home heating oil systems. However, as of July 20, 2015, no new sites will be accepted into the program.[14] Over $126 million have been spent in Dane County on petroleum cleanup from leaking underground storage tanks.[15]




[14] See http://dnr.wi.gov/topic/brownfields/pecfa.html

[15] Wisconsin Legislative Fiscal Bureau. 2015. *Petroleum Environmental Cleanup Fund Award (PECFA).* Information Paper 66.

As of May 2014, 1319 tanks were identified by the WDNR as leaking. Of this total, 1239 sites have been closed (cleaned up completed) with 80 sites remaining open (cleanup ongoing). These sites are shown on **Map 49** along with other open Remediation and Redevelopment Sites (185 total). **Table 24** shows the Wisconsin LUST program status compared to efforts throughout the U.S. New regulations require existing tank systems to be upgraded. This will help prevent future problems.

**Table 24. LUST Program Status In Wisconsin**

| | |
|---|---|
| Number of active underground storage tanks | 14,284 (national total: 565,956) |
| Number of confirmed releases | 19,442 (national total: 528,521) |
| Number of cleanups completed | 18,400 (national total: 456,660) |
| Number of cleanups in backlog to be completed | 1,042 (national total: 71,861) |

Source: U.S. EPA LUST Performance Measures as of September 30, 2015

However, the 2015-2017 Wisconsin budget does not include any funding for PECFA and effectively sunsets the program for releases after July 2017 and any claims after July 2020. According to the WDNR, any Wisconsin tank owner who has a release in the future will no longer be able to seek assistance from the State to handle the contamination, yet the environmental clean up requirements remain in place. While the Governor's office has stated the program has existed for a sufficient time and that its primary purpose has been completed, the sudden end of the PECFA fund will likely affect individuals and small business owners who lack the resources to respond adequately to a leaking tank on their own.

Underground storage tanks have been associated with several groundwater pollution incidents in Dane County. Volatile organic chemicals (VOCs) have been detected in private wells at various sites where gasoline leaks from underground tanks have occurred. The contaminants most commonly associated with leaks from petroleum underground storage tanks are benzene, toluene, ethyl benzene, and xylene (BTEX compounds). There has also been documentation of other underground tank leaks which have reached the groundwater table, but have not yet impaired drinking water supplies.

DATCP maintains Wisconsin's tank registration database and is responsible for tank regulations for both underground and aboveground tank systems. The Storage Tank Regulation Section is the primary unit responsible for the administration and regulation of Wisconsin Administrative Code ATCP 93 regarding the storage, transfer, and handling of flammable, combustible, and hazardous liquids.
As of July 2013, Wisconsin's regulatory program for cleanup of contamination from petroleum storage tanks is run by the WDNR. The WDNR is responsible for:

- Establishing investigation and remedial action requirements for contamination in the Ch. NR 700, Wis. Adm. Code, series of environmental rules.
- Oversight of cleanups at petroleum tank discharges.
- Wisconsin's fund for reimbursement of environmental cleanup costs (the Petroleum Environmental Cleanup Fund Award (PECFA) – since sunsetted).

When contaminated soil or groundwater is encountered, the first step is to report the contamination to WDNR in accordance with the Spills Law, Chapter 292, Wis. Stats. Property owners or the person who caused the discharge are responsible for reporting contamination, although an environmental consultant may make this report on behalf of the responsible person. The Spills Law applies equally to a recent spill and to an old contamination that has been discovered. If WDNR determines that further investigation is needed, the responsible person will receive a letter from WDNR outlining the requirements.

A private consultant is usually hired to do an environmental investigation and to recommend cleanup options. The cleanup must address the full extent of contamination in soil and groundwater, even if it has gone beyond the property boundaries. The WDNR is responsible for all environmental cleanups in

the state, other than agricultural-related cleanups, which are the jurisdiction of the Department of Agriculture, Trade and Consumer Protection.

The NR 700 rule series governs the process of investigating and cleaning up contamination. The rules allow development of site-specific soil performance standards and the use of natural attenuation for groundwater, which means that the contamination is allowed to naturally break down over time. Chapter NR 140 covers Wisconsin's groundwater standards. Most, but not all, of Wisconsin groundwater standards are the same as federal drinking water standards.

Wisconsin, like most states, may allow some residual contamination to remain after an environmental cleanup. The WDNR ensures long-term protection of public health and the environment in regard to those residuals by establishing continuing obligations in the state's cleanup approval document (closure letter). The most common obligations are obtaining WDNR approval prior to constructing a water supply well and properly treating or disposing of any excavated contaminated soil. Other obligations may include property-specific land use controls, such as maintaining pavement over a specified area of soil contamination. The WDNR adds these properties to an internet database (the Contaminated Lands Environmental Action Network – CLEAN) that advises the public and potential future property owners of these obligations.

CLEAN is an inter-linked system providing information on different contaminated land activities in Wisconsin to assist with the investigation, cleanup and eventual re-use of those lands. There are two main ways to view information about contaminated land activities:

1. **BRRTS[16] on the Web** - (BOTW) is a comprehensive on-line database that provides information on contaminated properties and other activities in Wisconsin. Updated daily. http://dnr.wi.gov/topic/Brownfields/botw.html

2. **RR[17] Sites Map** - RR Sites Map is a web-based mapping system that allows a user to view different layers of contamination data using a Geographic Information System (GIS) tool. Updated on a regular basis. http://dnr.wi.gov/topic/Brownfields/rrsm.html

Much of the BRRTS on the Web information can be viewed via the RR Sites Map.

**Use either system to find:**

- Cleanups still underway
- Cleanups that are completed
- Financial assistance (e.g., WDNR loans and grants)
- Liability incentives (e.g., liability clarifications and limitations)
- Other redevelopment information (i.e., brownfields)
- Continuing obligations (other states/agencies use terms such as "institutional control" or "land use control")
- Documents submitted for cleanups that are completed with residual contamination

[16] Bureau for Remediation and Redevelopment Tracking System
[17] Remediation and Redevelopment

**Use BOTW to find:**

- emergency spills (these are not on RR Sites Map);
- sites where WDNR has determined no cleanup action is required (these sites are not on the RR Sites Map); and
- properties identified by street address.

## Transmission Pipelines

Leaks in petroleum-product transmission lines can also pollute groundwater. Three petroleum pipelines exist in Dane County (**Map 48**). One is the Lakehead Petroleum line (actually two adjacent pipelines) which crosses northeastern Dane County. It carries crude oil from Superior, Wisconsin to Illinois. The second line is operated by the Badger Pipe Line Company, and it transmits refined petroleum products through southeastern Dane County. The third pipeline, operated by Koch Pipelines, Inc. carries petroleum product through northeast Dane County.

No significant leakage problems from these lines have been noted in the county. In early 1987, though, a backhoe struck the Badger pipeline causing about 2,500 gallons of fuel oil to be discharged southeast of Stoughton. The oil did not reach the water table, and remedial actions to remove contaminated soil were taken. Also in 1987, a leak occurred in the Lakehead pipeline near Rio in Columbia County. Over 30,000 gallons of oil were discharged, but nearby well water was not expected to be degraded.

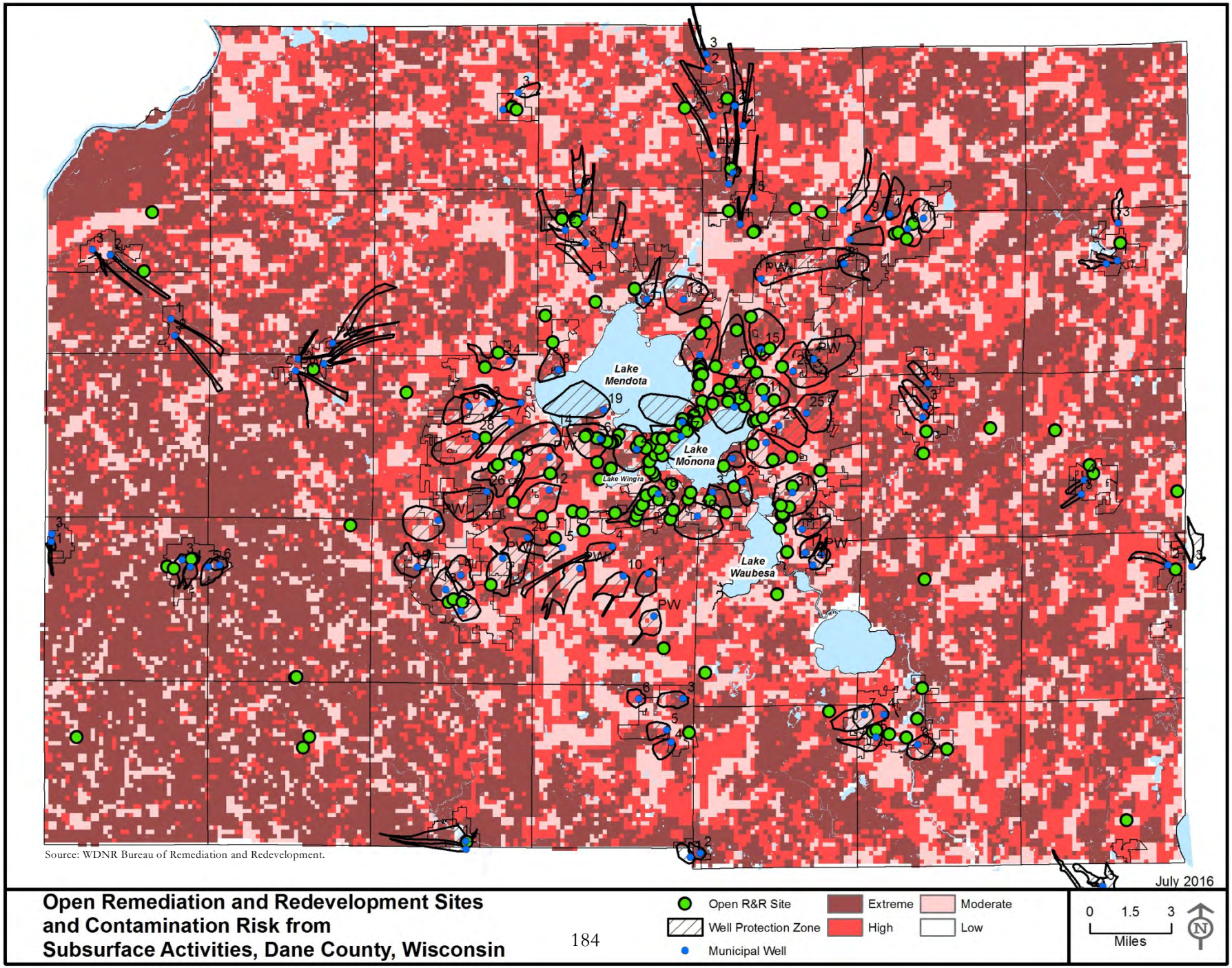
Many natural gas pipelines are present in Dane County; however, these lines are not considered a threat to groundwater quality. In the event of a spill or leak, natural gas would be emitted to the air rather than seep into the groundwater.

## Abandoned and Improperly Constructed Wells

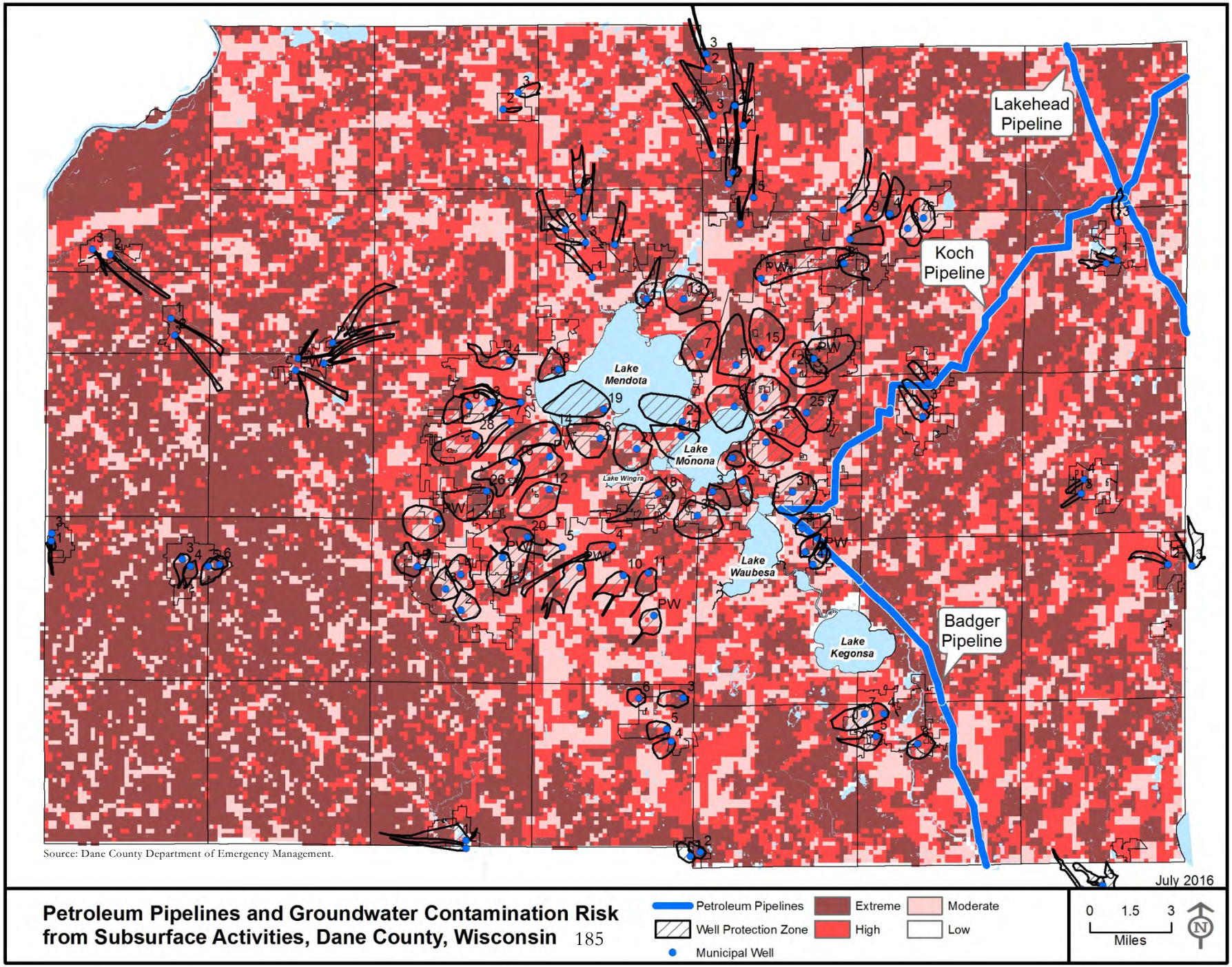
Unused, unsafe, or poorly constructed wells exist in Dane County and pose a threat to groundwater quality. Water wells can act as conduits for contaminants from the land surface to groundwater or from one geologic unit to another. For this reason, wells must be properly constructed, sealed, and maintained, as mandated by the WDNR well code, NR 811 and NR 812. Unused, unsafe, or noncomplying wells represent an unnecessary threat to groundwater, and efforts to ensure that these wells are properly abandoned should be given high priority.

Improperly abandoned wells represent a real threat to groundwater that can be removed at relatively low cost. Dane County ordinance Ch. 45 details the county's well construction and abandonment program. The Department of Public Health for Madison and Dane County (PHMDC) typically issues 60 to 70 abandonment orders each year. Unsafe wells are identified primarily as new wells are constructed through the well site permit review program. Some unsafe or unused wells are identified through complaints and are required to be abandoned as appropriate but many unsafe wells may go undetected. Since June 1, 2008, changes to Wisconsin Statutes require that wells be properly abandoned by a licensed well driller or pump installer.

# Map 47


Lake Mendota
Lake Monona
Lake Wingra
Lake Waubesa
PW
Source: WDNR Bureau of Remediation and Redevelopment.
July 2016
Open Remediation and Redevelopment Sites and Contamination Risk from Subsurface Activities, Dane County, Wisconsin
Open R&R Site
Well Protection Zone
Municipal Well
Extreme
High
Moderate
Low
0 1.5 3
Miles
N

# Map 48


Lakehead Pipeline
Koch Pipeline
Badger Pipeline
Lake Mendota
Lake Monona
Lake Wingra
Lake Waubesa
Lake Kegonsa
PW
Source: Dane County Department of Emergency Management.
July 2016
Petroleum Pipelines and Groundwater Contamination Risk from Subsurface Activities, Dane County, Wisconsin
185
Petroleum Pipelines
Well Protection Zone
Municipal Well
Extreme
High
Moderate
Low
0 1.5 3
Miles
N

# Surface Pollution Sources

## Bulk Storage of Fertilizers and Pesticides

Facilities that store bulk quantities of liquid fertilizers and pesticides present a potential groundwater pollution threat. At the state level, increasing attention is being placed on these facilities due to the large quantity of chemicals that may be released into the environment and documented cases of chemical impacts in nearby wells. Standards for storage containers, secondary containment (i.e., back-up containment for spills and leaks) and maintenance have been established for bulk storage facilities by DATCP. If the proper precautions are taken, the possibility of groundwater pollution can be greatly minimized at these facilities. Chapter ATCP 33, Wis. Adm. Code governs the bulk storage of fertilizer and pesticides. Chapter ATCP 29 contains general rules related to the manufacture, storage, labeling, distribution and use of pesticides. Persons who manufacture, label, distribute or commercially apply pesticides must be licensed by the department.

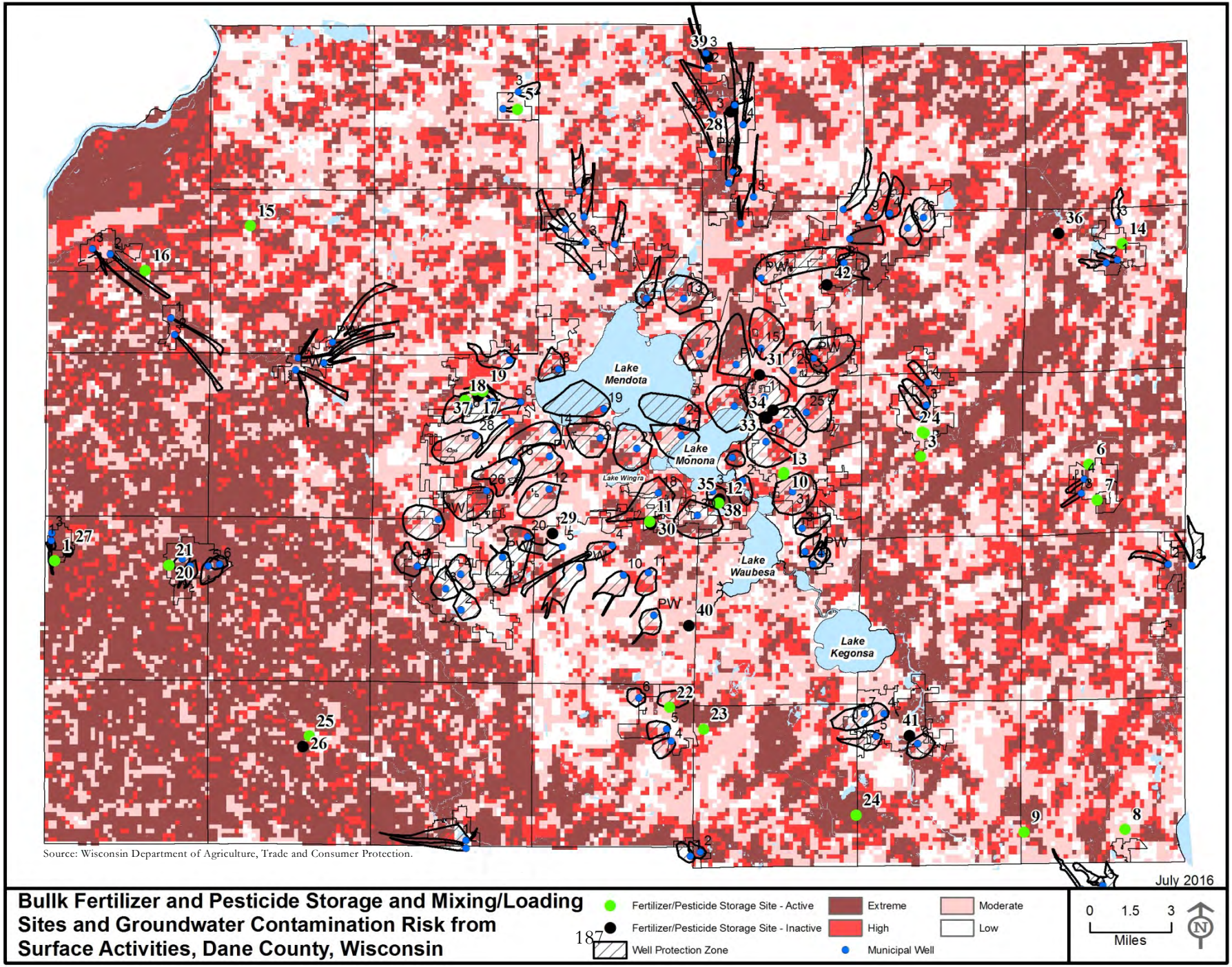
There are 25 active major chemical suppliers in the county (17 additional suppliers no longer active) providing area farmers and businesses with a vast variety of chemicals ranging from non-hazardous solid and liquid fertilizers to anhydrous ammonia and listed extremely hazardous herbicides and insecticides. Their names and locations are displayed on **Map 49** and in **Table 25**.

Agricultural operations are ubiquitous in the county and the potential exists for agricultural chemicals to be in transit between supplier locations and farm sites throughout Dane County at all times. These materials may be found in quantities from 50 pound bags to 1000 gallon anhydrous ammonia tanks. People that are paid to apply pesticides, or those who work for a pesticide application business or farmers who wish to use restricted use pesticides must be certified. DATCP is responsible for administration of the state's pesticide applicator certification and licensing programs. Certification is required to show that individuals can competently apply pesticides and follow regulations; licensing gives individuals the professional credentials to be a pesticide applicator. The department licenses pesticide application businesses, restricted-use pesticide dealers and commercial pesticide applicators. In 2014 there were 1102 commercial, and 616 private certified applicators in Dane County.

In 1991, the DATCP and WDNR published a study on pesticide mixing and loading sites. The agencies investigated 27 randomly chosen agricultural pesticide application businesses across Wisconsin, which ranged from farmers who custom apply pesticides to major facilities that handle and apply very large quantities. The results of the study indicated that soil and groundwater contamination is common at agri-chemical facilities. Soil contamination was found at almost all of the sites, while half of the sites had some groundwater contamination. In most cases, the contamination had not yet reached drinking water wells, but wells in close proximity to the sites were potentially at risk.

In 1993 the Agricultural Chemical Cleanup Program (ACCP) was established to help address these point sources of contamination by reimbursing responsible parties for cleanup costs related to pesticide and fertilizer contamination. The program directs cleanup of pesticide and fertilizer contamination that results from sudden accidental spills (acute spills) as well as small releases that occur through normal handling practices that, over time, can add up to significant contamination (long-term cleanup) of soil or groundwater at a given site. The program helps minimize contamination of surface water, groundwater, and the surrounding environment by ensuring that all agricultural chemical cleanups are conducted effectively and in a timely manner.

# Map 49


Lake Mendota
Lake Monona
Lake Wingra
Lake Waubesa
Lake Kegonsa
Source: Wisconsin Department of Agriculture, Trade and Consumer Protection.
July 2016
Bullk Fertilizer and Pesticide Storage and Mixing/Loading Sites and Groundwater Contamination Risk from Surface Activities, Dane County, Wisconsin
Fertilizer/Pesticide Storage Site - Active
Fertilizer/Pesticide Storage Site - Inactive
Well Protection Zone
Extreme
High
Moderate
Low
Municipal Well
0 1.5 3
Miles
N

## Table 25. Bulk Fertilizer and Pesticide Storage Facilities in Dane County

| Map No. | Facility Name | Status | Address | Community |
|---|---|---|---|---|
| 1 | MIDWESTERN BIOAG PRODUCTS & SERVICES | Active | 10955 BLACKHAWK DR | BLUE MOUNDS |
| 2 | HYDRITE CHEMICAL CO | Active | 150 W DONKLE ST | COTTAGE GROVE |
| 3 | LANDMARK SERVICES COOPERATIVE | Active | 2580 COFFEYTOWN RD | COTTAGE GROVE |
| 4 | LANDMARK SERVICES COOPERATIVE | Active | 126 CLARK ST | COTTAGE GROVE |
| 5 | LANDMARK SERVICES COOPERATIVE | Active | 301 HIGH ST | DANE |
| 6 | K & S KUSTOM SERVICE INC | Active | 928 ZECHZER RD | DEERFIELD |
| 7 | UNITED COOPERATIVE | Active | 841 LONDON RD | DEERFIELD |
| 8 | BLUE RIVER AG SUPPLY LLC | Active | 170 US HIGHWAY 51 | EDGERTON |
| 9 | HELENA CHEMICAL COMPANY | Active | 156 COUNTY ROAD N | EDGERTON |
| 10 | HELENA CHEMICAL COMPANY | Active | 2929 PROGRESS RD | MADISON |
| 11 | NATURESCAPE INC | Active | 3110 WATFORD WAY | MADISON |
| 12 | TRUGREEN LIMITED PARTNERSHIP | Active | 2251 KILGUST RD | MADISON |
| 13 | VITA PLUS CORPORATION | Active | 3019 PROGRESS RD | MADISON |
| 14 | GROWMARK INC | Active | 814 LEWELLEN ST | MARSHALL |
| 15 | GROWMARK INC | Active | 9119 STATE ROAD 19 | MAZOMANIE |
| 16 | PREMIER COOPERATIVE | Active | 10216 US HIGHWAY 14 W | MAZOMANIE |
| 17 | FUTURE RETIREMENT INC | Active | 2211 EAGLE DR | MIDDLETON |
| 18 | MIDDLETON FARMERS COOPERATIVE CO. | Active | 1755 PLEASANT VIEW RD | MIDDLETON |
| 19 | RANDAN AGRISERVICE INC | Active | 2000 DEMING WAY | MIDDLETON |
| 20 | PREMIER COOPERATIVE | Active | 501 W MAIN ST | MT HOREB |
| 21 | WINFIELD SOLUTIONS LLC | Active | 510 W GARFIELD ST | MT HOREB |
| 22 | OREGON FARM CENTER INC | Active | 321 MARKET ST | OREGON |
| 23 | OREGON FARM CENTER INC | Active | 4636 STATE ROAD 138 | OREGON |
| 24 | TITAN PRO SCI INC | Active | 511 DANKS RD | STOUGHTON |
| 25 | HANNA AG LLC | Active | 1100 COUNTY ROAD U | VERONA |
| 26 | HANNA BROS SOIL SERVICE INC | Inactive | 983 COUNTY ROAD U | BELLEVILLE |
| 27 | MIDWESTERN BIOAG PRODUCTS & SERVICES | Inactive | 10851 COUNTY ROAD ID | BLUE MOUNDS |
| 28 | DANCO PRAIRIE FS COOPERATIVE | Inactive | 209 E HOLUM ST | DE FOREST |
| 29 | DOLPHIN SWIMMING POOL COMPANY INC | Inactive | 5256 VERONA RD | FITCHBURG |
| 30 | CHEMLAWN CORPORATION | Inactive | 925 WATSON RD | MADISON |
| 31 | COMSTOCK SEED & FEED COMPANY | Inactive | 3710 COMMERCIAL AVE | MADISON |
| 32 | GROWER SERVICE CORPORATION | Inactive | 537 ATLAS AVE | MADISON |
| 33 | ROYSTER CLARK RESOURCES LLC | Inactive | 902 DEMPSEY RD | MADISON |
| 34 | THERMOGAS COMPANY OF MADISON | Inactive | 700 COTTAGE GROVE RD | MADISON |
| 35 | TRUGREEN LIMITED PARTNERSHIP | Inactive | 2100 INDUSTRIAL DR | MADISON |
| 36 | MARTINS FEED CO INC | Inactive | 1240 MILL ST | MARSHALL |
| 37 | RANDAN AGRISERVICE INC | Inactive | 8309 UNIVERSITY AVE | MIDDLETON |
| 38 | LESCO INC | Inactive | 2300 KILGUST RD | MONONA |
| 39 | HOME FEED INC | Inactive | 7837 MORRISON ST | MORRISONVILLE |
| 40 | DANCO PRAIRIE FS COOPERATIVE | Inactive | 2200 COUNTY ROAD MM | OREGON |
| 41 | DANCO PRAIRIE FS COOPERATIVE | Inactive | 700 E SOUTH ST | STOUGHTON |
| 42 | AGRO DISTRIBUTION LLC | Inactive | 3525 TERRA CT | SUN PRAIRIE |

Source: Wisconsin Department of Agriculture, Trade and Consumer Protection, May 2014.

## Hazardous Waste Storage

Leaks or spills of hazardous waste from storage tanks can be a major groundwater pollution threat. Due to the nature of waste stored, even a small spill could have a tremendous groundwater quality impact if not properly contained. Common hazardous wastes that are stored include solvents, paint and sludge residues. There are only a few facilities which store or transfer hazardous waste in Dane County (**Table 26**). These facilities are closely regulated and licensed by the WDNR.

Facilities which use or store hazardous chemicals in quantities greater than 10,000 pounds or listed extremely hazardous substances in quantities greater than 500 pounds are required to file annual Tier II Hazardous Chemical Inventory Reports with state and local emergency management agencies. In Dane County, approximately 500 facilities report each year. Dane County Emergency Management maintains a listing of these facilities.

A total of 50 hazardous materials spills/incidents occurred in Dane County in the three years between July 1, 2010 to June 30, 2013, the majority of which occurred within the City of Madison. The materials most frequently involved include diesel fuel, agricultural chemicals, gasoline, miscellaneous oils, and solvents. Eight of the reported releases involved extremely hazardous substances. Overall, Dane County has experienced hundreds of hazardous materials incidents of all types in the past. There are currently 645 Hazardous Waste Generators in Dane County. There is a potential for an incident to occur at any time and virtually any place. Dane County Department of Emergency Management and local police and fire personnel are responsible for coordinating and conducting emergency responses to hazardous material spills and incidents.

**Table 26**
**Hazardous Waste Storage/Transfer Facilities**

| Facility Name | Location |
|---|---|
| **1. Hydrite Chemical Co.** | 114 N. Main Street<br>Cottage Grove |
| **2. Budget Lamp Recyclers, Inc.** | 3224 Kingsley Way<br>Madison |
| **3. Hydrite Chemical C. West** | 150 Progress Drive<br>Cottage Grove |
| **4. Madison Environmental Resourcing, Inc.** | 1310 W. Badger Road<br>Madison |
| **5. PKK Lighting, Inc.** | 7182 USH 14<br>Middleton |
| **6. Safety–Kleen Systems, Inc.** | 3715 Lexington Avenue<br>Madison |
| **7. Transwood, Inc.** | 2733 Hwy N<br>Cottage Grove |
| **8. University of Wisconsin – Madison** | 30 East Campus Mall<br>Madison |

Source: Wisconsin Department of Natural Resources, Bureau of Waste Management, May 2015.

## Biosolids Application

Biosolids are organic by-products from municipal wastewater treatment plants. Biosolids are comprised of both water and organic matter, though water is responsible for up to 99 percent of its weight. Biosolids are considered a valuable source of plant nutrients and organic matter for agricultural crops. There are constituents of biosolids, however, which may impact groundwater quality. These can include nitrogen, chloride, pathogenic bacteria and viruses. Hazardous chemicals (e.g., PCBs and pesticides) and metals may also be found in biosolids as a result of concentration and removal in the wastewater treatment process.

Available data from EPA's National Sewage Sludge Survey and from WDNR's database suggests biosolids quality has improved significantly over the last 20 years, particularly with respect to metals. Federal regulations promulgated under 40 CFR Part 503 utilize a comprehensive risk-based approach to identify metal loading limits that are protective of human health and environmental quality. These limits are reflected in state regulations (NR 204), which also includes additional management practices that address such issues as nitrogen management and pathogen control. The EPA National Sewage Sludge Survey also looked at a number of organic compounds and pharmaceuticals. When detected, they were generally found at very low levels. EPA is evaluating the data from this survey to determine whether there is a need to regulate additional potential contaminants.

Biosolids are classified as either Class A or B, based upon how they are managed for three major criteria; namely heavy metal content, pathogen density, and vector attraction (flies, rodents, etc.).[18] Class A biosolids have lower heavy metal levels and no detectable pathogens, making them suitable for horticultural and home use in landscaping, gardens, and lawns. A well known example is the product Milorganite®, a Class A bagged product produced by the Milwaukee Metropolitan Sewerage District since the 1930s, which is distributed nation-wide. Because Class A materials are more expensive to produce, most Wisconsin municipalities produce Class B biosolids that are suitable for application to agricultural land, and can also be used in forestry and other non-agricultural settings.

Class B biosolids are treated to reduce the number of pathogens to a level that significantly reduces the risk to public health. They are handled in bulk and utilized primarily in agriculture as a fertilizer and soil amendment. The risk associated with heavy metals is managed by both adjusting soil pH and the establishment of biosolids metal ceiling concentrations that are somewhat higher than Class A materials or a limit on the lifetime loading of a field of each metal. Fields receiving Class B biosolids must have a soil pH greater than 5.5, which reduces the availability of heavy metals by forming insoluble compounds in the soil. The soil pH of most Wisconsin crop production fields is 6.0 or higher due to liming or calcareous parent material and therefore most fields meet this criterion for application. Municipalities must monitor metal concentrations in their biosolids. Metal levels in domestic wastewater are naturally low, but when the level of a metal increases often from an industrial source, that business may be required to take steps to limit metal discharge to the sewerage system. Applications also must meet numerous site and cropping conditions such as soil depth, slope, and distances from wells, schools, and surface water. The site criteria depend on the method of application (either surface, incorporation by tillage, or injection). Another criterion for limiting the risk of exposure to pathogens in Class B biosolids is the time interval between application and plant harvest. These restrictions effectively direct the majority of Class B biosolids to field crops, with the majority applied for corn production.

Biosolids are commonly landspread as a recycling practice. This permits utilization of the nutrients and organic content of biosolids, reducing the need for chemical fertilizers. The risk of groundwater pollution from landspreading is dependent upon numerous factors, such as its composition and application rate, depth to water, and the physical and chemical soil properties existing at the application site. Site approval and landspreading of biosolids are regulated by the WDNR. WDNR criteria for determining the suitability of a site are based on soil and product pH, soil permeability and available water capacity, slope, depth to bedrock and water table, soil cation exchange capacity, flooding potential and farming practices. In addition, biosolids

[18] Wolkowski, R. and F. Hegeman. 2010. *Land Applying Municipal Biosolids in Wisconsin.* UW. Madison Extension.

application rates are to be in accordance with the nitrogen uptake of crops. This regulatory control helps to minimize the risk of adverse environmental effects. If biosolids are properly applied to suitable sites, the threat of groundwater quality degradation is negligible. Therefore, it is important that biosolids applicators communicate with agricultural producers about the amount of nutrient applied through biosolids so that farmers can account for the nitrogen applied to their fields . This will help avoid the application of unneeded nitrogen through commercial or other organic sources such as manure, which would increase the overall risk of nitrate contamination of groundwater.

MMSD produces a high quality biosolids product which it recycles to agricultural lands through its Metrogro Program. Metals are consistently below the concentrations used by EPA to define an "exceptional quality" biosolid. The District's goal is to diversify its overall biosolids management program by developing a soil-like product called MetroMix. MetroMix will be produced by combining dewatered biosolids with materials such as sand and sawdust to provide bulk and texture. The plan is to upgrade and increase the capacity of the existing solids handling system. It is anticipated that he biosolids produced by the upgraded plant will consistently be of better quality than the current Class B biosolids production. Once fully operational, the plan is to generate 25 percent to Class A quality. This will be reserved for the MetroMix product because the energy cost is very high. It is expected that the land application of Class A and "exceptional" Class B biosolids will have an overall lower impact on water quality than even now.

In Dane County over 45,000 acres of land have been approved by the WDNR for use in the land-spreading of municipal and industrial biosolids. Most of this acreage has been approved for use by the Madison Metropolitan Sewerage District (MMSD), although on an annual basis MMSD only applies biosolids to approximately 4,800 acres. The majority of the MMSD application sites are in the central and south-central part of the county. Approximately 39 million gallons of treated biosolids are recycled each year as part of the MMSD biosolids application program (commonly termed "Metrogro"). Farmer interest in the program is high, with demand exceeding the supply. Many of the other application sites in the county are located near the cities and villages where the product is generated in order to minimize transportation costs. Although the application sites are not shown, most sites fall under the Low to Moderate categories on the Surface Contamination Risk Map.

An analysis of nitrate in shallow wells in the MMSD Service Area associated with Metrogro was conducted in 1993 on the District's behalf by the Department of Civil and Environmental Engineering at UW-Madison. Water samples from about 636 private wells located near biosolids application sites have been collected since 1978. The study included a statistical comparison of background and post-application data from private wells that were sampled as part of the District's monitoring program. It also compared the amount of nitrogen applied by the District through its Metrogro program to the total amount of nitrogen applied to agricultural land in Dane County from traditional commercial fertilizers.

Comparison of background and post-application data indicates that landspreading of biosolids has not adversely affected the water quality of nearby wells. Metrogro applications are based on meeting the nutrient requirements of the crop grown. The annual application rate has been about 725,000 lbs./yr. of available nitrogen between 2008 and 2012. This is roughly three percent of the fertilizer nitrogen applied to corn in Dane County. Any influence on groundwater quality due to the relatively small amount of nitrogen applied as biosolids was found to be negligible in comparison to the much larger effects of commercial fertilizer. Voluntary monitoring is continuing in order to evaluate any possible effects of continued biosolids application.

## Septage Application

Septage is a mixture of sludge, fatty materials, and wastewater pumped from septic tanks, holding tanks, grease traps, and portable toilets. Septage is more concentrated than domestic sewage and must be handled carefully to minimize public health hazards and nuisance problems. When properly managed, however, domestic septage is a valuable soil conditioner. Septage contains nutrients that can reduce reliance on chemical fertilizers for agriculture. A good septage management program recognizes the potential benefits of septage and employs practices to maximize these benefits.[19] One of the goals of the Dane County Water Quality Plan is the practice of returning organic waste to the land for the beneficial reuse of the nutrients. Realizing this objective requires careful management to avoid environmental problems and impacts on ground and surface water quality. Management practices need to be followed to ensure that application operations comply with the standards and regulations while maximizing the beneficial use of the organic wastes.

The most important water quality considerations of managing the land application of septage include:

(1) avoiding groundwater contamination from precipitation infiltrating through the waste into groundwater;
(2) preventing the accumulation or buildup of toxic or hazardous materials in soil, water, or plants; and
(3) avoiding contamination of surface waters from runoff from application sites;

About 26 million gallons of septage is disposed in Dane County annually. Septage is hauled and disposed of both at wastewater treatment plants and at landspreading sites. The proportion of septage that is landspread has continued to decline. Septage disposal at wastewater treatment plants has increased from 9 percent in 1983 to 60 percent in 1994 to about 89 percent in 2013, with the remainder being applied to landspreading sites.

It is important to maximize the benefits of land application of organic materials to the greatest extent possible, rather than looking at land application merely as a disposal technique. This means selecting sites and applications where the benefits of the nutrients and organic materials are utilized to the greatest extent in improving soil fertility and productivity, reducing erosion and also chemical fertilizer use.

State regulations have established standards for licensing disposal sites. The rules in effect since 1997 have specified the allowable slopes, soil permeability, minimum separation distances, and rate and manner of application necessary to protect public health and water quality. In addition, Dane County ordinance prohibits the spreading of septage on frozen or snow-covered ground.

While the regulations for landspreading septage under controlled conditions are sufficient to protect public health and water quality, there is not enough information to determine whether or not the required site conditions and application procedures are being observed. Many of the currently approved septage disposal sites are in close proximity to site conditions that are unsuitable for septage disposal.[20] This underscores the importance of a rigorous monitoring and inspection program for septage disposal sites.

The involvement of County staff in the review and approval of septage landspreading sites would incorporate greater knowledge and familiarity with local site conditions. It would also allow better monitoring and observation of site conditions and landspreading practices. The program should include site location and licensing requirements, application and operating criteria and procedures, surveillance and enforcement procedures, and the revenue necessary to support the program. The use of a geographic information system for record keeping would facilitate the tracking and analysis of the data.

[19] U.S. Environmental Protection Agency. 1994. *Guide to Septage Treatment and Disposal.*
[20] Capital Area Regional Planning Commission. 2013. *Private On-Site Wastewater Treatment Systems Management.*

The Department of Public Health for Madison & Dane County attempted to gain authority from WDNR to regulate septage spreading in Dane County, but their request was denied because the current county ordinance would hold the land owners responsible for any violations on their land rather than the septage hauler. PHMDC is currently working to incorporate the tracking of septage pumping and disposal into its septic maintenance program. This will help PHMDC and WDNR to track spreading activities and identify any potential problems.

Attachment D in *Private On-Site Wastewater Treatment Systems Management*[21] (CARPC 2013) contains maps showing the general location of WDNR approved septage disposal sites and the disposal site location criteria in NR 113. These maps indicate that many of the currently approved septage disposal sites are in close proximity to site conditions that are unsuitable for septage disposal. **Map 50** shows the location of state approved septage sites and surface contamination risk. This underscores the importance of a rigorous monitoring and inspection program for septage disposal sites. While most haulers conduct landspreading operations conscientiously and with due regard to safe disposal, management measures need to be adopted to ensure that disposal operations follow the standards and regulations.

**Table 27** shows the acreage of state licensed septage disposal land area by township in Dane County for 1997 and 2010. The total amount of land approved for septage disposal in Dane County has decreased by almost two-thirds from 5,848 acres to 2,080 acres. This is most likely due to the more stringent land disposal criteria adopted in NR 113 and in effect since 1997, as well as the ability of haulers to more easily dispose of septage at municipal wastewater treatment plants. The proportion of septage disposed at wastewater treatment plants has continued to increase. In 1983 it was only 9 percent. By 1994 it had grown to 60 percent. It is currently estimated to be 89 percent, based on WDNR and wastewater treatment plant records.[22]

**Figure 32** shows a 15-year record of the annual septage received at MMSD by type. Septage disposal at MMSD has more than doubled between 2000 and 2010, from about 9.6 million gallons to 22.5 million gallons. The majority of this increase is from septic tanks and holding tanks. Septic tank septage disposal has increased from about 1.2 million gallons in 2000 to 7.2 million gallons in 2010. Holding tank septage disposal has increased from 7.8 million gallons in 2000 to 14.4 million gallons in 2010.

The increase in septage disposal at MMSD, and at wastewater treatment plants in general, has been due to a number of factors including: an increase in the number of private on-site wastewater treatment systems, more frequent inspection and pumping requirements for on-site systems, increased standards and regulations for landspreading sites, and Dane County's prohibition on the spreading of septage on frozen or snow covered ground. These factors along with the relatively easy availability of wastewater treatment plants that accept septage at reasonable rates is expected to continue to favor septage disposal at treatment plants in the coming years. In support of this, additional septage receiving sites should be explored at the Belleville, Cross Plains, Stoughton, and Sun Prairie wastewater treatment plants, which do not currently accept septage.

[21] https://danedocs.countyofdane.com/webdocs/PDF/capd/2013_postings/Publications/Water_Quality_Plan_I_web_08.08.13.pdf CARPC, 2013.

[22] Capital Area Regional Planning Commission. 2013. *Private On-Site Wastewater Treatment Systems Management.*

# Map 50

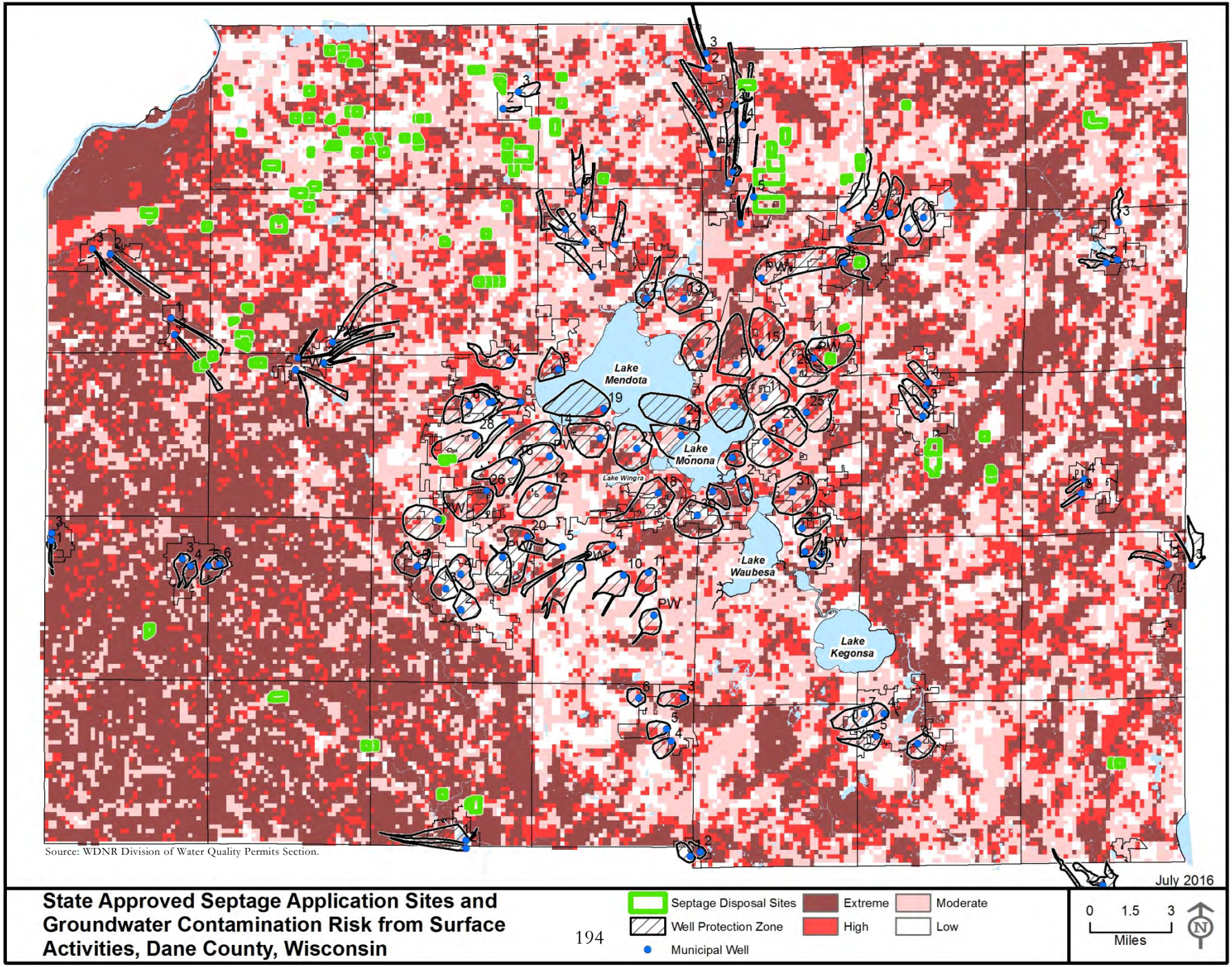
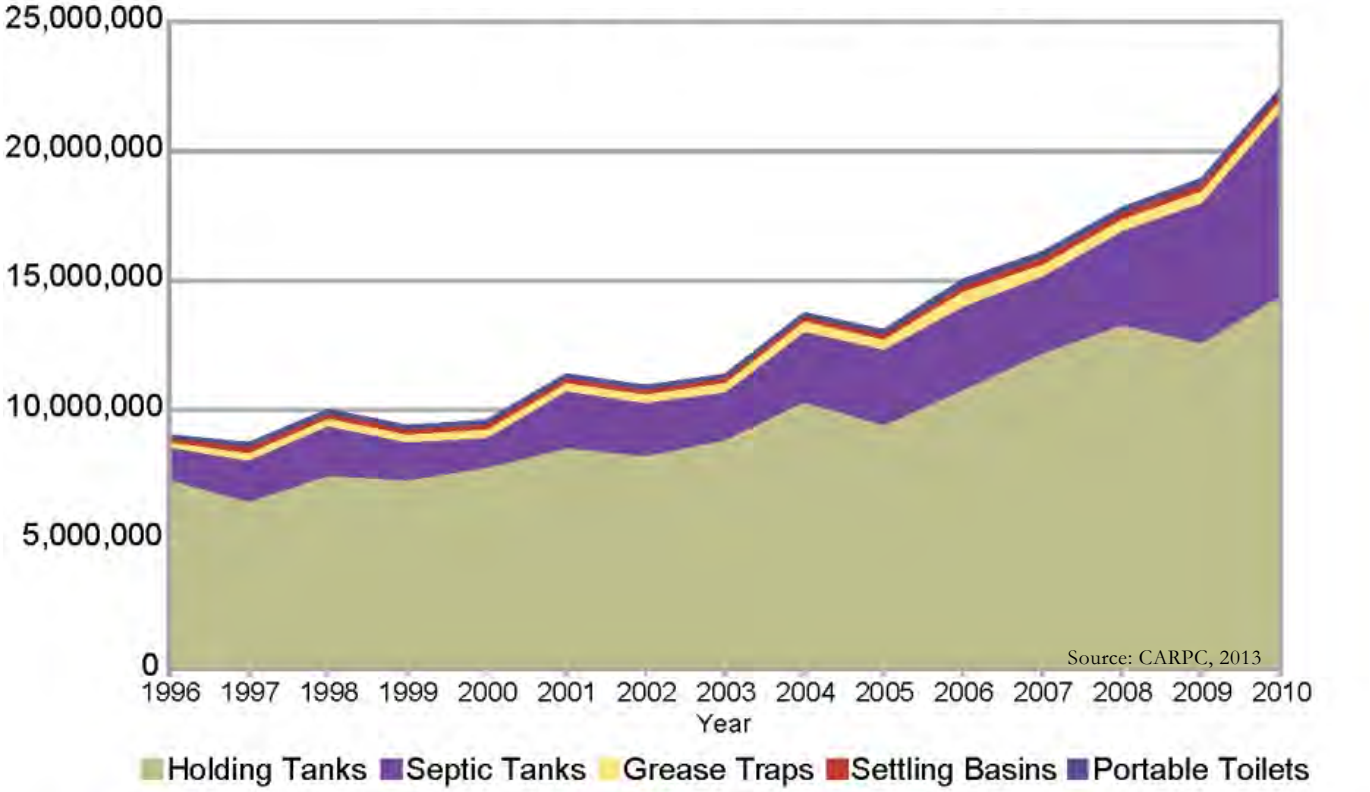

Lake Mendota
Lake Monona
Lake Wingra
Lake Waubesa
Lake Kegonsa
PW
Source: WDNR Division of Water Quality Permits Section.
July 2016
State Approved Septage Application Sites and Groundwater Contamination Risk from Surface Activities, Dane County, Wisconsin
Septage Disposal Sites
Well Protection Zone
Municipal Well
Extreme
High
Moderate
Low
0 1.5 3
Miles
N

**TABLE 27**
**LAND AREA APPROVED FOR SEPTAGE DISPOSAL BY TOWNSHIP**

| Township | 1997 (acres) | 2010 (acres) |
|---|---|---|
| Albion | 0 | 30 |
| Berry | 580 | 39 |
| Black Earth | 0 | 0 |
| Blooming Grove | 0 | 0 |
| Blue Mounds | 165 | 50 |
| Bristol | 431 | 10 |
| Burke | 442 | 101 |
| Christiana | 0 | 0 |
| Cottage Grove | 359 | 344 |
| Cross Plains | 190 | 68 |
| Dane | 103 | 306 |
| Deerfield | 65 | 0 |
| Dunkirk | 547 | 0 |
| Dunn | 0 | 0 |
| Madison | 0 | 0 |
| Mazomanie | 447 | 63 |
| Medina | 0 | 0 |
| Middleton | 180 | 30 |
| Montrose | 100 | 150 |
| Oregon | 0 | 0 |
| Perry | 15 | 0 |
| Pleasant Springs | 30 | 0 |
| Primrose | 35 | 52 |
| Roxbury | 167 | 203 |
| Rutland | 100 | 0 |
| Springdale | 0 | 0 |
| Springfield | 817 | 91 |
| Sun Prairie | 190 | 0 |
| Vermont | 0 | 17 |
| Verona | 0 | 17 |
| Vienna | 26 | 113 |
| Westport | 272 | 0 |
| Windsor | 543 | 352 |
| York | 44 | 44 |
| **TOTAL** | **5,848** | **2,080** |

Source: WDNR Records

## Figure 32
## Septage Received at MMSD



## Wastewater Irrigation and Landspreading

Only a few industries in Dane County discharge processed wastewater to the land surface (**Table 28**). If these land application systems are properly sited and proper application rates adhered to, the pollutants in the discharge will be attenuated in the soil. Currently these discharges do not represent serious sources of groundwater pollution in Dane County, and are regulated under the Wisconsin Pollutant Discharge Elimination System (WPDES) program. In addition, CARPC staff provide review and comments on proposed permits to better avoid adverse impacts. Wastewater permits contain all the monitoring requirements, special reports, and compliance schedules appropriate to the facility in question. Permits are issued for a five year term.

### Table 28
### Industrial Surface Wastewater Discharges to Groundwater

| Permit Holder | Receiving Water/Watershed | Description | Type of Discharge |
|---|---|---|---|
| Bailey Farms (Karem Inc.)<br>549 Karem Drive, Marshall, WI<br>WPDES Permit #WI-0046400-03-0 | Groundwaters of the Upper Rock River Basin | Processes cattle for various byproducts including hides and ground bones. | Landspread |
| Clear Horizons Dane LLC<br>6307 Cuba Valley Road, Dane, WI<br>WPDES Permit #WI-0064530-01-0 | Groundwaters of the Six Mile/Pheasant Branch Creek watershed | Three waste digesters to digest manure from local farms and a food processing substrate. | Landspread |
| Dairyfood USA Inc.<br>2819 CTH F, Blue Mounds, WI<br>WPDES Permit #WI-0046400 | Groundwaters of the Pecatonica River Basin | Cheese processing water | Landspread |
| GL Dairy Biogas LLC .<br>1900 S. Ave LaCrosse, WI<br>WPDES Permit #WI-0065099-01-0 | Groundwaters of Pheasant Branch Creek | Manure digestate | Landspread |
| MG&E Compensatory Recharge<br>4635 Odana Road, Madison, WI<br>WPDES Permit #WI-0063088-02-0 | Groundwaters of the Lower Rock River Basin | Filtered pond water | Concentrated infiltration |
| WI DNR - CWD Processing Facility<br>4738 Hwy 78, Black Earth, WI<br>WPDES Permit #WI-0063452 | Landspreading sites in the Lower Wisconsin River Basin | Wash water and sludge from equipment cleaning | Landspread |

Source: Wisconsin Department of Natural Resources 2015.

## Irrigation

Irrigation is generally not considered a direct source of groundwater pollution, but it can facilitate leaching of fertilizers or pesticides, whether these are applied directly to crops or through the irrigation system. High capacity irrigation wells, (pumping more than 70 gals./min) are regulated by WDNR. Back-siphoning valves are required on irrigation systems where fertilizers and pesticides are applied through the system. These valves are to be inspected annually.

Although direct groundwater contamination may occur from the malfunction of back-siphoning valves, which can allow backflow of chemicals to the irrigation well, in Dane County few farmers apply pesticides or fertilizers through irrigation systems. Thus back-siphoning failures do not represent a major groundwater quality threat.

## Manure Storage and Landspreading

Manure (livestock waste) is a potential source of groundwater pollution. Inadequately controlled animal feedlots, unconfined manure stacks, unlined manure pits and improper manure spreading are the main sources of livestock pollution of groundwater. Primary pollutants from this waste include nitrates, chlorides and pathogenic organisms.

The potential for pollution from manure may be highest during wet or snowy weather conditions. During these times, farmers who normally spread their manure daily may store it in temporary stacks without adequate protection. Precipitation may then leach nutrients and bacteria from the manure into the groundwater. A properly designed and managed manure storage facility reduces the potential for causing groundwater pollution.

### Manure Storage

Manure stored or disposed of improperly can seriously affect surface and groundwater. For example, many farm operators do not have adequate manure storage facilities. During the winter months, many farms pile waste until spreading it prior to spring cultivation. Rainfall and snowmelt on unprotected manure stacks can generate runoff that degrades groundwater quality. Potential pollutants from manure include nitrates, chlorides, bacteria, oxygen-demanding materials and phosphorus.

An inventory of manure storage facilities in Dane County has been prepared by the Land Conservation Department (DCLCD), **Map 51.** This effort is associated with the nonpoint source pollution abatement projects conducted by the RPC and DCLCD (e.g., Sixmile–Pheasant Branch, Black Earth Creek, Yahara–Monona, Yahara–Mendota, and Dunlap Creek priority watershed projects), and recently expanded to the rest of the county.

In general, areas in northern and southwestern Dane County are believed to have the greatest number of animal units per square mile. As a result, these areas probably have the greatest concentrations of manure. Both the Surface and Subsurface Contamination Risk Maps were viewed to determine pollutant attenuation and contamination risk for these areas. From the Surface Map, areas in northern Dane County are generally low to moderate risk, while the unglaciated areas of southwestern Dane County present extreme risk conditions. On a large-scale basis, the unglaciated area may be most critical in terms of groundwater pollution due to high animal waste production and more marginal pollutant attenuation conditions, largely the result of thin soils and shallow depths to bedrock.

Also, by comparing the Surface and Subsurface Contamination Risk Maps, the attenuation capacity of the soils in the northern portions of the county appears to be a critical factor between moderate or low risk conditions of surface storage, compared with the largely high or extreme contamination risk associated with manure pits.

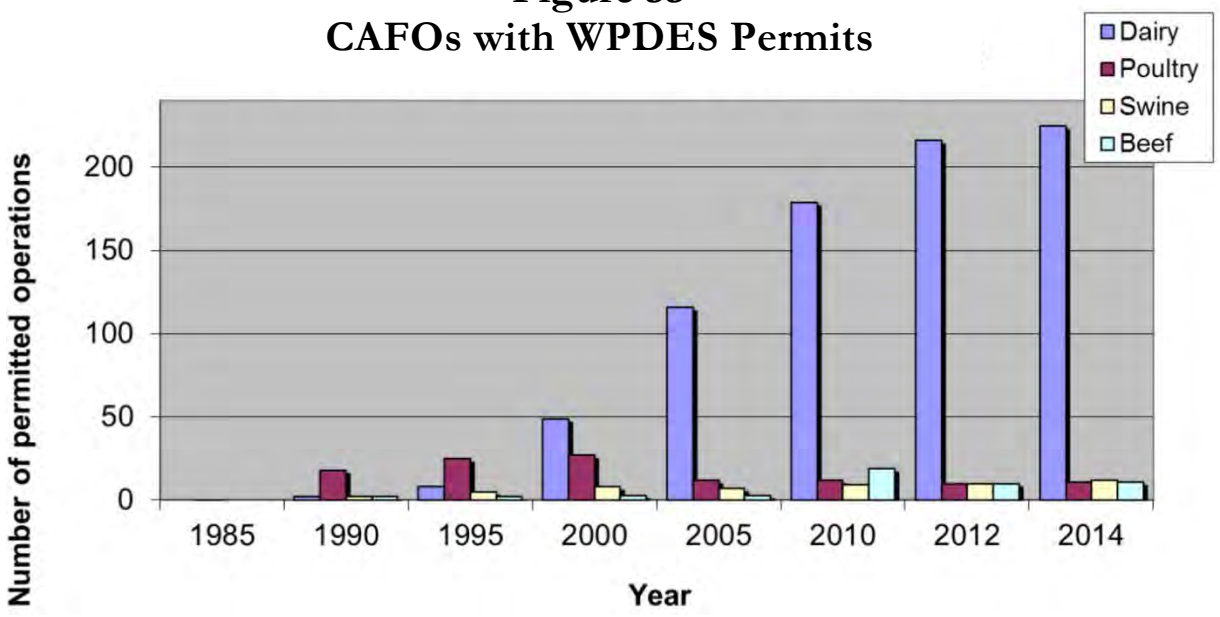
Although regional evaluations are helpful in defining target areas in the county, site-specific factors are most important in determining the threat of groundwater pollution from animal waste. Improperly designed and managed waste storage facilities have the greatest potential for causing groundwater pollution.

## Concentrated Animal Feeding Operations (CAFOs)

Feedlots are outdoor areas where animals are concentrated for feeding and other farm management purposes. For large animal feedlots (greater than 1,000 animal units) and smaller operations where pollution problems have been documented, the WDNR requires farm operators to obtain a WPDES permit. In addition, CARPC staff provides review and comments on proposed permits to better avoid adverse impacts. There are presently 14 farm operations in Dane County that are permitted due to their size (**Map 52**). In 1987 there was one. An overall increasing concentration of livestock in feedlot areas has been occurring in Dane County and Wisconsin overall (**Figure 33**).

Manure production is estimated to be near two million tons per year. Not only is this a large amount of animal waste produced, it is also high relative to most other counties in Wisconsin. Increasing herd sizes may result in additional manure management and associated groundwater quality problems. Water quality protection from large animal feedlots, and manure storage and disposal practices, therefore, should continue to receive state and local emphasis.

**Figure 33**
**CAFOs with WPDES Permits**




Source: Wisconsin DNR

### Landspreading of Manure

Manure is commonly spread on cropland as a fertilizer. Land application of manure on shallow soils (less than 20 inches over bedrock) represents a major groundwater hazard due to the ease of pollutant leaching. There are four soil series in the county that are less than 20 inches over bedrock: Dunbarton, Edmund, Elkmound, and Sogn. Manure applications on these soils (representing 10 percent of the land area in the county) should be avoided. Spreading of manure should also be limited on highly permeable soils and where a high water table exists.

If manure is applied on cropland in conjunction with commercial fertilizers, care should be given so as not to exceed crop nitrogen needs and induce nitrate-nitrogen leaching. In addition, precautions should be taken to avoid manure application near wells. If well casings are corroded or improperly grouted, groundwater quality can be degraded from pollutants transported by surface runoff

## Fertilizer Application

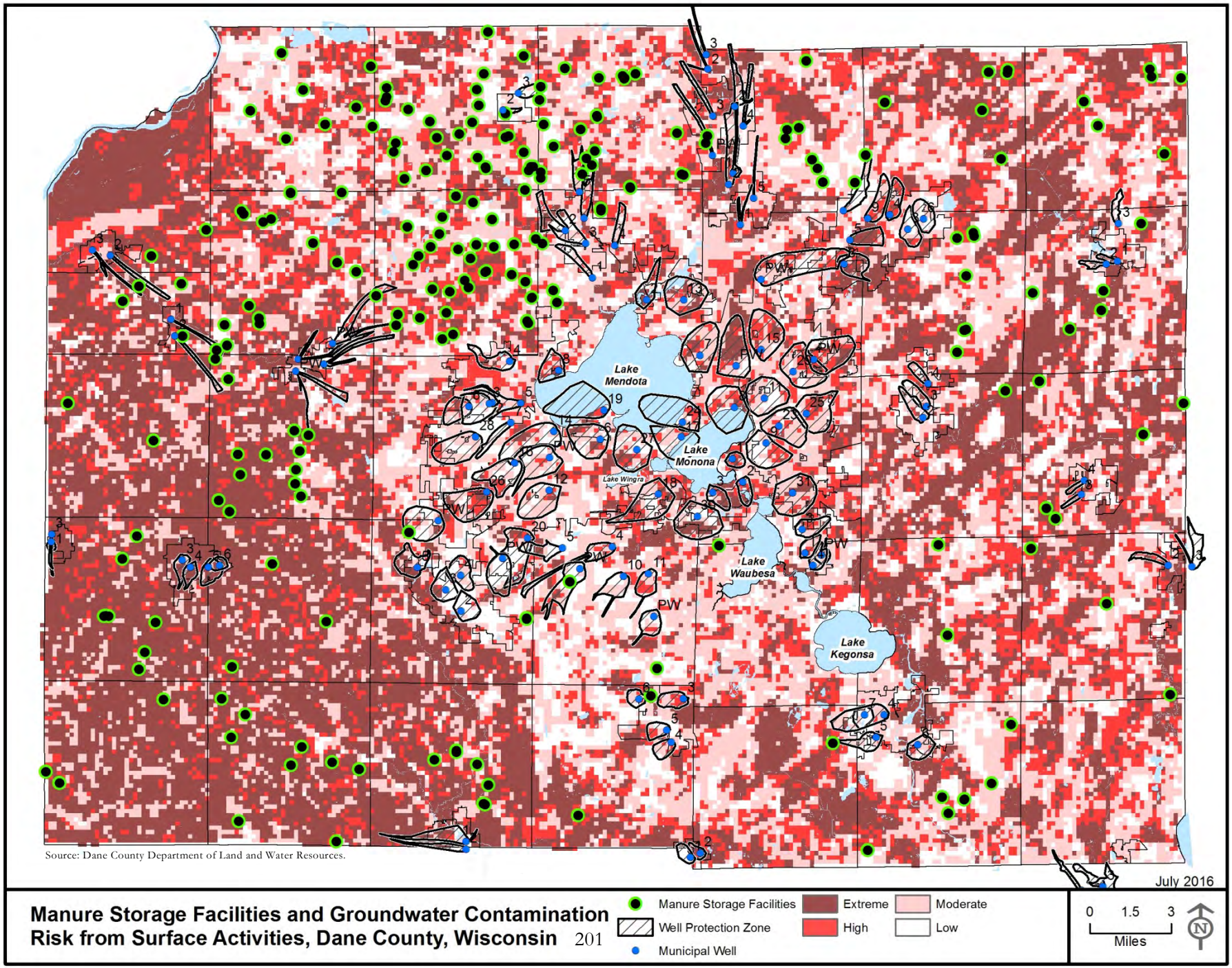
Chemical fertilizers are used to supply plant nutrients for agricultural crops and for urban land uses such as golf courses, lawns, and gardens. The agricultural sector, though, accounts for most fertilizer use. The primary nutrient from fertilizer that may impact groundwater quality is nitrogen. When a nitrogen fertilizer is applied to the soil, it may be oxidized to the nitrate form, which can easily leach through the soil to the groundwater. In Dane County, over-application of nitrogen fertilizer has been associated with elevated nitrate-nitrogen levels in shallow groundwater. High levels of nitrate-nitrogen in groundwater used for drinking purposes represent a human health concern for infants under age six months.

The greatest quantity of nitrogen fertilizer is applied to corn crops in Dane County, and this practice potentially has the most widespread impact on groundwater quality. Lawns, gardens, and other agricultural crops, such as tobacco, also receive nitrogen fertilizer; however, their acreage in the county is much less extensive than that of corn. Groundwater quality impacts from these areas should be localized and over-application is a concern. Lawn fertilizers have also been shown to be a source of nitrogen that can be leached to the groundwater table.

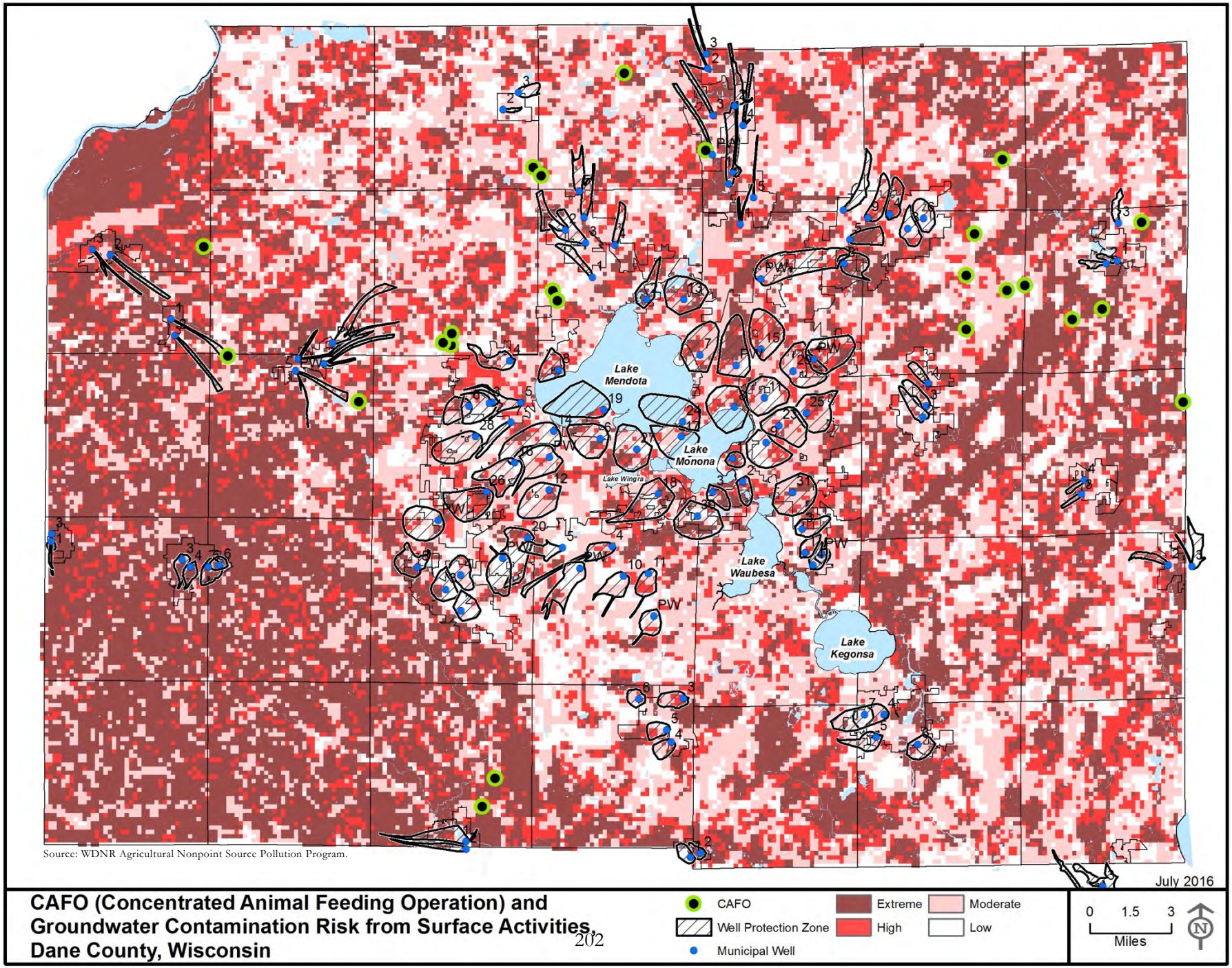
The greatest concentration of land acreage in corn is in eastern Dane County, specifically the towns of Rutland, York, Christiana and Dunkirk. Since these towns probably also have the greatest nitrogen fertilizer use, high nitrate levels in local groundwater supplies may be of particular concern.

Based upon the total corn acreage in Dane County and upon common nitrogen fertilization rates (120-190 lbs./acre), the estimated amount of nitrogen applied to corn in the county is 20 to 35 million pounds per year. About 50 to 70 percent of this quantity can be expected to be utilized by the crop, with much of the unused nitrogen potentially adding to the nitrate content of groundwater. Due to these large nitrogen inputs, fertilizer application represents an important areawide groundwater quality concern. Before fertilizers are applied, a soil test should be performed to determine the nutrient needs of the crop. Fertilizers should also be applied during times of greatest nutrient uptake. Both the University of Wisconsin and Dane County Extension continue to promote the economic and environmental benefits of nutrient management plans, programs and best management practices to control nitrate contamination of groundwater.

# Map 51


Lake Mendota
Lake Monona
Lake Wingra
Lake Waubesa
Lake Kegonsa
PW
Source: Dane County Department of Land and Water Resources.
July 2016
Manure Storage Facilities and Groundwater Contamination Risk from Surface Activities, Dane County, Wisconsin 201
Manure Storage Facilities
Well Protection Zone
Municipal Well
Extreme
High
Moderate
Low
0 1.5 3
Miles
N

# Map 52


Lake Mendota
Lake Monona
Lake Wingra
Lake Waubesa
Lake Kegonsa
PW
Source: WDNR Agricultural Nonpoint Source Pollution Program.
July 2016
CAFO (Concentrated Animal Feeding Operation) and Groundwater Contamination Risk from Surface Activities, Dane County, Wisconsin
CAFO
Well Protection Zone
Municipal Well
Extreme
High
Moderate
Low
0 1.5 3
Miles
N

## Pesticide Application

Pesticides are widely applied on agricultural land in Dane County for weed, insect and disease control. Pesticides are also used on roadside ditches, power line right-of-ways, woodlots, lawns and gardens. Pesticides that leach into the groundwater may pose a drinking water health hazard depending on the pesticide's toxicity, concentration and degradation rate. If properly applied, however, most pesticides will be taken up by plants or rapidly broken down by hydrolysis, sunlight, and bacteria or other soil microorganisms. Clay and soil organic matter are also important in binding pesticides and preventing them from leaching into the groundwater. The greatest potential for pesticide contamination of groundwater exists in soils with high permeabilities, thin soils over fractured bedrock, and soils with minimum clay and organic matter.

The principal agricultural pesticide of local concern currently is atrazine. Atrazine prohibition areas have been established under the authority of DATCP under Ch. ATCP 30. This includes the central two-thirds of Dane County as well as along the Wisconsin River. The distribution of wells tainted with atrazine is fairly random and widespread across the county, and generally the concentrations are low. An evaluation of the Atrazine Rule in 1997 shows a significant decline in groundwater atrazine levels between 1994 and 1996, although the percent of contaminated wells, remained about the same. It is believed the limits placed on atrazine use have contributed to its decline in groundwater.

The UW Extension technical bulletin *Nutrient and Best Management Practices for Wisconsin Farms* provides general guidance for pesticide and nutrient management in Wisconsin. However, more research on pesticide transport, degradation pathways and toxicity of metabolites (breakdown products) is needed.

## Salt Storage and Use for Deicing

Salt storage and deicing can affect groundwater quality. Precipitation may dissolve salt stored in piles or spread on road surfaces and form a leachate that can seep into the groundwater. Very high chloride concentrations (above 250 mg/l) in drinking water supplies represent a violation of the federal "secondary" drinking water quality standard.

A survey of road salt storage sites in cities, villages, and towns in Dane County indicates that most storage sites in the county are covered and have paved linings. Thus the potential for groundwater contamination from leachate formation and seepage is limited.

Deicing probably has a greater impact on groundwater quality than salt storage in Dane County. This is especially evident in urbanized areas where heavy salting occurs. Even though average chloride concentrations are still significantly below the drinking water standard, sodium and chloride levels in ground and surface waters have been increasing for over the past 30 years (**Reference Figures 24, 25, and 26**).

A road salt reduction program was instituted by the City of Madison in the mid-1970s to minimize adverse environmental effects. Despite gains in application efficiency, however, the use of road salt for winter road maintenance in Madison continues to grow (**Reference Figure 27)**. This indicates that road building has been increasing faster than salt reduction efforts can offset. Also, deicer use is not limited to the city. The state, county, nearly all local units of government, and private property owners and their agents all apply salt, and many are making some effort to reduce or better manage use of salt for deicing.

Two factors that influence the sodium and chloride levels at a well are length of the steel casing and proximity to major roadways (salt routes). A well with a short casing draws proportionally more water from the upper aquifer and water quality is more impacted by surface activities such as road salt application. It should be noted that that reductions in water table levels represented by the cones of depression northeast and

southwest of the Yahara Lake chain (**Reference Maps 38a and b**) do not currently indicate a discernable effect or cause of higher chloride levels in drinking water supplies (above and beyond well location, construction, and surrounding land uses). Therefore wellhead protection planning, as currently practiced, and reduced salt usage should continue to be the focus of municipal water utilities and transportation departments. This is less of a problem in rural areas because comparatively less salt is used (per acre), resulting in greater dilution – although, rural homeowners should have their wells tested, particularly if they notice a change in conditions (e.g., cloudiness or taste) or have other reasons to suspect contamination.

It should be noted that contamination potential is a function of several parameters: well location, construction, land use, geology, and pumping rate – so it is not a simple correlation. Pumping by high-capacity wells does increase the potential for contamination because the pumping lowers the potentiometric or apparent surface in the deep aquifer. This increases the downward gradient between the shallow and deep systems so there is increased potential for water and contaminants to move downward, if there is a pathway. Cross-connected (multi-aquifer) wells provide one such pathway. This is why it is recommended that wells be cased past the Eau Claire confining unit, and that old unused wells be plugged and properly abandoned. Chloride is a good water quality indicator because it is soluble and migrates easily through the ground.

But just because the potential exists doesn't mean that contamination is actually happening. Well contamination is spatially variable and depends on the presence of pathways (cross-connected wells, fractures, missing Eau Claire, etc.), along with a contamination source. For example, it is known that viruses reach many of the deep wells, and this would not happen if they were not pumping. Chloride concentrations are increasing in a number of the deep wells, often because they are cross-connected and the chloride would not be moving downward if the wells were not pumping. Cross-connected wells can be a problem, and are not even permitted in some other states. It is therefore recommended that all new municipal wells be cased into the deep Mt. Simon aquifer, and that existing wells be reconditioned where opportunities present themselves.

Another recommendation is to reduce application of salt at the source. Although it has been speculated that the public is intolerant of snow covered roadways and increased travel times, this may not be the case. A 1975 City of Madison-funded UW study found that after two years of reduced salt use in the Wingra basin, more than 90 percent of respondents believed the program was worthwhile and should be continued, while 85 percent supported city wide expansion of the program. Furthermore, the report found little difference in opinion between respondents living within or outside the reduced salt zone.[23],[24]

Municipalities in the region should continue to reevaluate their practices regarding the application of salt for ice and snow control and strive to achieve minimum application rates consistent with safe operation. It is also recommended that municipalities continue to consider alternatives to salt, such as a sand-salt mix (with enhanced street sweeping in the spring), as well as fostering less public expectation for bare pavement conditions, reducing travel speed, and anticipating increased driving times during adverse conditions. This is all part of a public education and awareness campaign being promoted through the Wisconsin Salt Wise Partnership[25]

## Other Potential Pollution Sources: Stockpiles, Spills, and Stormwater Management

In addition to salt, unlined and uncovered stockpiles of other materials, such as coal or construction debris, may also pose as a pollution source. If soluble, these materials can dissolve in precipitation and seep into the groundwater. In some instances, silage storage at farms is also a concern. Silage leachate is a liquid which has a high biochemical oxygen demand (BOD) and nitrate concentration. When not properly contained, leachate can be a ground or surface water pollutant.

[23] City of Madison 2012 Road Salt Report.
[24] UW-Madison. 1975. *City-University Road Salt Study – Overview Report.* Department of Mechanical Engineering.
[25] https://www.wisaltwise.com/

Spills of hazardous substances occur frequently in Dane County and certain spills may pollute groundwater. Most Dane County communities have documented some spills since state reporting requirements were enacted. Spills can occur from almost any source and take place at any time. Frequent causes of spills are chemical equipment malfunction and deterioration, human errors, and traffic accidents. The quantity of a spill and subsequent cleanup and containment efforts are important in determining the likelihood and extent of groundwater pollution.

The design of stormwater management facilities that involve infiltration of stormwater should also consider the potential impacts on groundwater quality. Such facilities include infiltration trenches, infiltration basins, bioretention facilities, rain gardens, grassed swales, subsurface storage and infiltration galleries, and detention basins. The WDNR has developed post-construction stormwater management technical standards for site-specific evaluation of stormwater facilities.[26] Those standards include provisions intended to protect groundwater quality, and it is recommended that the standards continue to be refined and applied in stormwater management facilities design. In addition to review by WDNR and local municipalities, CARPC staff also review stormwater facility designs as part of its Water Quality Plan consistency review in urban and limited service areas so that proposed measures are protective of groundwater quality.

[26] http://dnr.wi.gov/topic/Stormwater/standards/index.html

# Chapter 6: Groundwater Management

## Federal Government

Groundwater protection is a complex issue involving decisions, actions and programs at all levels of government – federal, state, and local. The U.S. Environmental Protection Agency (U.S. EPA) is the principal federal authority concerning groundwater management. The primary responsibility for groundwater management, though, rests with state and local government and these programs are emphasized in this chapter. While there is no comparable federal law to Wisconsin's Groundwater Protection Act, a number of federal regulations do support state and local government in protecting groundwater. Major federal laws with groundwater provisions include:

**1. Safe Drinking Water Act of 1974 (SDWA), as amended in 1986 and 1996**

The EPA is authorized by this law to set maximum contaminant levels and monitoring requirements for public water systems. The EPA also has authority to designate sole source aquifers, which are the principal sources of drinking water to an area and consequently require special protection.

The 1986 amendment greatly expanded the number of substances addressed by the primary drinking water standards, and also provided secondary standards relating to the aesthetic qualities of drinking water (e.g., smell and taste). In addition, states are required to adopt wellhead protection programs.

The 1996 amendment also require states to develop and implement a Source Water Assessment Program (SWAP). In 1999 Wisconsin submitted its SWAP plan for approval by U.S. EPA. States must identify sources of public drinking water, assess water systems' susceptibility to contamination, and inform the public of the results.

**2. Resource Conservation and Recovery Act of 1976 (RCRA), as amended in 1984**

This act authorizes a hazardous waste program which establishes standards for transportation, treatment, storage and disposal of hazardous material. RCRA establishes EPA's "cradle-to-grave" management system that regulates hazardous wastes from their point of generation to their point of ultimate disposal. The program has a major emphasis on protecting groundwater.

Amended in 1984, RCRA also created a regulatory program to address leaking underground storage tanks (LUSTs).

**3. Toxic Substances Control Act of 1976 (TOSCA)**

This law authorizes EPA to restrict or prohibit the manufacture, distribution and use of products presenting an unreasonable risk of injury to health or the environment. Groundwater is included in the definition of "environment."

**4. Clean Water Act of 1972 (CWA), as amended in 1977**

General references to groundwater protection in municipal wastewater treatment, planning and research programs are made in this law. Its principal regulatory programs, however, focus on surface water.

**5. Federal Insecticide, Fungicide and Rodenticide Act of 1978 (FIFRA)**

The EPA is given the responsibility in this act to control the use of pesticides, taking environmental impacts into consideration, including those affecting groundwater.

**6. Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA or Superfund), and Superfund Amendments and Reauthorization Act of 1986 (SARA)**

The act authorizes U.S. EPA to respond directly to environmental threats caused by chemical spills or releases of hazardous materials which may endanger public health safety and welfare. CERCLA regulates a greater number of hazardous substances than does RCRA, and also has lower reporting requirements.

SARA encourages and supports emergency planning efforts at the state and local levels and provides the public and local governments with information concerning potential chemical hazards in their communities. Although codified as Title III of SARA, it is not part of the Superfund law itself.

**7. Pollution Prevention Act (PPA) of 1990**

The Pollution Prevention Act established a new national policy for environmental protection: "that pollution should be prevented or reduced at the source whenever feasible..." This deceptively simple statement heralds a profound change in how EPA meets its obligations to protect human health and the environment. The 2010-2014 Pollution Prevention Program Strategic Plan focuses industry, government, and public attention on reducing the amount of pollution through cost-effective changes in production, operation, and raw materials use. Pollution prevention includes practices that increase efficiency in the use of energy, water, or other natural resources as well as protect our resource base through conservation. According to EPA, preventing pollution and conserving our natural resources offers the exciting possibility of reconciling economic growth with environmental protection to enhance the quality of life for everyone.

## Summary of Wisconsin Groundwater Management

Wisconsin has a long history of groundwater protection. The first law is the1983 Wisconsin Act 410, Wisconsin's Comprehensive Groundwater Protection Act, which created Chapter 160, Wisconsin Statutes. This law expanded the State's legal, organizational, and financial capacity for controlling groundwater pollution. Chapter 160 provides a multi-agency comprehensive regulatory approach, using two-tiered numerical standards, based on the premise that all groundwater aquifers in Wisconsin are entitled to equal protection. There are a number of major components to Wisconsin's groundwater quality protection program:

### Standards

Under chapter 160, Wis. Stats., the Department of Natural Resources (WDNR) must establish state groundwater quality standards based on recommendations from the Department of Health Services. Standard setting is a continuing process based on a priority list of substances detected in groundwater or having a high possibility of being detected, established by the WDNR in conjunction with other state agencies. The state groundwater standards are contained in chapter NR 140, Wisconsin Administrative Code. For each substance there is an enforcement standard (ES) which determines when a violation has occurred and a preventive action limit (PAL) which is set at a percentage of the ES. The PAL serves as a trigger for possible remedial action.

## Regulatory Programs

Once groundwater quality standards are established, all state agencies must manage their regulatory programs to comply. Each state regulatory agency must promulgate rules to assure that the groundwater standards are met and to require appropriate responses when the standards are not met. The state regulatory agencies are the WDNR (waste and materials management, industrial and municipal wastewater, wetlands, remediation and redevelopment, and drinking water and groundwater); DSPS (private sewage systems); DATCP (petroleum product storage tanks, pesticide use and storage, fertilizer storage, and agrichemical clean-up program and fund); and DOT (salt storage). **A summary of state regulatory controls of pollution sources can be found in Appendix E of this report.**

## Aquifer Classification

One of the most important features of Wisconsin's groundwater law is an item that was intentionally omitted. When Wisconsin was debating the groundwater protection legislation, the U. S. EPA tried to develop a nationwide groundwater approach. A keystone of EPA's proposal was aquifer classification - each aquifer would be classified according to its potential use, value or vulnerability, and then would be protected to that classification level. Some aquifers would not be entitled to protection and might never again be usable for human water supply. Wisconsin opposed aquifer classification. The foundation of Wisconsin's groundwater law is the belief that all groundwater in Wisconsin must be protected equally to assure that it can be used for people to drink today and in the future.

## Monitoring and Data Management

At the time the groundwater legislation was created, there was concern that Wisconsin needed a groundwater monitoring program to determine whether the groundwater standards were being met. Therefore, a groundwater monitoring program was created under s. 160.27, Wis. Stats. Money from the Environmental Fund has been used for problem-assessment monitoring, regulatory monitoring, at-risk monitoring, and management-practice monitoring, as well as establishment of a data management system for collection and management of the groundwater data.

## Research

Although all state agencies must comply with the groundwater standards, the processes by which groundwater becomes contaminated, the technology for cleanup, the mechanisms to prevent contamination, and the environmental health effects of the contamination are often not well understood. In addition, basic data on geology, soils, and groundwater hydrology is often not available. The University of Wisconsin System (UWS) and the state agencies have recognized that additional efforts in these research areas are badly needed. The Governor and the Legislature included a groundwater research appropriation for the UWS beginning with the 1989-1991 biennial budget. Since 1992, the UWS, DATCP, WDNR, and DSPS have participated in a joint solicitation for groundwater-related research and monitoring proposals.

## Coordination

In enacting the Comprehensive Groundwater Protection Act, the Legislature recognized that management of the state's groundwater resources was a responsibility divided among a number of state agencies. Therefore, the Groundwater Coordinating Council (GCC) was created to advise and assist state agencies in the coordination of non-regulatory programs and the exchange of information related to groundwater. The Council has been meeting since 1984.

## Wisconsin's Groundwater Protection Act, 2003 Wisconsin Act 310

As the result of a bipartisan legislative effort and support, significant groundwater quantity legislation was enacted - 2003 Wisconsin Act 310. This law expanded Wisconsin's authority to consider environmental impacts of high capacity wells and established a framework for addressing water quantity issues in rapidly growing areas of the state. Act 310 recognizes the link between surface water and groundwater, and the impact wells may have on groundwater quality and quantity. Chapter NR 820, formally defines the extent of Groundwater Management Areas as required by Act 310 and also creates a mechanism for evaluating proposed high capacity wells to determine whether the well will have a significant environmental impact on springs, trout streams, outstanding and exceptional resource waters.

Major components of 2003 Wisconsin Act 310 includes:

1) *Tracking well construction and water use.* The law requires all high capacity well owners to report water use annually, including those with wells approved before enactment of the law. Collection of pumping data assists in evaluating proposed new wells, monitoring approval conditions, calibrating groundwater flow models, improving water use estimates, identifying trends, and contributes to a better understanding and management of groundwater resources throughout the state.

2*) Expanded regulation of high capacity wells.* The Act directs WDNR to consider the environmental impacts associated with high capacity wells in the following situations:

- Wells located in a "groundwater protection area" (an area within 1,200 feet of an Outstanding or Exceptional Resource Water or Trout Stream).
- Wells that may have a significant environmental impact on a spring with a flow of at least one cubic foot per second (cfs) at least 80 percent of the time.
- Wells where more than 95 percent of the amount of water withdrawn will be lost from the basin.

3) *Designation of Groundwater Management Areas (GMA).* The Act directed the WDNR to establish two GMAs: one in Southeastern Wisconsin and another in the Lower Fox River Valley. In these areas the water level of the deep sandstone aquifer has been drawn down more than 150 feet since pre-development. The intention of the groundwater management area is to encourage a coordinated management strategy among state, local government units, regional planning commissions, and public and private users of groundwater to address problems caused by over-pumping of the deep aquifer, including increased levels of radium, arsenic and salinity. The WDNR will assist local government units and regional planning commissions in those areas as they undertake research and planning related to groundwater management.

*Groundwater Attention Areas (GAAs)* are geographic areas of the state where groundwater management problems are emerging and, if current trends continue, are likely to become a GMA. Dane County has been identified as a GAA. Designation as a GAA is intended to be a proactive mechanism for identifying and managing or mitigating stresses to groundwater and surface water systems *before* the water resources become significantly degraded and *before* significant adverse environmental impacts occur.

4) *Creation of a Groundwater Advisory Committee.* The committee issued a report to the Legislature in December 2006 regarding groundwater management areas. The committee issued a a second report to the Legislature in 2007 that assessed the effectiveness of Act 310 and considered changes to the regulatory framework applicable to high capacity wells. The GAC concluded that Act 310 is working as originally intended as a first step in integrated water management. The GAC, while acknowledging that more work remains to build upon initial improvements in groundwater management provided under Act 310, also recognized that the law has provided an added level of environmental protection for trout streams, outstanding resources waters, exceptional resource waters and springs. The 2007 report contains extensive recommendations and alternatives for enhancing the effectiveness of Act 310.

Pursuant to Act 310, the GAC was terminated at the end of 2007 following submittal of its second report to the Legislature.

## Great Lakes Compact, 2007 Wisconsin Act 227

The Great Lakes Compact took effect on December 8, 2008 after Wisconsin and the other Great Lakes states' ratification of the Compact and the U.S Congress' subsequent consent. The Compact addresses water quantity management in the Great Lakes – Saint Lawrence River Basin. It sets out requirements for Basin water uses in the areas of registration, reporting, management, and water conservation and efficiency. It also prohibits diversions of Basin water with limited exceptions for straddling communities and intra-basin transfers (from one Great Lake basin to another). Under the Compact, states are required to develop a program for managing Basin withdrawals from groundwater and surface water, that relies on a decision-making standard for new or increased withdrawals. States are also required to develop and implement a Basin water conservation and efficiency program.

Wisconsin's legislation implementing the Great Lakes Compact is extensive. Wisconsin Act 227 calls for statewide registration of existing and new water withdrawals with the capacity to withdraw more than 100,000 gallons per day averaged over 30 days. Withdrawals over 100,000 gallons per day averaged over 30 days must be reported annually (existing state statutes already require this reporting for groundwater withdrawals; however, most surface water withdrawals, other than municipal, were not reported prior to 2010). This requirement applies statewide. Initial withdrawal amounts from 2008 are the basis for determining if a proposed increase in a withdrawal exceeds the threshold for applying a decision-making standard. Act 227 directs that Basin withdrawals over 100,000 gallons per day averaged over 30 days require a permit.

Act 227 requires the WDNR to develop a statewide water resources inventory and publish a State Water Use Report every five years. Act 227 also requires that the WDNR develop and implement a water conservation and efficiency program with voluntary measures to apply across the state. Additional mandatory elements apply in the Great Lakes Basin, with the most stringent requirements for communities applying for diversions or water uses with high rates of water loss.

An additional element of the new legislation is the requirement for water supply service area plans. Act 227 requires all municipalities with water supply systems that supply more than 10,000 people to have an approved water supply plan by 2026. This planning process is modeled after the wastewater planning process and uses a cost-effectiveness analysis that assesses the environmental and economic impacts of alternatives in the plan to determine the approach that maximizes environmental benefits and minimizes total resource costs over the planning period.

### Lake Beulah Supreme Court Case

In July 2011, the Wisconsin Supreme Court issued its decision in the case of Lake Beulah Management District v. State Department of Natural Resources. To briefly summarize, the Court reached the following conclusions:

The Court held that, pursuant to Wis. Stat.s 281 (water and sewage management) and the Legislature's delegation of the State's public trust duties, the WDNR has the authority and a general duty to consider whether a proposed high capacity well may harm waters of the state. Upon what evidence, and under what circumstances the WDNR's general duty is implicated by a proposed high capacity well is a highly fact-specific matter that depends upon what information is presented to the WDNR decision makers by the well owner in the well permit application, by citizens, and by other entities regarding that permit application while it is under review by the WDNR.

The Court further held that "to comply with this general duty, the WDNR must consider the environmental impact of a proposed high capacity well when presented with sufficient concrete,

scientific evidence of potential harm to waters of the state. The WDNR should use both its expertise in water resources management and its discretion to determine whether its duty as trustee of public trust resources is implicated by a proposed high capacity well permit application, such that it must consider the environmental impact of the well or in some cases deny a permit application or include conditions in a well permit."

**Richfield Dairy Decision**

In September 2011, an Administrative Law Judge (ALJ) considered whether the WDNR is required to consider "cumulative impacts" when issuing approvals for high capacity wells. The ALJ determined that, despite the lack of any authority authorizing the WDNR to consider these cumulative impacts during the high capacity well approval process, there is "implied" statutory authority and that he *Lake Beulah* decision must be interpreted broadly to require WDNR to consider cumulative impacts.

# State Agencies and Responsibilities

## Department of Natural Resources

The WDNR has statutory authority to protect, maintain and improve the quality and management of the waters of the state, ground and surface, public and private (s. 281.11 Wis. Stats.). The WDNR establishes the groundwater quality standards for the state under authority of Chapter 160, Wis. Stats. In addition, the WDNR manages groundwater quantity under provisions of ss. 281.11, 12, 34, and 346, Wis. Stats. The WDNR programs that protect and manage groundwater are as follows:

*Drinking Water and Groundwater (DG)* – Regulates public water systems, private drinking water supply wells, well abandonment and high capacity wells. DG is responsible for adoption and implementation of groundwater standards contained in chapter NR 140, Wis. Adm. Code, and works closely with other programs and agencies to implement Chapter 160, Wis. Stats., including groundwater monitoring, database management, and staffing the Groundwater Coordinating Council. The provisions under 2003 Wisconsin Act 310 (codified at s. 281.34, Stats., and NR 820) and the Great Lakes Compact (2007 Wisconsin Act 227, codified at ss. 281.343 and 281.346, Stats.) are also being implemented by DG. The program also coordinates the state's Wellhead Protection and Source Water Protection programs. See *http://dnr.wi.gov/topic/DrinkingWater/* and *http://dnr.wi.gov/topic/Groundwater/*

*Remediation and Redevelopment (RR)* – Oversees response actions at spills, hazardous substance release sites, abandoned containers, drycleaners, brownfields, high priority leaking underground storage tanks, closed wastewater and solid waste facilities, hazardous waste corrective action and generator closures, and sediment cleanup actions. A significant amount of the RR's work relates to groundwater contamination. In 2013 the authority to fund the removal of underground petroleum storage tanks was transferred from DSPS to the WDNR. In 2015 the State budget no long included any funding for the Petroleum Environmental Cleanup Fund Award (PECFA), Any Wisconsin tank owner who has a release in the future will no longer be able to seek assistance from the State to handle the contamination, yet the environmental clean up requirements remain in place. See *http://dnr.wi.gov/topic/Brownfields/* and *http://dnr.wi.gov/topic/Brownfields/Cleanup.html*.

*Waste and Materials Management (WMM)* – Regulates and monitors groundwater at proposed, active, and inactive solid waste facilities and landfills. WMM reviews investigations of groundwater contamination and implementation of remedial actions at active solid waste facilities and landfills. WMM also maintains a Groundwater and Environmental Monitoring System (GEMS) database of groundwater quality data from over 600 solid waste facilities and landfills and uses reports from GEMS to evaluate whether sites are impacting groundwater quality. See *http://dnr.wi.gov/topic/Landfills/gems.html*

*Water Quality (WQ)* – Regulates the discharge of municipal and industrial wastewater, by-product solids and sludge disposal from wastewater treatment systems and wastewater land treatment/disposal systems. WQ also issues permits for discharges associated with clean-up sites regulated by WQ for the RR program. See *http://dnr.wi.gov/topic/Wastewater/* and *http://dnr.wi.gov/topic/TMDLs/*.

*Watershed Management (WT)* –WT has primary responsibility for regulating stormwater and agricultural runoff as well as managing waste from large animal feeding operations. See *http://dnr.wi.gov/topic/Watersheds/*, *http://dnr.wi.gov/topic/SurfaceWater/*, and *http://dnr.wi.gov/topic/Waterways/*.

## Department of Agriculture, Trade and Consumer Protection

DATCP's major activities in this area include management of pesticides and nutrients, research, and funding of local soil and water resource management projects http://www.privacy.wi.gov/Contacts/index.aspx. In compliance with Chapter 160, Wisconsin Statutes, DATCP manages pesticides and pesticide practices to assure that established groundwater standards for contaminants are not exceeded. This may include prohibition of certain activities including pesticide use. DATCP regulates storage, handling, use, and disposal of pesticides, and the storage and handling of bulk quantities of fertilizer. DATCP has authority to develop a statewide nutrient management program through section 92.05 Wis. Stats. The program includes compliance, outreach, and incentive components. Enforcement standards have been established in Wisconsin for many known and potential groundwater contaminants, including over 30 pesticides. DATCP assists landowners with compliance to these standards and the Groundwater Law. DATCP also funds research projects; local development, demonstration, and implementation of improved nutrient and pesticide management practices; as well as collection and disposal of waste pesticides and containers through county Clean Sweep programs. In 2013 the Bureau of Petroleum Products and Tanks was transferred from DSPS to DATCP.

### Nonpoint Source Activities

*Pesticides*

DATCP's primary effort related to nonpoint contamination of groundwater from pesticides continues to involve the herbicide atrazine. In response to concerns about atrazine contamination, DATCP amended administrative rule chapter ATCP 30 in 1992 to manage the use of atrazine in an effort to reduce or eliminate the potential for further groundwater impacts. Rule revisions have been made in several subsequent years in response to additional detections of atrazine in groundwater.

*Nutrients*

Through its Land and Water Resource Management program, DATCP assists in the protection of water resources through nutrient management and conservation practice implementation. DATCP also tracks fertilizer purchases on a statewide basis via fertilizer tonnage reporting. The WDNR rules on runoff management to protect both groundwater and surface water (NR 151 Wisconsin Administrative Code) lay out the procedures for implementing and enforcing compliance with agricultural performance standards including nutrient management. Through ATCP 50, DATCP identifies the technical standards and practices necessary for agricultural producers to meet WDNR's performance standards including the adoption of the USDA-NRCS 590 nutrient management standard. A nutrient management plan accounts for all N-P-K nutrients applied, and planned to be applied, to each field over the crop rotation as well as all crop management practices utilized. A nutrient management plan manages nutrient applications to maximize farm profitability while minimizing degradation of both surface water and groundwater.

**Point Source Activities**

*Agricultural Chemical Cleanup Program*
In August 1993, section 94.73 of the Wis. Stats. was created and established the ACCP to address point sources of contamination and reimburse responsible parties for cleanup costs related to pesticide and fertilizer contamination. To date, more than 520 cases involving soil and/or groundwater remediation related to improper storage and handling of pesticides and fertilizers have been initiated at storage facilities. Over this same time period DATCP has assisted clean ups at over 1,000 acute agrichemical spill locations including applications for more than $40.6 million in reimbursement payments.

Since 1990, the Agricultural Clean Sweep grant program has helped farmers dispose of unwanted pesticides, farm chemicals, and empty pesticide containers. Beginning in 1996, the program extended collection services to small agricultural businesses. In 2004 DATCP began operating and managing the state's household hazardous waste grant program. In 2007 prescription drug collection was added.

## Department of Safety and Professional Services

Prior to July 2011, the Wisconsin Department of Commerce was responsible for establishing, maintaining and enforcing uniform statewide standards for plumbing (including on- site waste systems) under Section 145.02, Wisconsin Statutes. Those duties are now part of the Department of Safety and Professional Services. Chapter SPS 383 of the Wisconsin Administrative Code (previously Comm 83) contains administrative procedures, standards, and specifications to assure the proper siting, design, installation and inspection of private onsite wastewater treatment systems.

Effective July 1, 2013, programs within Department of Safety and Professional Services (DSPS), Division of Industry Services were transferred to other departments. The Bureau of Petroleum Products and Tanks was transferred to DATCP. The authority to fund the removal underground petroleum product storage tanks has been transferred to WDNR

## Department of Health Services

Chapter 160, Wis. Stats., directs the Department of Health Services (DHS) to recommend health-based enforcement standards for substances found in groundwater and specifies the protocol for developing the recommended standards. Recommended standards are sent to the WDNR and are submitted through the rule-making process as amendments to chapter NR 140, Wis. Adm. Code.

DHFS staff are the primary resource for information about the health risks posed by drinking water contaminants. The agency provides additional advice to owners of wells that are seriously contaminated with volatile substances such as benzene and vinyl chloride. DHFS is responsible for investigating suspected cases of water-borne illness and has conducted several studies into the health impacts of contaminated groundwater.

## Wisconsin State Laboratory of Hygiene

At the Wisconsin State Laboratory of Hygiene (WSLH), a great deal of effort is focused on identifying and monitoring chemical and microbial contaminants in groundwater through testing, emergency response, education and outreach, and specialized research. The activities related to groundwater span several departments at WSLH and, collectively known as the Drinking Water Quality Program. The mission of the WSLH Drinking Water Quality Program is to protect the health of drinking water consumers by providing analytical expertise, research and educational services to the scientific and regulatory communities and the public.

## Department of Transportation

The Department of Transportation (DOT) regulates the storage of highway salt (ss. 85.17 and 85.18, Wis. Stats.) to protect the waters of the state from harm due to contamination by dissolved chloride.

### Salt Storage

Highway salt is stored statewide by suppliers, counties, cities, villages, and private companies. Annual inspections occur and reports are provided for salt storage sites to insure that storage practices are in accordance with chapter Trans 277, Wis. Adm. Code (Highway Salt Storage Requirements). The intent of the Code is to help prevent entry of highway salts into waters of the state from storage facilities.

### Salt Use

The DOT Bureau of Highway Maintenance produces the Annual Winter Maintenance Report describing statewide salt use based on weekly reports from each county. Current policy in the State Highway Maintenance Manual restricts the spreading of deicer salts to a maximum of 400 pounds per lane mile per initial application, and 300 pounds per lane mile for subsequent applications. Electronic controls for salt spreader trucks are continually tested to record and verify application rates and coverage effectiveness. Other technology is used on county highway patrol trucks to keep salt on pavement surfaces (e.g., zero-velocity spreaders, ground speed controllers, and onboard liquid pre-wetting units). Additional efforts to minimize and conserve salt applications include the use of in-situ weather monitoring system. Pavement temperature sensors recorded at 54 locations along major highway routes are used to determine application methods. Annual training for snowplowing and salt spreading techniques is also provided for county snowplow operators.

### Salt Usage Tracking

The DOT Bureau of Highway Maintenance is currently in the process of having all of the county trucks that work on the state system equipped with AVL/GPS equipment. This technology will allow the bureau to better track the application of salt usage across the state. It will also help in the optimization of plow routes to make plowing most efficient. In conjunction with the AVL/GPS equipment the bureau is testing out new software called the Maintenance Decision Support System or MDSS. MDSS combines the science of snow removal with weather forecasting. The goal is to only apply the minimum amount of salt necessary given the current weather conditions and forecasts. Many other state who have implemented these technologies are seeing cost savings and salt reductions across their highways.

## Wisconsin Public Service Commission

The PSC regulates public utility rates and associated services under Chapter 196 of the *Wisconsin Statutes*. The PSC must approve any proposed changes in water rates before they are implemented. The PSC also has broad authority to review and approve construction projects by public water utilities pursuant to Section 196.49(2) of the *Wisconsin Statutes*. Projects. The PSC has authority to regulate various aspects of water utility operations. Examples of operations regulated under this authority include metering requirements, water accounting and loss control requirements, and standards for pressure management. The PSC also conducts outreach and training programs directed at public utilities and related to rate-setting, improving efficiency of operations, and reducing water loss from distribution systems.

## Wisconsin Geological and Natural History Survey

The Wisconsin Geological and Natural History Survey (WGNHS), University of Wisconsin-Extension, performs basic and applied groundwater research and provides technical assistance, maps, and other information and education to aid in the management of Wisconsin's groundwater resources. The

WGNHS groundwater program is complemented by the geology and soils programs, which provide maps and research-based information essential to the understanding of groundwater recharge, occurrence, quality, movement, and protection of this vital resource.
WGNHS maintains a statewide groundwater-level monitoring network and data management system that provides the basic information for conducting groundwater research in the county and throughout the state. For example, water levels collected from the network help scientists and managers evaluate the effects of well pumping, the response of groundwater levels to drought and climate change, and the effects of land-use change on groundwater resources. These data are also routinely used in the development and calibration of sophisticated regional groundwater flow models, such as the one developed for Dane County as well as other parts of the state. WGNHS also conducts geologic and groundwater studies on important and emerging topics of interest. Viruses in groundwater, cross-connection of aquifers due to multi-aquifer wells, groundwater recharge, and investigation of unsewered rural subdivisions are just some of the topics being investigated. WGNHS also provides significant education and outreach to both professionals and the general public on the technical aspects of well hydraulics, wellhead protection, waste disposal, comprehensive planning, etc.

## University of Wisconsin System

The University of Wisconsin System (UWS) has research, teaching and outreach responsibilities. These three missions are integrated through cooperation and joint appointments of teaching, research and Extension personnel who work on groundwater issues. UWS staff members work with state and federal agencies and other partners to solve groundwater resource issues. Citizen outreach is accomplished through publications, video and audio podcasts, social media, media relations, public meetings, teleconferences, and water testing and satellite programs. Activities of several specific programs are described below.

### UW Water Resources Institute (WRI)

The UW Water Resources Institute (WRI) is one of 54 water resources institutes located at Land Grant universities across the nation with core funding provided and administered by the U.S. Department of the Interior through the U.S. Geological Survey. It promotes research, training and information dissemination focused on Wisconsin's and the nation's water resources problems. The WRI research portfolio includes interdisciplinary projects in four broad areas: groundwater, surface water, groundwater-surface water interactions, and drinking water. Groundwater is a top priority and an area of particular strength at the WRI.

### UW-Extension's Central Wisconsin Groundwater Center

The Central Wisconsin Groundwater Center provides groundwater education, research and technical assistance to the citizens and governments of Wisconsin. Assistance includes answering citizen questions, helping communities with groundwater protection, describing the extent and causes of groundwater pollution, assessing drinking water quality, and working on groundwater policy. Recent policy work focuses on groundwater pumping and impacts on surface waters.

### UW Environmental Resources Center (ERC)

The UW Environmental Resources Center (ERC) hosts UWEX state specialists addressing water resources, land and water conservation, forestry, conservation professional training, citizen engagement, and volunteer monitoring. ERC also coordinates a number of regional and national programs addressing water resources and water education initiatives related to groundwater.

**UW Nutrient and Pest Management (NPM) program**

In 1989 a broad coalition of agricultural organizations, environmentalists, and the University sought funding for a water quality program for farmers and the agricultural community. The NPM outreach program has conducted on-farm demonstrations and education throughout Wisconsin to promote management practices that reduce groundwater and surface water contamination from agriculture while maintaining or improving farm profitability.

**UW Soil Science Department**

The UW Soil Science Department provides greater understanding of the practical application of biology, chemistry, physics, and earth science principles to integrate land use and environmental protection. Research is conducted with local farmers, agriculture agents, and university specialists on working farms across the state each year to collect data and find answers and solutions to Wisconsin crop fertility questions and problems. Notable examples include SnapPlus software, Nutrient Recycling and Upcycling (NRU) studies, crop nutrient application guidelines, field trials, among other leading topics of research.

## Groundwater Coordinating Council

In 1984, the Legislature enacted Wisconsin Act 410 to improve the management of the state's groundwater. This act required establishment of a Groundwater Coordinating Council (GCC) to be made up of representatives of state agencies with groundwater protection responsibilities.

The GCC is directed by s. 160.50, Wis. Stats., to serve as a means of increasing the efficiency and facilitating the effective functioning of state agencies in activities related to groundwater management. The GCC advises and assists state agencies in the coordination of nonregulatory programs and the exchange of information related to groundwater, including, but not limited to, agency budgets for groundwater programs, groundwater monitoring, data management, public information and education, laboratory analysis and facilities, research activities, and the appropriation and allocation of state funds for research.

The GCC consists of high-level administrators of all state agencies with some responsibility for groundwater management plus a Governor's representative. The GCC also has five subcommittees to assist in its work. Additionally, the WDNR has one permanent position with half-time responsibilities related to coordination of the GCC. The GCC meets quarterly to discuss issues of interest and make decisions regarding groundwater issues of concern such as:

- Coordinating a joint solicitation for groundwater research and monitoring proposals among four state agencies.
- Promoting efforts to enhance the utility of groundwater monitoring and research funded by the state.
- Ensuring consistency in groundwater education, data management, and mapping efforts.
- Working with representatives of federal and local agencies to promote communication and coordination with state groundwater activities.
- Preparing an annual Report to the Legislature due each August.
- Sponsoring and participating in forums and other outreach events to promote discussion of groundwater issues.

| Table 29. State Agencies with Responsibilities for Groundwater Management | |
|---|---|
| Wisconsin Department of Natural Resources | Protects, maintains, and improves state's water quality and management; monitoring groundwater, setting state groundwater quality standards |
| Wisconsin Department of Agriculture, Trade, and Consumer Protection | Regulates pesticide use and cleanup, oversees farm nutrient management, research where pesticides have entered groundwater. Approves and inspects underground storage tanks |
| Wisconsin Department of Safety and Professional Services | Enforces septic system regulations |
| Wisconsin Department of Health Services | Recommends enforcement standards for substances of health concern, investigates health effects from contamination |
| Wisconsin State Lab of Hygiene | Conducts research on virus and pathogen occurrence in groundwater |
| Wisconsin Department of Transportation | Conducts research on road salt and groundwater |
| Wisconsin Public Service Commission | Approves expenditures of new public water/electrical utilities, regulates setting of rates |
| Wisconsin Geological and Natural History Survey; University of Wisconsin-Extension | Assesses, characterizes, and maps groundwater resources; provides information and education on hydrology and groundwater resources |
| Groundwater Coordinating Council | Improves management of state's groundwater by sharing information and improving interagency cooperation |
| | Source: Modified after Lindorff et al. (1997) and Chern et al. (1999). |

## Local Groundwater Management

The Groundwater Protection Act also clarified the powers and responsibilities of local governments to protect groundwater in partnership and consistent with state law.

a. Zoning authority for cities, villages, towns and counties was expanded to "encourage the protection of groundwater."
b. Counties can adopt ordinances regulating disposal of septage on land, consistent with WDNR requirements. Cities, villages or towns may do so if the county does not. There is limited authority under NR 151 for adoption of local restrictions on land application of manure and waste.
c. Counties can regulate, under WDNR supervision, well construction and pump installation for certain private wells.
d. Property assessors must consider the time and expense of repairing or replacing a contaminated well or water supply when assessing the market value of real property. They must also consider the "environmental impairment" of the property value due to the presence of a solid or hazardous waste disposal facility.

Local units of government possess a variety of controls (regulatory and non-regulatory) which may be used to manage and protect groundwater. Some of the most powerful regulatory tools available to local governments for groundwater management are those that control land uses. For instance, local zoning provisions which determine the location and, in some cases, density of various land use practices are important in the siting of potential groundwater pollution sources. By enforcing county sanitary codes,

such as the permitting of on-site wastewater systems, local government has further regulatory responsibility for protecting groundwater. Authorization for carrying out certain state regulatory programs, such as state private well code and septage disposal programs, may also be more effectively handled at the local level.

Local government can also have substantial influence in promoting non-regulatory approaches that protect groundwater. These approaches include public education and information on groundwater, promotion of best management practices for fertilizer and pesticide use, and establishment of recycling programs and household hazardous waste disposal programs.

Local and state groundwater management controls, both regulatory and non-regulatory, are described in the following pages for each major pollution source. Brief assessments of the effectiveness of these controls are also presented. Due to the nature of this report, county roles are emphasized in the local control section; however, the county must coordinate regulatory and non-regulatory activities with cities, villages and towns. In many instances this is essential because the county may not be authorized by statute to adopt particular regulations, whereas cities and villages have home-rule powers allowing them to have more extensive regulatory authority. Thus, involvement and cooperation by all local units of government is imperative for carrying out an effective countywide groundwater protection program.

# Chapter 7: Management Controls for Potential Pollution Sources

## Land Disposal of Solid Waste

### State Controls

WDNR licenses all solid waste disposal sites and regulates their construction, operation, monitoring and closure (chapter NR 500). In 1984, WDNR performed an exhaustive search for abandoned waste disposal sites in Wisconsin, as mandated by the Environmental Repair Law of 1983. In 1990, the list was updated and published as *The Registry of Waste Disposal Sites in Wisconsin*. The Registry includes about 200 sites in Dane County. The Registry is WDNR's "master list" of known solid and hazardous waste disposal sites in Wisconsin. WDNR has also established a hazard ranking system, under NR 710, and criteria for determining necessary remedial actions. The inclusion of a site on the Registry does not mean that environmental contamination has occurred, is occurring, or will occur. The Registry is intended to serve as a general information source for the public and state and local officials as to the location of waste disposal sites in Wisconsin.

### Local Controls

Solid waste management planning is undertaken by the county in meeting the criteria of chapter NR 185. The Dane County Zoning Ordinance (Chap. 10) sets conditional use provisions for landfills in certain land use districts; however, the state can override local zoning in the siting of a landfill through the Waste Facility Siting Board. State solid waste management rules preempt local controls.

### Impact/Effectiveness

Strict regulatory controls help to minimize groundwater quality impacts at new landfill sites. However, numerous landfills constructed before these controls were enacted exist in Dane County, and some may be polluting groundwater. Groundwater monitoring is required for only a small number of landfills in the county and the effect of most inactive or closed landfills on groundwater quality is largely unknown.

## Land Disposal of Wastewater

### State Controls

Land disposal of municipal wastewater is regulated by the WDNR (chapters NR 110 and NR 206). Industrial wastewater disposal is regulated under chapter NR 214. Design and construction criteria, discharge limitations and effluent monitoring requirements are set forth in these regulations. A Wisconsin Discharge Elimination System (WPDES) permit is required by the WDNR for all pollutant dischargers.

### Local Controls

No local regulatory controls are in effect in Dane County. CARPC provides review and comments on permits, facilities plans, and disposal sites.

### Impact/Effectiveness

State controls for municipal and industrial wastewater dischargers are stringent. Dane County has few facilities that discharge large quantities of wastewater through land application systems. To date, monitoring has not revealed any detrimental groundwater quality impacts. Currently, these discharges are regulated under the WPDES program and do not represent serious sources of groundwater pollution in Dane County.

## Sanitary Sewers

### State Controls

Interceptor and collector sewers are regulated by the WDNR (chapter NR 110). The WDNR code contains sewer design and leakage criteria. It also establishes well-separation distances from sewers. DSPS regulates all lateral sewer connections (SPS 382) and requires non-leakage design adherence.

### Local Controls

The Capital Area Regional Planning Commission in conjunction with local governmental units, maps planned sewer service areas and sensitive environmental areas or corridors. This mapping reflects groundwater protection concerns, along with other factors. Proposed sanitary sewer extensions are reviewed to ensure that sewered development is directed to the areas where it is best suited while minimizing environmental impacts, including groundwater impacts.

### Impact/Effectiveness

The extent of sewage leakage or exfiltration from sanitary sewers in Dane County is not known. Design regulations are probably sufficient to minimize substantial leakage; however, exfiltration may still occur from pipeline breakage by tree roots or rupture by superimposed heavy loads. Groundwater infiltration rather than sewage exfiltration is a more common problem. Evidence of viruses in deep municipal wells is a growing concern. Breaks or leaks in pressure sewers or force mains are subject to WDNR enforcement.

Mapping sewer service areas and reviewing sanitary sewer extensions for consistency with plans is an effective tool in reducing the environmental impacts of expanding urban development and protecting sensitive areas and resources.

## On-Site Wastewater Systems

### State Controls

The Department of Safety and Professional Services (DSPS) regulates the siting, design, installation, and inspection of private on-site sewage systems. (chapters SPS 383 and SPS 385). SPS 383 contains administrative procedures, standards, and specifications to assure the proper siting, design, installation, and inspection of private onsite wastewater treatment systems. SPS 385 contains standards and procedures for soil and site evaluations conducted for the treatment or dispersal of wastewater, treated wastewater, final effluent or human wastes into soil. DSPS also administers the Wisconsin Fund for the replacement or rehabilitation of failing private onsite systems serving a principal residence or small commercial business. For large-scale (cluster or small community) on-site wastewater systems having a discharge capacity of over 12,000 gallons per day, state review and inspection is mandated prior to installation. A Wisconsin Pollutant Discharge Elimination System (WPDES) permit is required for these

systems by the WDNR (NR 200.03[3][d]). In addition, CARPC staff provides review and comments on proposed permits to better avoid adverse impacts.

WDNR may also prohibit septic tanks where they could cause a water quality problem under NR 113. Every governmental unit responsible for the regulation of private sewage systems is required to adopt a private sewage system ordinance that conforms to the state plumbing code (Wis. Stat.s Chap. 145).

### Local Controls

The Department of Public Health for Madison and Dane County (PHMD) administers the private sewage system ordinance. The ordinance and administrative procedures are included in Chapter 46, Dane County Code of Ordinances. The ordinance and all systems installed in Dane County must conform to the State Plumbing Code with respect to siting, design, installation and inspection. The county issues state sanitary permits which are required before any septic tank or other on-site system may be installed. The ordinance also requires owners of all septic systems to have the systems inspected and, if necessary, pumped every three years. The county also administers a state grant program (the Wisconsin Fund) to repair septic systems against which enforcement orders have been issued. The Dane County Zoning and Subdivision Regulations (Chaps. 10, 11, 17, and 75) set design standards for subdivisions (minimum lot area of 20,000 $ft^2$.) and control on-site system placement in floodplain and shoreland districts.

### Impact/Effectiveness

Nitrate-nitrogen data from private well water analyses indicate that high nitrate levels (above the drinking water standard) exist for wells in some rural subdivisions. On-site wastewater systems are suspected as a likely, but not the primary, nitrate source. Since on-site systems do not generally remove nitrate, and nitrates in groundwater are not transformed by flowing through soil or rock, the general assumption is that nitrate levels in groundwater are related to nitrogen loading at the surface. Proper maintenance and placement of private wastewater systems is important to avoid detrimental groundwater impacts from system failures or other contaminants, but the only effective way to reduce nitrates in groundwater is to reduce nitrogen loading to groundwater, either by using alternative on-site systems which remove nitrogen, or by reducing the density of on-site systems. Research and information from Wisconsin and other states is fairly consistent that there is a low probability of significant problems where housing densities are less than one house per two acres, and a higher probability of problems at densities greater than one house per 1-1.5 acres, based on the gross acreage of the development. These developments should include an evaluation to ensure that drinking water supplies are protected.

## Land Application of Biosolids (Sludge) and Septage

### State Controls

Biosolids recycling practices are regulated by both U.S. EPA and WDNR. These regulations are designed to ensure biosolids recycling is conducted in a manner protective of human and animal health and environmental quality. U.S. EPA has established comprehensive risk-based regulations for recycling programs (Part 503 Regulations) including potential pathways, maximum soil concentrations and loading rates for trace elements, such as copper, zinc, selenium, etc. WDNR regulates biosolids, applications under NR 204, which contain the same risk-based limits as U.S. EPA, with additional site management requirements such as setbacks from wells and homes. Landspreading of industrial sludge is regulated under NR 214. Biosolids handling and storage requirements are also covered by NR 110, and NR 113, which establishes licensing and site criteria. WDNR has the authority to prohibit landspreading of biosolids at any site where groundwater quality may be adversely affected.

## Local Controls

Although WDNR has exclusive authority to regulate the landspreading of biosolids, the Groundwater Law (Wis. Act 410) provides concurrent authorization for county regulation of land application of septage. Site criteria and septage application procedures contained in a county regulatory program must be identical to WDNR statewide rules. If a program is adopted, the county can establish a license fee for each septage application site to offset the costs of program operation.

Dane County Chapter 46 prohibits the spreading of septage on frozen or snow-covered ground. *Private On-Site Wastewater Treatment Systems* Management (Appendix I of the Dane County Water Quality Plan) includes township maps showing the general location of WDNR approved septage disposal sites and the disposal site location criteria in NR 113. These maps indicate that many of the currently approved septage disposal sites are in close proximity to site conditions that are unsuitable for septage disposal. This underscores the importance of a rigorous monitoring and inspection program for septage disposal sites in Dane County. The Department of Public Health for Madison and Dane County attempted to gain authority from WDNR to regulate septage spreading in Dane County, but their request was denied because the current county ordinance would hold the landowners responsible for any violations on their land rather than the septage hauler. PHMDC is currently working to incorporate the tracking of septage pumping and disposal into its septic maintenance program, which should include a monitoring component. This will help PHMDC and WDNR to track spreading activities and identify any potential problems.

## Impact/Effectiveness

Biosolids are a byproduct of our modern society and the need to manage their use will continue in the future. They provide an excellent source of plant nutrients and organic matter for agriculture, which should not be wasted by landfilling or incineration. Their creation is carefully managed to reduce the health risks associated with pathogens and heavy metals. Their use is closely monitored by both the USEPA and the WDNR. Research on biosolids process and management has been conducted at the University of Wisconsin for over 80 years and continues to this day. The land application of biosolids should be incorporated into a farm's nutrient management plan to reduce the risk of water quality degradation. Private well water analyses adjacent to biosolids application sites have not indicated adverse groundwater quality impacts in Dane County. An active site inspection and permitting program by the WDNR has helped minimize detrimental environmental effects.

Septage application and siting, on the other hand, have not been as actively regulated by WDNR. WDNR does not currently have adequate staff to effectively implement the septage program. Although there is limited documentation of pollution incidents resulting from septage application in Dane County, this may be due to the lack of surveillance and monitoring of land application sites. Even though standards for landspreading are outlined in NR 113, WDNR staff resources are currently too limited to provide routine field inspections, stringent surveillance or enforcement.

The involvement of County and CARPC staff in the review and approval of septage landspreading sites would incorporate greater knowledge and familiarity with local site conditions. It would also allow better monitoring and observation of site conditions and landspreading practices. The program should include site location and licensing requirements, application and operating criteria and procedures, surveillance and enforcement procedures, and the revenue to support the program.

Provisions for receiving septage at municipal wastewater treatment plants at a reasonable cost are important to provide waste haulers flexibility and to avoid the need to landspread under adverse conditions (such as on frozen ground in winter). This recommendation has largely been implemented. Opportunities for disposing of septage at treatment plants have expanded considerably; about 89 percent of septage is currently disposed of at wastewater treatment plants. The relative ease and availability of

wastewater treatment plants that accept septage is expected to continue to favor septage disposal at treatment plants in the coming years.

## Manure Management

### State Controls

Regulatory authority over manure management rests with the WDNR (chapter NR 243). A WPDES permit is required for large animal feedlot operations, (more than 1,000 animal units) and smaller operations where pollution problems are evident. The placement of wells in relation to animal feedlot operations is regulated under chapter NR 812.

In 1997 Wis. Act 27 and 1999 Wis. Act 9, the legislature directed the WDNR and DATCP to redesign state programs related to non-point source pollution. To meet this legislative mandate the DATCP adopted ATCP 50 that identifies conservation practices a farmer must follow to meet WDNR's Agricultural Performance Standards and Prohibitions in NR 151 Subchapter II. ATCP 50 also reflects DATCP's lead responsibility for nutrient management. DATCP administers the program in cooperation with County Land Conservation Committees and Departments.

As part of the redesign of the nonpoint source pollution program, Wisconsin Act 27 modified Chap. 92.10 Wis. Stats. to enable County Land and Water Conservation Committees and Departments to develop Land and Water Resource Management Plans. More specifically, Wis. Stat. 92.15 extends beyond manure storage and provides new authority for local governments to regulate livestock operations through local ordinances. Generally, local ordinances may not be more restrictive than state minimum performance standards. The Livestock Facility Siting Law, Wis. Stat. 93.30 and Adm. Rule ATCP 51 established state standards and procedures local governments must use if they choose to require conditional use or other permits for siting new and expanded livestock operations.

### Local Controls

In 2005 Dane County's Manure Storage and Utilization Ordinance was updated (Chapter 14, Sub. I). The purpose of the amended ordinance is to regulate the design, construction, maintenance and proper abandonment of animal waste storage facilities and manure stacks; including the transfer of wastes into storage facilities; provide for adequate disposal of animal waste in order to prevent water pollution, and comply with provisions in NR 151 Agricultural Performance Standards as outlined in the Dane County Land and Water Resource Management Plan and ATCP 50.56. CARPC staff also provides review and comment on proposed WPDES permit applications. Existing animal waste storage facilities are not subject to regulation under this ordinance unless the facility is not maintained, leaking, reconstructed, enlarged or altered in some way. Emergency repairs to a manure storage facility, such as repairing a broken pipe or equipment, repairing leaking dikes, or the removal of stoppages also do not require a permit.

### Impact/Effectiveness

The WPDES program has had increasing impact in Dane County, due to the growing numbers of larger farming operations. Currently, 14 farms are regulated under this program in Dane County (compared to only one in 1987). There are currently 278 large farms statewide. Smaller operations have been exempt from manure management controls, although they may be cited under NR 243 for discharge of significant amounts of pollutants to waters of the state (including groundwater). Cost-sharing/technical assistance is available to help farmers remedy discharge citations.

The Wisconsin Soil and Water Resources Management Program and other cost-sharing programs have been historically based on voluntary participation by state farmers. Typically, however, there was low participation in such voluntary programs – although the state Priority Watershed Program had provided some funding in priority project areas. In 2002 the WDNR rule NR 151 went into effect. This rule set performance standards and prohibitions for agricultural facilities, operations, and practices. The Dane County Land Conservation Division (LCD) developed an implementation strategy and accompanying checklist document as part of the 2003 Land and Water Resource Management Plan. Ordinance amendments to manure storage and utilization requirements located within Chapter 14, Dane County Code of Ordinances went into effect on January 31, 2006. These amendments provided the necessary mechanisms for Dane County to administer and enforce NR 151 agricultural performance standards at the local level.

## Pesticide and Fertilizer Applications

### State Controls

Under the Wisconsin Groundwater Law, DATCP manages pesticides and pesticide practices to assure that established groundwater standards for contaminants are not exceeded. This may include prohibition of certain activities including pesticide use. DATCP regulates storage, handling, use and disposal of pesticides, and the storage of bulk quantities of fertilizer. Under chapter ATCP 29, applicators of restricted-use pesticides are required to be properly trained and certified. Use of a pesticide by an applicator in a manner inconsistent with its labeling is illegal.

DATCP's primary effort related to nonpoint contamination of groundwater continues to involve the herbicide atrazine. In response to concerns about atrazine contamination, DATCP amended administrative rule chapter ATCP 30 in 1992 to manage the use of atrazine in an effort to reduce or eliminate the potential for further groundwater impacts. Rule revisions since then have increased the number of atrazine use prohibition areas. Information suggests that atrazine use has declined as a result of the atrazine management rule and concern about groundwater contamination.

DATCP is also responsible for identifying pesticides that have the greatest potential for polluting groundwater, and for compliance with groundwater standards by adopting administrative rules to be taken if standards are exceeded (ATCP 31). Requirements for proper labeling of pesticide containers by manufacturers are also set forth. In addition, ATCP 33 regulates fertilizer and pesticide bulk storage. ATCP also establishes the Agricultural Chemical Cleanup Program. The program identifies and help manage the clean up of pesticide and fertilizer spills to prevent these products from reaching groundwater. Once a site has been identified as needing a clean up, the ACCP provides re-imbursement for eligible costs by the responsible parties.

In 2007, the department updated Wisconsin Administrative Code ATCP 50. This code incorporates the phosphorus and nitrogen based NRCS 590 standard. This standard provides the technical guide to how Nutrient Management Plans (NMPs) should be development, what they must include, and what risk reduction factors must be met. It includes a number of practices specifically directed toward reducing the potential for groundwater contamination. Incorporating this nutrient management standard is intended to meet the water quality performance standard requirements outlined in NR 151.07.

While the rules require all farms to have an NMP, the state cannot enforce on this requirement without offering 70 percent cost-share. On the other hand, many cross-compliance mechanisms exist; such as county manure storage ordinances, WPDES permits for the state's largest CAFOs, and the Farmland Protection Program (FPP) that require an NMP without the cost-share requirement. The FPP in particular is driving a significant increase in NMP acreage across the state. In 2013, 26 percent, or 2.3

million acres of the state's cropland was covered by an NMP, this is up approximately 600,000 acres in 2003.

Also, DATCP's Manure Advisory System[1] includes interactive maps and other information to help farmers identify the sensitive areas on their farms, such as shallow depth to bedrock or water table, highly permeable soils, etc., and help reduce groundwater contamination risk.

### Local Controls

Local controls are limited. County and UW-Extension have the responsibility for training pesticide applicators within Dane County and providing information regarding proper application of fertilizers. County-approved waste management plans are required for all new manure structures.

Historically, there has been increasing documentation of groundwater quality degradation attributable to agricultural inputs. Moreover, the costs of overapplication of agricultural fertilizers and pesticides may reduce the profitability of farming operations in the county. The UW Nutrient and Pesticide Management program has documented this extensively. More recently, County-approved waste management plans and other conservation practices appear to be working. After 4 decades of increasing nitrates in area streams, baseflow concentrations are beginning to show early signs of improvement. This is supported by more recent analysis of historic nitrate sample results obtained from shallow wells across the region.

### Impact/Effectiveness

While historically there has been documentation of increased groundwater quality degradation attributed to agricultural inputs, more recent results indicate improvements in some areas of the county – likely associated with the programs and practices being conducted to reduce contamination. This is particularly evident in baseflow nitrate concentrations in streams and atrazine concentrations in shallow private wells. While significant progress has been made, more work needs to be done to protect and improve this vital resource. More funding needs to be provided to assist farmers in developing NMPs for their farms.

## Underground and Aboveground Storage Tanks

### State Controls

As part of the 2013-2015 biennial budget, the responsibility for administering the state's storage tank regulations, including the tank registry, has been transferred from the Department of Safety and Professional Services (DSPS) to the Department of Agriculture, Trade and Consumer Protection (DATCP). Aboveground and underground storage tanks containing flammable and combustible liquids are regulated under ATCP 93. In addition, the WDNR oversees investigation and cleanup of petroleum tank discharges and other hazardous wastes through its Remediation and Redevelopment Program (see Spills of Hazardous Materials, NR 700 series). WDNR also administers the Petroleum Environmental Cleanup Fund Award (PECFA), which reimburses responsible parties for eligible cleanup costs. The PECFA program was created in response to federal regulations requiring release prevention from underground storage tanks and cleanup of existing contamination from those tanks. However, the 2015-2017 Wisconsin budget does not include any funding for PECFA and effectively sunsets the program for releases after July 2017 and any claims after July 2020. According to the Governor's office, the program has existed for a sufficient time and that its primary purpose has been completed. According to the WDNR, any Wisconsin tank owner who has a release in the future will no longer be able to seek

[1] http://www.manureadvisorysystem.wi.gov/

assistance from the State to handle the contamination, yet the environmental cleanup requirements remain in place. Program initiatives have resulted in identifying a large population of underground tanks, reducing the number of underground tanks in use, and upgrading those in use to meet federal requirements. Educational outreach efforts and annual inspections by the Department and its agents has resulted in a high level of regulatory compliance, and a reduction of system failures and environmental contamination.

Bulk storage of pesticides and fertilizers are regulated by DATCP (chapters ATCP 29 and ATCP 32, respectively). Standards are established for storage containers, loading areas and secondary containment. On-site inspection, tank maintenance and contingency plans are also required. On-farm storage tanks are excluded from these regulations.

### Local Controls

On-site tank inspection responsibilities (excluding bulk storage of fertilizers and pesticides) can be conducted by city, village, and town fire chiefs who are DATCP designated deputies. If a local fire department elects not to perform the inspections, DATCP will have this responsibility.

### Impact/Effectiveness

Substantial progress has been made in attempting to prevent leaks and spill from storage tanks and in reducing associated environmental impacts. Of the 1319 identified leaking underground storage tanks, 94 percent have been officially "closed," where investigation and clean-up of the contamination has been completed and the state has approved all cleanup actions. Many underground storage tanks have also been removed where no action was required. Frequent testing is especially important for older tanks near public wells, as is vigorous long-term enforcement of existing regulations. The end of the PECFA fund will likely affect individuals and small business owners who lack the resources to respond adequately on their own to a leaking tank.

## Spills of Hazardous Materials

### State Controls

The WDNR (chapter series NR 600 and NR 700) has authority regarding hazardous waste management and response to hazardous spills. The Bureau of Remediation and Redevelopment oversees clean-up actions at spills, abandoned containers, state funded responses, closed wastewater and solid waste facilities, hazardous waste corrective actions and generator closures, and sediment clean-up actions.

The Hazardous Substance Spill Law, Wis. Stat. Chap. 292, requires immediate notification when hazardous substances are discharged, as well as taking necessary actions to restore the environment to the extent practicable. NR 700-726 specifies the required response (clean-up actions). Approximately 850 discharges are reported annually to the WDNR, and of those, approximately 65 percent are petroleum-related, with another 5 percent being agri-chemicals. Groundwater monitoring is performed when necessary to delineate the extent of contamination.

DATCP also has rules (chapter ATCP 29) which govern the transport of pesticides and call for the preparation of contingency plans at pesticide storage facilities. Preventive spill measures are also included in transportation regulations regarding hazardous materials. DATCP also administers the Agricultural Chemical Cleanup Program (ATCP 35). The program identifies and helps manage the clean up of pesticides and fertilizer spills to prevent those substances from reaching groundwater.

### Local Controls

Local government can monitor spill sites. Under its regulatory authority, the county can also require contingency plans for facilities handling hazardous materials. The Dane County Department of Emergency Management updates its *Dane County Strategic Plan for Emergency Response to Hazardous Materials Releases* annually. The plan identifies the potential for hazardous materials emergencies and develops policies and procedures for responding to hazardous materials incidents in the county. The plan also defines the roles, responsibilities, and inter/intra-organizational relations of government and private organizations in response to a hazardous materials incident.

### Impact/Effectiveness

Reporting of hazardous spills, contingency plans and proper storage of hazardous materials has received increasing emphasis at the state and local level. The threat of groundwater pollution from spills clearly exists. The Dane County Emergency Response Plan provides an efficient and effective organizational structure for assessing, coordinating and addressing the threats associated with hazardous materials. Effective March of 1997, all discharges of hazardous substances that adversely impact, or threaten to adversely impact public health, welfare or the environment must be immediately reported to WDNR.

## Junkyards/Salvage Yards

### State Controls

Junkyards are no longer licensed by the WDNR. This authority was removed in 1981 because environmental hazards from junkyards were not documented. The WDNR does regulate the disposal of solid and hazardous waste generated at salvage yards through laws and rules which are intended to prevent contamination of the land, surface, and groundwater. In addition, auto salvage yards must have a Stormwater Discharge Permit issued by the WDNR's Watershed Program. The WDNR may inspect and monitor activities involving hazardous substances at salvage and junk yards.

### Local Controls

A conditional use permit and an annual license is required by Dane County before a salvage or junk yard can be operated (Chap. 10, Dane County Code of Ordinances).

### Impact/Effectiveness

Groundwater impacts from salvage and junkyards are not documented in the county. Attention has not been focused on these areas for inspection or monitoring.

## Salt Storage and Use for Highway Deicing

### State Controls

The Department of Transportation (DOT) has established standards for salt storage (Ch. Trans. 277). Standards apply to all persons who store bulk quantities (more than 1,000 pounds) of highway salt. The DOT must conduct periodic inspections, at least annually, of salt storage facilities. This chapter does not restrict the actual use of salt on highways.

### Local Controls

Local units of government can voluntarily attempt to minimize the amount of salt applied to roadways. Many have evaluated and begun implementing various options to address this, such as purchasing new equipment (e.g., automated spreaders) and/or using alternative materials (e.g., sand).

### Impact/Effectiveness

A survey of salt storage sites in the county revealed that most sites are protected by coverings and linings. Salt use is probably a greater threat to groundwater quality than salt storage in Dane County. Increasing chloride and sodium concentrations in Madison wells are associated with deicer use. Many communities have begun instituting salt reducing measures, but these do not appear to be keeping up with the increase in lane miles being traveled. Increasing salt concentrations in wells and surface water is cause for concern. Additional efforts are needed to reverse this disturbing trend.

## Stormwater Management

### State Controls

Proper infiltration of stormwater has many benefits, including maintaining groundwater recharge and reducing stormwater runoff and pollutant loads. In order to ensure safe drinking water, contaminants must be removed from stormwater before it reaches groundwater aquifers. Although soil is a tremendous natural filter, it cannot treat contaminated stormwater runoff beyond its limits. Pretreatment practices have a wide range of removal rates for different contaminants. This why it is important to design and implement practices to remove pollutants that take into account the potential contaminants in stormwater, site specific conditions, and maintenance needs.

Under NR 151.124 and 151.244, a construction site landowner must meet the performance standard for infiltration of runoff taking into account site restrictions. A technical standard has been developed to assist site designers in the assessment of the site and its adequacy in providing infiltration that is both protective of groundwater and practical to implement. The intent of the infiltration standard is to encourage infiltration of runoff. This requirement is tempered by a series of prohibitions and exemptions for the purpose of minimizing the risk of groundwater contamination and to address the practicality of implementation.

### Local Controls

In 1989 the Legislature created the Dane County Lakes and Watershed Commission to serve as a coordinating and advisory agency for water quality issues within Dane County government (Wisconsin Act 324). Under the Act, the Commission may propose to the county board minimum standards for local regulations and ordinances for municipalities and the county to protect and rehabilitate the water quality of the surface waters and groundwater. In addition, CARPC provides review and approval of stormwater practices through its Urban Service Area amendment process. Dane County, local municipalities, and CARPC encourage and promote development practices that minimize surface water runoff and maximize infiltration and groundwater recharge. Several researchers have pointed out that stormwater infiltration practices that have been designed correctly pose little threat to the groundwater.[2,3,4] Current stormwater regulations and technical standards require pretreatment to remove contaminants prior to infiltration.

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[2] Pitt, R. et al. 1999. *Potential Groundwater Contamination from Intentional and Nonintentional Stormwater Infiltration.*
[3] Mikkelsen, P. et al. 1997. *Pollution of Soil and Groundwater from Infiltration of Highly Contaminated Stormwater.*
[4] Barraud, S. et al. 1999. *The Impact of Intentional Stormwater Infiltration on Soil and Groundwater.*

### Impact/Effectiveness

With the emphasis on volume control BMPs in recent years, the issue of soil and groundwater contamination is gaining more attention. Recent research has improved the outlook on the risks of soil and groundwater contamination. Long-term (20 year or more) studies of groundwater below infiltration basins have shown no adverse effects from infiltrating stormwater.[5] Pretreatment of stormwater runoff from critical pollutant sources areas is required. The WDNR has developed program guidance and technical standards for best management practices for meeting the infiltration performance standard of NR 151.[6,7] By standard, no stormwater is infiltrated without treatment unless it is clean rooftop runoff.

## Well Construction and Abandonment

### State Controls

The operation and design of public water systems is regulated by the WDNR under Chapter NR 811. This chapter requires the proper abandonment of all unused or unsafe private wells within municipal water service areas. Well construction, siting and abandonment is further regulated by the WDNR (chapter NR 812). This code prohibits the use of any well for disposal of sewage or for surface discharge drainage. Drillers of potable wells and pump installers need to be licensed, and well construction reports must be sent to the WDNR. Chapter. NR 141 establishes standards for designing, installation, construction and abandonment of groundwater monitoring wells.

### Local Controls

Chapter NR 845, Wis. Adm. Code, was developed to allow for county administration of the private well construction and abandonment program. Dane County ordinance Chap. 45 details the county well construction and abandonment code. Improperly abandoned wells represent a real threat to groundwater that can be removed at relatively low cost. PHMD typically issues 60 to 70 abandonment orders each year.

The City of Madison has a local ordinance (Madison General Ordinance Sec. 13.21) which addresses well abandonment and operation permits within the Madison Water Utility service area. The ordinance provides that all unused and unsafe wells be properly abandoned. Owners of all other wells are required to obtain an operating permit from the utility which requires the owner to show that the well meets code and produces safe water. Well operating permits must be renewed every five years.

### Impact/Effectiveness

Abandoned or unused wells pose a great threat to the safety and quality of groundwater drinking water supplies. An unused well provides a direct path for contaminants and pollutants to the underground aquifers that supply working wells. The WDNR considers a well to be permanently abandoned when it has been completely filled and sealed by a licensed well driller or pump installer using materials and methods as prescribed in section NR 812.26 of the Wisconsin Administrative Code. This generally means that the pump and any piping inside of the well casing have been removed and the well has been filled from bottom to top with proper filling materials, such as cement grout, concrete grout, concrete, a clay/sand slurry mix or, in some cases, bentonite chips. Some unsafe or unused wells are identified through complaints and are required to be abandoned as appropriate, but many wells may go undetected.

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[5] Emmons and Oliver Resources. 2012. *Update on the Science of Volume Control BMPs.*
[6] http://dnr.wi.gov/topic/Stormwater/standards/postconst_standards.html
[7] http://dnr.wi.gov/topic/stormwater/documents/InfiltrationPerformanceStandardGuidance.pdf

Unused wells are a direct line for contamination into clean ground water. The WDNR provides financial assistance for low income well owners to properly abandon unused private wells. The WDNR also provides Well Compensation grants for replacing, reconstructing or treating contaminated private water supplies that serve a residence or used for watering livestock. Well construction work must be done according to WDNR specifications and the contaminated well properly abandoned.

# Groundwater Quantity

## State Controls

The Groundwater Quantity Act (2003 Wisconsin Act 310) expanded the State's authority to consider environmental impacts resulting from certain high capacity wells. Under that law, proposed high capacity wells that are within 1200 feet of trout streams and other designated high quality waters, wells that could have significant impacts on a spring, and wells with a high water loss are subject to more rigorous evaluation. Since the 2004 adoption of Act 310, the scope of the WDNR's review of proposed high capacity wells has expanded even more as a result of the July 2011 Wisconsin Supreme Court decision in the *Lake Beulah* case and a September 2014 administrative law decision in the *Richfield Dairy* case. When reviewing high capacity well applications, WDNR staff now consider impacts to all waters of the state including streams, lakes, wetlands, municipal wells and private wells, cumulative impacts of the proposed well along with other wells on the same property and water withdrawals on other nearby high capacity well properties. If significant impacts are predicted, the well application may be modified or the approval may be denied.

In terms of current administrative code, NR 860 and NR 820 establishes the process, requirements, and criteria for water use permitting. NR 856 establishes requirements for registering water withdrawals and accurate reporting to support management efforts. NR 852 establishes a statewide water conservation and efficiency program, specifying mandatory measures in the Great Lakes Basin. In other areas of the state, the regulation applies to wells that would result in an average water loss greater than 2,000,000 gals./day over a 30 day period (although, relatively few wells exceed this amount).

Wisconsin law also requires a statewide water supply service area planning process for public water supply systems (Wis. Stats. 281.348). This is being promulgated through proposed rule NR 854. This rule would apply to water supply systems that serve a population of 10,000 or more. These systems would be required to be covered by an approved water supply service area plan by December 31, 2025.

The goal of the planning process is to help sustainably manage the state's waters to provide an adequate quantity and quality of water to customers; to prepare for increasing demands on the state's groundwater and surface water resources; and to protect springs, streams, wetlands, and other natural features. The law requires that communities assess the quantity and quality of available water supply through a practical planning process to ensure dependable, safe, and cost-effective water delivery to customers.

## Local Controls

Local units of government in Dane County can voluntarily manage their water supplies to help minimize impacts to their environment and promote more sustainable water use. Significant collaborative efforts have been made among federal, state, and local entities to conduct groundwater modeling and planning activities in the region coordinated by CARPC. While much has been accomplished, more can be done in this regard.

### Impact/Effectiveness

The WDNR has the "authority and general duty" to consider whether a proposed high capacity well may harm waters of the state.[8] The WDNR is also required to consider the cumulative impacts when deciding whether to approve, condition or deny high capacity well approvals.[9] The WDNR uses both its expertise in water resources management and its discretion to determine whether its duty as a trustee of the Public Trust resources is implicated by a proposed high capacity well permit application. The approvals are predicated on the facts and information presented to the WDNR by the well owner in the permit application, by citizens, and by other entities while the permit is under review. In Dane County significant state-of-the-art scientific tools have been developed (presented in this report) that can help inform communities and aid the WDNR in its decisions and approvals. Furthermore, continued regional collaboration will be needed among municipalities to minimize and mitigate the impacts of high capacity well withdrawals on the region's ground and surface waters, and promote more sustainable plans and practices in the future. Therefore, cooperative groundwater management policy in the region should include:

- a regional/watershed approach
- up-to-date hydrologic science
- increased focus on addressing cumulative impacts
- opportunities for water conservation and reuse
- monitoring and reporting
- adequate funding
- widespread participation and collaborative support

## Public Information and Education

A well-developed educational program concerning groundwater protection should continue to be pursued in Dane County. Only through an informed public will groundwater be adequately protected. Public education on the occurrence and movement of groundwater, potential pollution sources and groundwater protection strategies is necessary to maintain the high quality of groundwater in the county. Also, in many instances, public knowledge is imperative for complying with state and local regulatory programs pertaining to groundwater management.

Particular emphasis in groundwater educational programs should be placed on how land use activities affect drinking water quality. This is especially relevant in Dane County because all residents obtain their drinking water from groundwater supplies. If individuals understand that their drinking water supply may be at risk, they will probably be more inclined to prevent water pollution.
General as well as detailed groundwater educational programs should be promoted to the public. Various federal and state agencies have all developed general educational and resource materials that are available to Dane County residents. A good place to begin with groundwater education is in the school systems of the county, where environmental awareness may be instilled at an early age. The Groundwater Coordinating Council publishes the *Wisconsin Groundwater Education Resource Directory,* which is a compendium of the agencies, people and resource materials available for use in groundwater education.

In addition to general educational efforts, specific programs should be developed (or intensified) and targeted at groups that have a direct land use impact on groundwater. In many instances, this means the agricultural community. Thus, educational programs concerning agricultural best management practices should receive emphasis. Best management practices that minimize detrimental groundwater impacts include pest control strategies that limit pesticide use (e.g., crop rotation), proper pesticide container and

[8] Wisconsin Supreme Court *Lake Beulah* decision, July 2011 .
[9] Administrative Law Judge *Richfield Dairy* decision, September 2014.

rinse water disposal, fertility and manure management, and irrigation. County and UW-Extension promote many of these practices, and educational outreach programs are needed to reach more farmers. Renewed staff and resource commitments to Extension are necessary to expand existing educational efforts. CARPC also has a role in water service area planning.

## Waste Recovery Programs

Waste recovery programs reduce the overall quantity of refuse to be disposed of in the county. As a result, a reduction in the need for landfill space can occur along with a reduction in associated environmental concerns. In addition, the need to use raw materials is diminished and an economic cost savings may be realized. The Dane County Solid Waste and Recycling Plan, adopted by Dane County and the RPC as a specific element of the *Dane County Water Quality Plan*, sets the policy framework for each segment of the solid waste system. The Dane County Solid Waste Division is responsible for the siting, construction, operation, maintenance, closure, and post-closure care of Dane County's landfills, compost sites, and landfill gas-to-energy systems. This Division also coordinates and manages the County's recycling and Clean Sweep programs and activities, for example:

### Recycling

Recycling consists of the separation of waste into components that are later converted into new products. This is now required for many common materials. All local units of government in Dane County have developed recycling programs to various levels. There is always room for improvement to further the amount of waste being landfilled.

### Clean Sweep

Household hazardous materials (e.g., paint, cleaning compounds, pesticides, wood preservatives) have become an increasing concern in waste collection and disposal. Such waste is often disposed of by residents along with other household refuse. A community or countywide educational program promoting the safe collection and disposal of household hazardous waste is a non-regulatory approach that can be used to lessen disposal problems.

Dane County and the City of Madison have joined in establishing a successful household hazardous waste collection and disposal program (Operation Clean Sweep and the Product Exchange Program). The Product Exchange is a program where customers are encouraged to reuse quality waste products left by others (about 15 percent of material that comes into the facility), including paint, solvents, cleaning products, etc.

### Waste Oil Collection

Waste oil collection is another waste recovery method which helps to safeguard the environment. Individuals who sell motor oil are now required by law to either post a sign directing consumers to the nearest waste oil collection site or set up a collection center themselves. Design and locational criteria for such sites are set forth in NR 679. Numerous waste oil collection sites exist in Dane County.

### Pharmaceuticals and Personal Care Products (PPCPs)

Scientific evidence shows that a growing number of drugs and chemicals found in personal care products are ending up in waterways across the country. The potential for harm to human health is not known at this time, but because drinking water is drawn from these same sources, there is a growing concern about how these drugs and other substances may be affecting people, especially with long-term exposure. To protect out drinking water and our health, it makes sense to reduce the amount of these PPCPs in our wastewater as

much as possible. In Dane County, MedDrop is the best way to dispose of medicines or pharmaceuticals. Lotions, soaps, sunscreen, shampoo, and perfume also wash off easily when we shower, bathe, or go swimming. These chemicals end up in our waterways and little is known about the effect they may have. We can make conscientious choices to reduce these products or buy those that contain only biodegradable or natural ingredients.

## Groundwater Quality Monitoring

Monitoring of groundwater through public, private and observation wells provides needed information on existing water quality conditions. Such monitoring is essential in determining the existence and extent of groundwater pollution. If monitoring is maintained over an extended period, water quality changes may also be observed. Monitoring is routinely done for public water supply wells and near groundwater pollution sources.

Since it is impossible to monitor all sources of potential pollution, monitoring programs focus on identifying the most important ones. The importance of a potential pollution source is related to the magnitude of potential pollution (volume, degree of toxicity, etc.), the risk associated with such pollution (population exposed, seriousness of effects, etc.) and the probability or likelihood of pollution occurring.

### Public Well Water Monitoring

Monitoring of public water supply systems is particularly important because of the large population at risk if a well is polluted. The federal Safe Drinking Water Act requires periodic monitoring of all public wells. Monitoring requirements and frequency for various organic and inorganic contaminants are detailed in chapter NR 809.

Since 1999, public water suppliers have been required to publish Consumer Confidence Reports, plainly worded reports which raise general awareness about drinking water and help consumers make informed decisions about their health. The reports include information such as the source of water, drinking water standards, regulated and unregulated contaminant levels, health concerns, and who to call for more information. The reports are sent to all customers by mail and efforts also made to reach those not billed, such as through local newspapers.

In addition, the 1996 Safe Drinking Water Act Amendments require states to develop and implement a Source Water Assessment Program (SWAP). Source water assessments are documents produced by WDNR staff during the period between 1999 and 2003 intended to provide basic information to public water suppliers. This program: 1) Delineates source water assessment boundaries for all public water systems in the state; 2) Inventories existing and potential sources of contamination within those boundaries; 3) Analyzes the susceptibility of the water systems to the contaminants; and 4) Makes the results of the assessments available to the public. The goal of the program is to use the assessments to protect public water supplies through prevention strategies, especially those most vulnerable to contamination.

### Private Well Water Monitoring

The Department of Public Health for Madison and Dane County has been delegated state authority to administer and enforce well siting and abandonment permits and requirements. For new wells drilled or new pumps installed only a test for bacterial contamination is required. Testing for nitrates is recommended. Some mortgage lenders may require testing be conducted associated with property transfers. Also, any private well owner in the Madison Water Utility service area is required to obtain an operating permit which requires the well to be tested every five years. Outside of these requirements, private well owners are not compelled to have their wells tested, usually because of cost and

inconvenience. Private well owners are recommended to test their water for bacteria and nitrates on a yearly basis, or whenever there are changes in taste, color or odor. Nitrate levels greater than 20 mg/l indicate a pathway connection to the surface and pesticides should also be tested. WDNR performs private well water monitoring for VOCs and pesticides on a risk assessment basis, and also publishes brochures which recommends various tests for drinking water from private wells.

## Observation Well Monitoring

Observation well monitoring is required by the WDNR at several waste disposal sites in Dane County. The degree of monitoring varies with each site.

## Groundwater Data Management

The collection, coordination, and exchange of groundwater data within the WDNR and with outside agencies continue to be an important issue. WDNR places priority on coordinating the collection and retrieval of all groundwater data to meet inter-agency responsibilities and cooperative agreements.

Groundwater data from WDNR's consolidated Groundwater Retrieval Network (GRN) system is available on the following website http://prodoasext.dnr.wi.gov/inter1/grn$.startup. GRN accesses groundwater data from database systems in the Waste and Materials Management, Drinking Water and Groundwater, and Watershed Management programs including information on approximately 300,000 wells in the state and nearly 15,000 wells in Dane County. These wells represent public and private water supply wells, piezometers, monitoring wells, non-potable wells, and groundwater extraction sites. Data from the Bureau of Remediation and Redevelopment (LUST, spills, or remediation sites) is not currently retrievable through the GRN system. Rather, the Contaminated Lands Environmental Action Network (CLEAN), http://dnr.wi.gov/topic/Brownfields/clean.html, is an inter-linked system providing information on different contaminated land activities in Wisconsin, to assist with the investigation, cleanup and eventual re-use of those lands.

DATCP also needs up-to-date, reliable data about pesticide and nitrate contamination of groundwater. DATCP uses these data to develop substance specific rules about pesticide use, to respond to citizen requests on groundwater quality data for specific locations, and to investigate pesticide contamination of groundwater. DATCP's groundwater database currently contains information for over 62,000 wells (about 811,000 data records). DATCP is also the primary agency responsible for administration and regulation of the petroleum and hazardous materials storage tanks http://datcp.wi.gov/Consumer/Hazardous_Materials_Storage_Tanks/. Program initiatives have resulted in identifying a larger population of underground storage tanks

WGNHS has responsibility for geologic mapping, collection and analysis of basic data, survey and research on Wisconsin's groundwater resources. Products from the geologic mapping program support land-use planning, county-wide inventories of groundwater resources, and groundwater quality management and protection.

The UWS Central Wisconsin Groundwater Center maintains a database of private well testing data for nearly 228,000 test results from samples covering the state for various inorganic chemical and biological parameters. In addition, the Wisconsin Well Water Quality Interactive Viewer (http://www.uwsp.edu/cnr-ap/watershed/Pages/WellWaterViewer.aspx) was created as an educational tool to help people better understand Wisconsin's groundwater resources that we rely on for our drinking water.

DOT maintains records of hazardous material investigations associated with highway projects, including groundwater contamination.

In 1998, The Wisconsin Groundwater Coordinating Council updated the *Directory of Groundwater Databases*, which cross-references agency databases and principal contacts. The directory describes the agencies which have responsibilities or conduct activities related to groundwater protection, and principal contacts, as well as internet sites for retrieving groundwater or related information.

# Chapter 8: Groundwater Protection Recommendations

This chapter presents groundwater protection recommendations for each potential groundwater pollution source. They incorporate and expand upon much of the work and findings from previous plans and studies, as well as information from the supporting sections of this plan. These proposals provide a range of both regulatory and non-regulatory approaches to groundwater protection that should be promoted and implemented by various state and local organizations as early as opportunity and circumstance allow. Chapter 9 follows with selected short-range priority actions recommended for immediate management agency consideration.

## Siting and Land Use Decisions Affecting Groundwater

**Assessment of Conditions and Management Controls:**

Sources of groundwater pollution are many and varied. Many activities that contribute to groundwater pollution are closely integrated into our economic and cultural way of life. The type, duration, and intensity of our use of the land will largely determine the risk posed to groundwater.

Thus, siting and land use decisions made by state agencies, and by county and local governments and private landowners, can have a significant effect on drinking water supplies. In addition, wellhead protection programs are an important approach to drinking water supply protection. Although these programs are being required by federal and state regulations, given the catastrophic impacts on a community resulting from contamination of their water supply, the costs of replacing a contaminated well, the near impossibility of cleaning up a contaminated aquifer, and the importance of citizen confidence in the safety of their drinking water, this preventive approach has been strongly supported by communities – basically giving them local control and responsibility for their drinking water supplies.

Some aspects of wellhead protection programs, such as protecting important recharge or source areas, may need to extend beyond municipal boundaries, and will therefore require intergovernmental cooperation. Communities may want to consider extraterritorial zoning, intergovernmental agreements, open space plans, etc. Such an approach can reduce the risk of drinking water contamination and may avoid future infrastructure costs such as new wells or treatment.

Much of the information and analytical capacity for incorporating groundwater protection concerns into land use planning and decision making processes exists (e.g., hydrogeologic model, contamination risk maps, guidelines and criteria in **Reference Table 20,** etc.). Greater efforts are needed to ensure that impacts on groundwater quality are routinely and adequately considered in siting and land use decisions.

**Recommendations:**

1. All significant land use and siting decisions should include evaluation of potential groundwater and hydrologic impacts. Local units of government and other responsible agencies should seek CARPC staff participation, technical review and comment on land use proposals.

2. Specific language should be added to county and municipal zoning and subdivision ordinances to require that groundwater protection receives adequate consideration and assessment during the review and approval process. CARPC staff can provide technical assistance in this regard.

3. Local units of government with land use authority should be encouraged to collaborate with the county and formally incorporate groundwater impact assessment procedures into their land use decisions. In addition, municipalities should consider treating facilities with the potential to affect groundwater quality as conditional or prohibited uses in wellhead protection areas under a municipal wellhead protection ordinance. Also consider alternative options for plan implementation such as intergovernmental agreements and open space plans, CARPC staff can provide technical assistance in this regard.

4. CARPC staff should continue to provide assistance, through the Regional Hydrologic Modeling and Management Program, to local units of government and water supply agencies in Dane County, to maximize participation in the state Wellhead Protection Program and develop groundwater protection programs to protect all major water supply wells and aquifers in the region.

## Solid Waste Disposal Sites

**Assessment of Conditions and Management Controls:**

A deterioration in groundwater quality has occurred near several closed landfills in Dane County. Strict regulatory requirements have been established for landfills since the 1980s; however, most closed landfills in the county were developed before these requirements were enacted. Groundwater quality is being monitored near only a small number of landfills, thus the extent of groundwater pollution may not be realized.

**Recommendations:**

1. The WDNR in conjunction with the Regional Planning Commission should establish a priority list for monitoring closed or inactive landfills.

   Highest priority for monitoring should be closed or inactive landfills located in areas of high or extreme contamination risk in municipal well protection zones. Subsequent priority should be for landfills in areas of moderate risk in well protection zones.

2. New solid waste disposal sites and landfills should continue to be located and designed to protect surface and groundwater. Proposed landfills should be located outside of municipal well protection zones and in areas of low to moderate groundwater contamination risk. WDNR and other responsible state agencies should seek CARPC staff participation, technical review and comment on proposed locations.

## Land Application of Wastewater

**Assessment of Conditions and Management Controls:**

A few industries in Dane County discharge wastewater through land application systems, mainly organic food processing and canning wastewaters. State controls for wastewater dischargers are stringent, but groundwater monitoring is limited. No detrimental impacts have been reported.

**Recommendation:**

1. Sites for land application of wastewater should be carefully located and designed to avoid groundwater contamination, and should not be located in areas of extreme contamination risk or municipal well protection zones. All significant land application sites should be subject to groundwater monitoring. WDNR and other responsible state agencies should continue to request CARPC staff technical review and comment on proposed application sites and permit renewals.

2. Dane County should continue to support and promote recycling and waste-reduction programs to decrease waste loads going to landfills – ultimately reducing the need for additional landfills. The county should continue to support and expand Clean Sweep programs to collect household hazard wastes for proper disposal.

## Sanitary Sewers

**Assessment of Conditions and Management Controls:**

Recently, viruses and other microbial pathogens have been found in municipal wells, challenging previous assumptions about their occurrence. Virus serotypes detected in sewage and groundwater were temporally correlated, suggesting very rapid virus transport, on the order of weeks, from the source(s) to wells. Virus levels in the wells were associated with precipitation events. The most likely source of the viruses in the wells is leakage of untreated sewage from sanitary sewer pipes. As older, failing infrastructure is replaced, emphasis should continue to be focused on adequate construction, testing, and disinfection of public drinking water supplies.

**Recommendation:**

1. Continued emphasis should be placed on municipal sanitary sewer inspection and repair programs to reduce infiltration of groundwater into sewers and also sewage leaking into groundwater.

2. Municipal wells should be properly constructed and cased to discourage contamination. Testing and retrofitting existing wells should be conducted where opportunities present themselves.

3. Continued disinfection of municipal drinking water supplies is necessary to protect and maintain human health.

## On-Site Wastewater Management

**Assessment of Conditions and Management Controls:**

Over 23,000 homes in rural Dane County are served by on-site wastewater systems. Private well samples indicate that a significant proportion (approximately 25 percent) of domestic wells have nitrate levels exceeding the drinking water standards. While it does not appear that on-site systems are a major source of nitrates on an areawide basis, localized well contamination can result from high loading from clusters of on-site systems (rural subdivisions). Although the impacts on groundwater of septic systems in all the soil-geologic-hydrogeologic settings in the county are not clearly understood, systems which: a) have failed hydraulically or b) are not treating and purifying wastes as they are designed to, are probably adversely impacting groundwater. Implementation of the triennial inspection and required maintenance program for all on-site systems has helped the continued proper functioning of those systems which have not failed, and identifying those that have.

**Recommendations:**

1. Governmental units responsible for the regulation of private on-site wastewater treatment systems should continue to implement an effective inspection and required maintenance program for all on-site wastewater disposal systems.

2. Local management and planning agencies should cooperate in investigating and developing community water systems for existing concentrations of rural development experiencing on-site wastewater system problems and/or nitrate contamination issues.

3. Large on-site wastewater systems and clusters of more than 20 systems with an average density of 1.0- to 1.5-acre lot size should be planned and evaluated to ensure that wells and water supplies are protected from excessive nitrate levels.

4. Holding tanks should continue to be used for wastewater disposal only in instances when adequate servicing and pumping can be assured, and when suitable disposal methods (well-regulated land disposal sites or wastewater treatment plants) are specifically available for receiving the wastes.

5. Explore innovative methods for improving waste disposal and groundwater quality through site design and new technologies.

6. Local units of government and Public Health Madison and Dane County should encourage all residents with private wells to have their water tested for nitrates, especially those with infants.

7. State and local funding for on-site wastewater management and septage disposal programs should be increased to adequate levels.

## Biosolids Applications

**Assessment of Conditions and Management Controls:**

Biosolids are a byproduct of our modern society and the need to manage their use will continue in the future. They provide an excellent source of plant nutrients and organic matter for agriculture, which should not be wasted by landfilling or incineration. Their creation is carefully managed to reduce the health risks associated with pathogens and heavy metals. Their use is closely monitored by both the USEPA and the WDNR. Research on biosolids process and management has been conducted at the University of Wisconsin for over 80 years and continues to this day. The land application of biosolids should be incorporated into a farm's nutrient management plan to reduce the risk of water quality degradation. In Dane County no detrimental groundwater quality changes have been indicated from private well water monitoring near biosolids application sites. The current state regulatory program has been effective and should continue.

**Recommendations:**

1. Organic biosolids should continue to be recycled as a fertilizer and soil conditioner for agricultural cropland, nurseries, and sod farms.

2. The location and operation of biosolids land application sites should continue to be regulated by WDNR. Criteria for sites should be expanded to reflect groundwater protection, and sites should not be located in areas of extreme groundwater contamination risk. WDNR and other responsible agencies should seek CARPC staff participation, technical review and comment on proposed locations.

3. Wastewater treatment plants should continue to maintain adequate biosolids storage capacity (180 days) to avoid the need to apply biosolids to land during winter months or under saturated soil conditions.

4. Increase communication between biosolids applicators and landowners to ensure biosolids nutrient applications are being accounted for in nutrient management plans.

## Septage Applications

**Assessment of Conditions and Management Controls:**

About 26 million gallons of septage, a high-strength organic waste, is handled in Dane County annually, with about 90 percent of the total discharged to wastewater treatment plants and the remainder applied to landspreading sites. Landspreading septage under controlled and monitored conditions would be consistent with the *Dane County Water Quality Plan.* However, there is much less routine monitoring and supervision of application sites and procedures than other similar waste management programs, such as land application of wastewater treatment plant sludge or biosolids. Consequently, there is not

enough information to determine whether or not the required site conditions and application procedures are being observed, or whether any significant problems are occurring.

**Recommendations:**

1. Public Health-Madison and Dane County should assume responsibility for or participate in the approval and inspection of landspreading sites for the disposal of septage.

2. Land application sites for septage should be carefully located and designed to avoid groundwater contamination, and should not be located in areas of extreme groundwater contamination risk or well protection zones. Existing sites located in these areas should be monitored and subjected to stringent design and operating requirements, and eventually phased out. WDNR and other responsible agencies should seek CARPC staff participation, technical review and comment on proposed locations.

3. Municipal wastewater treatment plants should include provisions for receiving and treating septage generated within a reasonable distance. This recommendation has largely been implemented. Additional sites should be explored that do not currently accept septage.

## Manure Storage

**Assessment of Conditions and Management Controls:**

Animal waste (manure) handling and management is an integral part of much of the agriculture in the county. Manure storage pits and manure-spreading can pose a threat to groundwater quality. Chapter 14 of the County Zoning Ordinance has been modified to include the proper design and construction of manure storage facilities. A state permit system exists for the few large feedlot operations in the county.

**Recommendations:**

1. Manure storage pits or lagoons should be located and designed in accordance with specifications necessary to protect groundwater. Large storage pits should not be located in areas of high or extreme groundwater contamination risk. WDNR and other responsible agencies should seek CARPC staff participation, technical review and comment on proposed locations.

## Fertilizer and Manure Spreading

**Assessment of Conditions and Management Controls:**

A high level of nitrate-nitrogen is evident in Dane County's shallow groundwater system. Excessive fertilizer application in excess of crop uptake is believed to be increasing groundwater nitrogen concentrations on an areawide basis. Limited regulatory controls over fertilizer application exist.

**Recommendations:**

1. Further educational programs and best management practices aimed at reducing nitrogen fertilization should be stressed to county farmers as well as to residential and commercial applicators of fertilizers. Emphasis should be placed on the vulnerability of

groundwater to contamination and the difficulty/expense of restoring drinking water supplies. This should be a collaborative effort among local partners including the county Land Conservation Division, Madison and Dane County Public Health, CARPC, the Clean Lakes Alliance, Yahara Pride Farms, among other groups.

## Pesticide Applications

**Assessment of Conditions and Management Controls:**

Atrazine was the most widely used herbicide in Wisconsin for more than 40 years because it is effective and inexpensive. According to DATCP, 40 percent of private wells tested across the state have atrazine detections, while about 1 percent of wells contain atrazine over the groundwater enforcement standard. Limited groundwater monitoring for pesticides has occurred in Dane County. Approximately two-thirds of central Dane County is designated an atrazine prohibition area. Applicators of restricted use pesticides are required to be trained and certified, while applicators of general use pesticides have no training requirements.

In 1997 and 2007 DATCP conducted an *Atrazine Rule Evaluation Survey* to evaluate the restrictions on the use of atrazine in Wisconsin. The results showed a significant decline in atrazine concentrations in Wisconsin. However, while the average atrazine concentrations in wells with detections declined 44 percent (from 0.96 to 0.54 *u*g/l) the percent of contaminated wells did not show a significant decline. The results of a DATCP *Weed Management Survey in Atrazine Prohibition Areas* survey suggests that although many corn growers would like the option to use atrazine in a prohibition area, they have adapted well to growing corn without it.

**Recommendations:**

1. Increased monitoring for pesticides in groundwater should be conducted in areas of extreme contamination risk where pesticides are commonly used. This should be done by the Department of Agriculture and the WDNR.

2. Support should be provided for the state Atrazine Management Program, which currently bans the use of atrazine in a major portion of the county and allows only for reduced usage in other areas.

3. Adoption by county farmers of Integrated Pest Management (IPM) strategies, which direct pesticide application only when needed, should be encouraged and supported by Dane County Land Conservation Division and Dane County UW Extension.

4. Educational efforts aimed at farmers, homeowners and commercial applications of pesticides by Dane County UW Extension should be expanded and continue to emphasize the vulnerability of groundwater to contamination and the tremendous difficulty of restoring groundwater once it has been contaminated.

5. Stimulate innovation at the local/farmer level; Dane County Land Conservation Division and Dane County Extension should encourage farmers to apply for grants that support innovation in the development of sustainable practices (such as the U.S. Department of Agriculture's Sustainable Agriculture, Research, and Education (SARE) program).

## Irrigation

**Assessment of Conditions and Management Controls:**

Irrigation can facilitate the leaching of fertilizers and pesticides to the groundwater. Irrigation, though, is not widespread in the county. High-capacity irrigation wells are regulated by the state.

**Recommendation:**

1. Continue registration and monthly reporting of high capacity wells and withdrawals.

## Household Hazardous Materials

**Assessment of Conditions and Management Controls:**

Household hazardous materials (e.g., cleaning agents, paint products) are commonly used by residents and ultimate disposal of these materials often means landfilling or improper dumping. If not safely disposed, hazardous materials can degrade groundwater quality. Dane County and the City of Madison have established the Clean Sweep and Product Exchange programs for proper collection and disposal of hazardous wastes.

**Recommendation:**

1. A countywide information and education program concerning the safe collection and disposal of household hazardous materials, along with the use of alternative products to these materials, should continue to be promoted through the Clean Sweep and Product Exchange programs. Emphasis should be made on the vulnerability of groundwater to contamination, and the tremendous difficulty/expense of restoring groundwater once it has been contaminated.

2. Local units of government should continue to promote public information and education programs concerning pharmaceuticals, personal care products, and endocrine disrupting compounds in groundwater, along with continued support for the MedDrop program for expired and unused medications.

## Aboveground Storage Tanks

**Assessment of Conditions and Management Controls:**

Chemicals leaking from aboveground storage tanks may infiltrate the soil and pollute groundwater. The threat of pollution, though, is less than from underground tanks. The Department of Agriculture, Trade and Consumer Protection has an ongoing program to regulate above and underground tanks. The program requires registration and inspection. Inspection responsibilities can be conducted by city, village, and town fire chiefs, who serve as the state agency's

designated deputies.

Regulations for large aboveground tanks storing petroleum products should help minimize adverse impacts from leaks or spills. Requirements for the bulk storage of pesticides and fertilizers should also minimize groundwater quality threats from these sites.

**Recommendation:**

1. There are information gaps regarding smaller (1,100 gals. or less) fuel and chemical tanks in rural parts of the county. Proper on-farm storage of fuel, pesticides, and fertilizers should receive greater emphasis, including education, increased security and safety/containment.

## Underground Storage Tanks

**Assessment of Conditions and Management Controls:**

Leaking underground tanks have a significant potential to contaminate groundwater and threaten municipal and private water supplies.

State regulations for underground tanks contain permitting, testing and on-site inspection requirements have significantly reduced the threat of groundwater quality degradation. While the responsibility for this program rests largely with state government, the county should continue to encourage on-site inspection to prevent discharge of contaminants to groundwater due to tank failure. Pollution prevention costs are substantially less than remediation.

Recommendations:

1. Although tank testing is required on a five-year basis, this may not be of sufficient frequency to adequately detect and respond to leaks, particularly in municipal well protection zones. More frequent monitoring and testing requirements should be considered in wellhead protection plans for tanks in these areas, as well as other areas of high or extreme contamination risk. Existing tanks not providing adequate corrosion protection or leak containment should be replaced or properly abandoned.

2. The State should consider reinstating the Petroleum Environmental Cleanup Fund Award (PECFA) to help individuals and small business owners who lack the resources to respond adequately to a leaking tank on their own.

## Transmission Pipelines

**Assessment of Conditions and Management Controls:**

Groundwater quality problems have not been documented from the major petroleum pipelines in Dane County. Leaks from these pipelines, though, could pose a serious groundwater hazard due to the amount and type of pollutant released. The federal government has regulatory authority over petroleum pipelines. No local management proposals are suggested.

## Hazardous Spills

**Assessment of Conditions and Management Controls:**

In Dane County, numerous hazardous spills have been reported to the WDNR. Some of these spills have reached the groundwater table. Strict state requirements pertaining to hazardous substance handling, spill contingency plans and spill reporting assist in preventing harmful impacts.

**Recommendation:**

1. Dane County should continue to provide funding to allow the City of Madison to provide response assistance for local fire departments and emergency response personnel throughout the county. This will allow spill response equipment and emergency efforts to be more cost-effective and readily available on a countywide basis.

## Junkyards/Salvage Yards

**Assessment of Conditions and Management Controls:**

Although groundwater quality problems have not been identified at many of these sites, leakage of hazardous materials from improperly managed junkyards and salvage yards can represent a pollution threat. A conditional use permit and an annual license are required by Dane County before a salvage or junkyard can be operated.

**Recommendation:**

1. Active local and state oversight of hazardous materials at junkyards/salvage yards should be continued.

## Salt Storage and Deicing

**Assessment of Conditions and Management Controls:**

Sodium and chloride concentrations have been increasing in the water of Madison wells. These increases are associated with salt use. Generally, salt storage sites are not a problem in the county due to adequate containment and state regulatory controls. Temporary snow storage sites should be located and managed to avoid groundwater pollution.

**Recommendation:**

1. Municipalities in the region should re-evaluate their practices regarding the application of road salt for snow and ice control and strive to achieve minimum application rates consistent with safe operation. This includes alternatives to salt, such as sand-salt mix with enhanced street sweeping, metered application, and promoting less expectations by the public for clean pavement conditions and anticipating increased driving time and slower speeds during winter events.

2. Continue to promote the public information and education efforts of the SaltWise Partnership directed to municipalities, homeowners, motorists, and commercial applicators.

## Stormwater Infiltration

**Assessment of Conditions and Management Controls:**

Significant progress has been made in Dane County and around the state to reduce or mitigate the potential increase in flood peaks through stormwater volume control ordinances. Maintaining pre-development infiltration promotes additional benefits as well, including maintaining stream baseflow, water temperatures, and also water quality considerations (since pollutant loading is a function of runoff volume).

Both NR 151 and Dane County Chapter 14 require development projects to maintain some level of pre-development stay-on volumes. Dane County's ordinance (mirrored by other municipalities in the county) is more stringent, requiring 90 percent of pre-development stay-on for all development types. Additional requirements common to both regulations effectively protect groundwater quality. Municipalities should consider maintaining 100 percent pre-development stay-on volumes, where opportunities exist, as well as enhanced recharge above natural rates to help make up for well water withdrawals in a community.

**Recommendations:**

1. Stormwater Best Management Practice designers should consult WDNR Technical Standards for guidance and acceptability of infiltration practices and performance.

2. Municipalities should consider enhanced infiltration (above current levels) to help offset well water withdrawals in appropriate areas and where potential groundwater mounding/flooding will not negatively impact existing development or property.

3. Municipalities should actively encourage, promote, and track demonstration infiltration practices as part of current urban development in the region. Opportunities for public and private partnerships to undertake and assess new and innovative options for infiltration should be actively sought in partnership with CARPC. Practices such as porous pavement, roof gutters connected to infiltration trenches, and channeling of residual runoff to an infiltration pond could be installed and their effectiveness monitored.

## Well Construction and Abandonment

**Assessment of Conditions and Management Controls:**

High-capacity wells serve most communities and many industries in Dane County. These wells are generally deeper and of larger diameter than private domestic wells. Although many of these wells produce water from the deep sandstone aquifer, such wells are sometimes constructed with well casings extending only into the shallower bedrock units. High-capacity wells with shallow casings create a vertical conduit that can allow groundwater to move rapidly between the shallow and deep bedrock aquifers. Contamination in the deep bedrock is extremely expensive and difficult to remediate. In addition, viruses found in deep municipal wells indicate that *all* aquifers are potentially vulnerable to microbial contamination.

**Recommendation:**

1. Municipalities and industries in Dane county designing new high-capacity wells should design the wells (e.g., adequate casing depth, etc.) to be sure to avoid cross-connecting the shallow and deep aquifers across the Eau Claire aquitard . Older wells with inadequate casings should be reconstructed with deeper casings or properly abandoned as they go out of service. The Wisconsin Geological and Natural History Survey and WDNR can assist in designing new wells and abandoning old wells.

## Groundwater Quality Monitoring

**Assessment of Conditions and Management Controls:**

Easy access to available geologic and groundwater information is essential if this information is to be useful for day-to-day management decisions. In the long term, it is likely that land planning and resource management will continue to evolve toward a total system/network based on computerized geographic information systems (GIS) storing a wide array of data and information for specific locations and small geographic areas, including geologic and groundwater data. It is important that appropriate information be gathered that is suitable for such a system, and can be linked with other databases and systems.

**Recommendation:**

1. Additional groundwater quality monitoring and testing should be conducted in Dane County by WDNR and DATCP, with specific needs related to the impacts of closed landfills, underground and aboveground storage tanks, barnyards and manure storage, agricultural fertilizer and pesticide use, and the impacts of on-site wastewater systems. The groundwater contamination risk maps and well protection zones can be used to prioritize geographic areas needing more urgent attention.

2. Public Health Madison and Dane County and Dane County UW Extension should provide rural homeowners with information and guidelines for testing their wells.

## Groundwater Quantity Management

**Assessment of Conditions and Management Controls:**

Groundwater Quantity Management is currently a work in progress in Wisconsin. Under current law, a person may not construct a high capacity well without an approval from WDNR Current law also requires WDNR to administer a planning process for public water supply systems that serve a population of 10,000 or more. A water supply plan specifies the area for which a public supply system will provide water and how the system will provide the water.

Significant research and progress has been initiated in the region to address the impacts of well water withdrawals through the CARPC Regional Hydrologic Modeling and Management Program. These efforts need to continue to be supported and expanded throughout the region. Efforts should be focused on coordinated and comprehensive strategic implementation of plans among communities, using the information and tools detailed in this plan, to arrive at the least cost alternatives for each community addressing reliability, sustainability, and resource-based issues.

**Recommendations:**

1. In cooperation with local management agencies, CARPC should conduct proactive and collaborative regional groundwater planning among communities to address water availability and sustainability issues related to ground and surface water resources.

2. In cooperation with local management agencies, CARPC should maintain an inventory of information on the location, quantity, and uses of the region's groundwater.

3. In cooperation with local management agencies, CARPC should conduct targeted research and modeling of the impact of groundwater withdrawals on surface waters.

## Groundwater Data and Information Management

**Assessment of Conditions and Management Controls:**

Much of the current groundwater data is being gathered by separate agencies and filed in such a manner that it is difficult to extract and utilize. Easy access to available geologic and groundwater information is essential if this information is to be useful in day-to-day management decisions.

The first step in improving the accessibility and utility of available groundwater data is to develop an organizational framework by which this information may be collected, analyzed and shared among resource management agencies and decision-makers in Dane County. The interagency Regional Hydrologic Modeling and Management Program is part of an ongoing collaborative effort between CARPC, WGNHS, WDNR, and USGS in cooperation with participating state and local governments to establish an information management

program and provide analytical tools to promote better management of Dane County's water resources. CARPC also coordinates an ongoing Cooperative Water Resource Monitoring Program which includes water quality baseflow sampling on representative streams throughout the county, to better assess problem areas and groundwater quality improvements to surface waters.

In the long term, resource and land planning and management will continue to evolve using computer tools, technologies, and geographic information management systems that store a wide variety of data and information for specific locations and small geographic areas, including geologic and groundwater data. It is important that comprehensive groundwater quantity and quality data be collected that is available for use at the local level that is also useful at a regional scale for evaluating groundwater conditions and trends.

**Recommendation:**

1. Dane County, CARPC, and other federal, state and local agencies should continue to develop and use a cooperative and comprehensive groundwater data and information management system for more effective and groundwater protection, planning, and management in the region overall through the ongoing Regional Hydrologic Modeling and Management Program.

# Chapter 9: State and Local Government Priority Actions

In this section, those actions and programs which need priority attention in the near future are presented for each level of government. These proposals are limited to the most important areas of immediate concern based on the review of present programs and deficiencies presented at the end of Chapter 8.

## State Government

### Department of Natural Resources

1. Consider and utilize the information, tools, criteria and guidelines identified in this planning framework in site approvals, or permits that could impact groundwater in Dane County. These include high-capacity well approvals, WPDES permits for wastewater facilities discharging to groundwater, site approval for biosolids and septage landspreading sites, stormwater infiltration practices, sanitary landfills, large manure storage lagoons or feedlots, and prioritizing remediation sites and monitoring. WDNR and other responsible agencies should seek CARPC staff participation, technical review and comment on proposed projects and locations.

2. Work with local governments, Dane County and CARPC to develop effective wellhead protection programs and source protection plans for all municipal wells in Dane County. Also, provide information, guidelines and contacts to rural homeowners for testing drinking water quality in cooperation with the Department of Public Health – Madison and Dane County.

3. Support increased groundwater monitoring directed at priority concerns: closed or inactive landfills; leaking underground storage tanks; barnyards and manure storage practices; fertilizer and pesticide use; and land application of biosolids, septage and wastewater.

### Department of Agriculture, Trade and Consumer Protection

1. Consider and utilize the information, tools, criteria and guidelines outlined in this planning framework in site approvals, or permits that could impact groundwater in Dane County. These include large manure storage lagoons and feedlots, and targeting pesticide monitoring and control efforts. DATCP and other responsible agencies should seek CARPC staff participation, technical review and comment on proposed projects and locations.

2. Support increased promotional and educational efforts directed at expanding development of farm nutrient management plans and integrated pesticide management programs in order to reduce pesticide and fertilizer applications.

3. Increase emphasis on proper on-farm storage of fuel, pesticides, and fertilizers.

4. Support increased groundwater monitoring directed at priority concerns: closed or inactive landfills; leaking underground storage tanks; barnyards and manure storage practices; fertilizer and pesticide use.

### Department of Safety and Professional Services

1. Consider and utilize the information, tools, criteria and guidelines identified in this plan in site approvals, or permits that could impact groundwater in Dane County. DSPS and other responsible agencies should seek CARPC staff participation, technical review and comment on proposed projects and locations.

2. Support and work with Dane County in implementing a program for tracking and ensuring that required inspection and maintenance is provided for all on-site wastewater systems in Dane County.

3. Increase support of monitoring and research directed at the groundwater impacts of on-site wastewater systems, and the development of practical and economical nitrogen-removing on-site systems.

## Local Government

### Dane County

1. Incorporate and utilize the information, tools, criteria and guidelines identified in this planning framework in all land use decisions, site approvals, or permits that could impact groundwater. Support and participate in the cooperative Regional Hydrologic Modeling and Management Program. Dane County should seek CARPC staff participation, technical review and comment on proposed projects and locations.

2. Add specific language to the county zoning and subdivision ordinances to require that groundwater impacts and protection receive consideration and assessment during the review and decision-making process. CARPC staff can provide technical assistance in this regard.

3. Work with WDNR, CARPC, and local units of government to develop effective wellhead protection programs and source protection plans for all municipal wells in Dane County, particularly where protection programs need to extend beyond local jurisdictional boundaries.

4. Maintain an inventory of livestock, feedlots, and manure storage facilities in Dane County.

5. Increase promotional and educational efforts directed at developing farm nutrient management plans and integrated pesticide management programs.

6. Continue implementation of the triennial inspection and required maintenance tracking system for all on-site wastewater systems in Dane County. Expand distribution of public informational materials on proper use and maintenance of on-site wastewater systems and private wells, including safe use and storage, collection and disposal of household hazardous materials and personal care products. Provide information, guidelines and contacts to rural homeowners for testing drinking water quality.

7. Continue to seek to assume responsibility for, or participate in, approval of septage landspreading sites.

8. Continue to expand and improve household hazardous waste programs, and emergency response capability for hazardous material spills.

## Cities, Villages, Towns, and Local Water Supply Agencies

1. Conduct water supply service area planning in the region as required by Wis. Stats. 281.348 with assistance provided by CARPC and in collaboration with local management agencies.

2. Incorporate and utilize the information, tools, criteria and guidelines identified in this plan in all land use decisions, site approvals, or permits that could impact groundwater. Support and participate in the cooperative Dane County Regional Hydrologic Modeling and Management Program. Municipalities and water supply agencies should seek CARPC staff participation, technical review and comment on proposed projects and locations.

3. Add specific language to the local zoning and subdivision ordinances to require that groundwater impacts and protection receive consideration and assessment during the review and decision-making process. CARPC staff can provide technical assistance in this regard.

4. Work with WDNR, Dane County and CARPC to develop effective wellhead protection programs and source protection plans for all municipal water supplies. Fix wells with faulty casing separating deep and shallow aquifers to help prevent downward movement of contaminants.

5. Work with DATCP and WDNR to expand monitoring and testing of older underground tanks in municipal well protection zones and areas of high or extreme contamination risk.

6. Continue and expand efforts to reduce the groundwater impacts of salt storage and use and snow removal practices.

7. Cooperate with WDNR and utilize the information and criteria in this plan and through the CARPC Regional Hydrologic Modeling and Management Program in locating and designing new high-capacity wells, in order to minimize adverse groundwater impacts.

8. Continue to work with WDNR, Dane County and CARPC to incorporate stormwater infiltration practices into local erosion/stormwater control ordinances that will protect groundwater.

9. Cooperate in expanding and improving household hazardous waste collection and public information programs, and in improving emergency response to hazardous materials spills.

## Capital Area Regional Planning Commission

1. Conduct water supply service area planning efforts in the region as required by Wis. Stats. 281.348. More specifically, promote proactive and collaborative regional groundwater management planning among communities to address water availability and sustainability issues related to both ground and surface water resources.

2. Assist municipalities and resource management agencies consider and utilize the information, tools, criteria and guidelines outlined in this plan in all land use decisions, site approvals, or permits that could impact groundwater. These include high-capacity well proposals, WPDES permits for wastewater facilities discharging to groundwater, biosolids and septage land spreading sites, stormwater infiltration practices, sanitary landfills, large manure storage lagoons or feedlots, large unsewered subdivisions, prioritizing remediation sites and monitoring, etc.

3. Assist municipalities and resource management agencies in providing public information, education, and technical resources to citizens and landowners concerning groundwater quality protection and management throughout the region.

Presented as such, the Dane County Groundwater Protection Planning Framework is intended to provide the basis for and foster more detailed evaluations and strategic planning at the local level.

## Summary of Groundwater Protection Roles and Responsibilities

**Table 30** summarizes the governmental roles and responsibilities for the various regulatory, non-regulatory and other program activities for the array of potential groundwater pollution sources. This table indicates the level of government (local, state or federal) having significant responsibility for each area of program activity for each potential pollution source.

**Table 30** has been used to indicate the entire array of existing groundwater protection programs and strategies and areas needing substantial improvement, or requiring priority attention or action because of the importance of the pollution source or shortcomings in existing protection programs. These priority areas are indicated by shaded boxes in **Table 30,** and highlight the short-term priority actions for state and local government.

# Table 30
# Groundwater Protection Roles and Responsibilities

| Potential Pollution Sources / Groundwater Management Controls | | Regulatory | | | | | | Non-Regulatory | | | | | Other | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Permits | Site Approval | Land Use Controls | Construction Standards | Use Restrictions | Inspection & Testing | Guidelines/Criteria | Minimizing Input of Pollutants | Education | Voluntary BMP | Governmental Coordination | Training & Demonstration | Monitoring | Research & Inventory | Remedial Action | Emergency Response |
| Waste Disposal | Solid Waste Disposal Sites | S | S | L | S | | sl | sl | L | | | SL | | sl | sl | SL | |
| | Land Application of Wastewater | S | S | | S | | SL | S | | | | | | sl | sl | L | |
| | Sanitary Sewers | S | | SL | SL | | S | S | | | | SL | | | | L | SL |
| | On-Site Wastewater Systems | SL | SL | sL | S | | L | L | | L | | SL | | | SL | | |
| | Sludge/Biosolids Application | S | S | S | | | S | S | | | | SL | | L | SL | | |
| | Septage Applications | S(L) | S(L) | S(L) | | | S(L) | S(L) | | | | SL | | | S(L) | | |
| Agriculture | Manure Storage | L | | | SL | | | sL | | sL | L | | | | L | | |
| | Fertilizer & Manure Spreading | | | | | | | sL | | sL | L | | SL | | | | |
| | Pesticide Application | | | | | S | | SL | L | SL | L | | SL | S | | | |
| | Irrigation | S | | | S | | S | | | sL | L | | | | | | |
| Hazardous Materials | Household Hazardous Materials | | | | | | | | L | sL | | | | | | | |
| | Above-ground Storage | S | | | S | | L | S | | SL | | SL | | | | SL | SL |
| | Underground Storage | S | | | S | | sl | S | | SL | | SL | | SL | S | SL | SL |
| | Transmission Pipelines | F | | | F | | F | F | | | | | | | | S | S |
| | Spills | | | | | | | | | | | SL | SL | SL | S | SL | SL |
| | Junkyards/Salvage Yards | L | | L | | | L | | | | | | | | | | |
| Other | Salt Storage & Deicing | | | | | S | L | S | | L | L | L | | | SL | | |
| | Well Construction & Abandonment | SL | SL | | SL | | SL | S | | SL | | L | | | L | | |
| | Groundwater Quality and Quantity Management | sl | sl | | | | | sL | | sL | | L | | S | sL | L | |

F = Federal Role

S = State Role

L = Local Role (including CARPC)

= Priority Action Needed

L or S = Primary Role

l or s = Assisting or Advisory Role

(L) = Possible Future Regulatory Program

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# Attachment A

## Chemical Analyses for Public Water Supplies in Dane County

| Municipality | Well # | Alkalinity ($CaCO_3$) (mg/l) | Arsenic (ug/l) | Barium (ug/l) | Cadmium (ug/l) | Calcium (mg/l) | Chloride (mg/l) | Chromium (ug/l) | Copper (ug/l) | Fluoride (mg/l) | Hardness ($CaCO_3$) (mg/l) | Iron (mg/l) | Lead (ug/l) | Magnesium (mg/l) | Manganese (ug/l) | Mercury (ug/l) | $NO_3$-$NO_2$ (as N.) (mg/l) | pH (SU) | Selenium (ug/l) | Silver (ug/l) | Sodium (mg/l) | Sulfate (mg/l) | Zinc (ug/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MCL | | | 10 | 2000 | 5 | | | 100 | 1300 | 4 | | | 15 | | | 2 | 10 | | 50 | | | | |
| Belleville | D | | | | | | | | 200 | 0.52 | | | 5.30 | | | | | | | | | | |
| | 1 | 310 | ND | 10 | ND | 61 | ND | 0.2 | | 0.05 | 330 | ND | | 44 | ND | ND | 0.06 | 7.7 | ND | ND | 2.4 | | 22 |
| | 2 | 270 | ND | 10 | ND | 59 | 4.8 | ND | | ND | 320 | ND | | 43 | ND | ND | 1.10 | 7.7 | ND | ND | 4.4 | | 19 |
| Black Earth | D | | | | | | | | 298 | 0.84 | | | 7.80 | | | | | | | | | | |
| | 1 | 310 | ND | 27 | ND | 59 | 0.9 | ND | | 0.29 | 291 | 0.16 | | 36 | 4 | 0.03 | 0.17 | 7.5 | ND | ND | 1.8 | | ND |
| | 2 | 310 | ND | 20 | ND | 58 | 1.4 | ND | | 0.29 | 285 | 0.08 | | 36 | 2 | 0.03 | 0.41 | 7.6 | ND | ND | 2.1 | | ND |
| Blue Mounds | D | | | | | | | | 140 | 0.73 | | | 2.80 | | | | ND | | | | | | |
| | 1 | 296 | 3.1 | 39 | 0.17 | 80 | 58.4 | ND | | 0.14 | 391 | 0.10 | | 47 | 11 | ND | 1.72 | 7.7 | ND | ND | 27.5 | | 447 |
| | 3 | 266 | ND | 18 | 0.20 | 59 | 2.7 | ND | ND | 0.15 | 295 | 0.40 | ND | 36 | 14 | ND | ND | 7.7 | ND | 0.10 | 2.5 | 21.0 | 2 |
| Cambridge | D | | | | | | | | 172 | 0.65 | | | 3.30 | | | | | | | | | | |
| | 2 | 310 | 2.0 | 24 | ND | 65 | ND | ND | | 0.11 | 320 | 0.72 | | 37 | 33 | ND | ND | 7.6 | ND | ND | 4.0 | | 15 |
| | 3 | 320 | 3.1 | 62 | ND | 71 | 2.6 | 1.4 | | 0.50 | 310 | 5.50 | | 33 | 110 | ND | ND | 7.9 | ND | ND | 4.7 | | 32 |
| Cottage Grove | D | | | | | | | | 118 | 0.72 | | | 1.80 | | | | | | | | | | |
| | 1 | | ND | 15 | ND | | | ND | | 0.16 | | | | | | ND | 5.05 | | ND | | 7.9 | | |
| | 2 | 345 | ND | 8 | ND | 69 | 1.5 | ND | 6 | 0.09 | 374 | ND | ND | 49 | 11 | ND | ND | 7.6 | ND | ND | 3.2 | 6.7 | ND |
| | 3 | 346 | ND | 7 | ND | 71 | 1.5 | ND | | 0.10 | 377 | ND | | 48 | 18 | ND | ND | 7.5 | ND | 0.10 | 3.6 | | ND |
| | 4 | 341 | ND | 13 | ND | 77 | 1.4 | ND | | 0.09 | 368 | 0.30 | | 43 | 49 | ND | ND | 7.5 | ND | ND | 3.2 | | 9 |
| Cross Plains | D | | | | | | | | 30 | 0.81 | | | ND | | | | | | | | | | |
| | 1 | 310 | ND | 34 | ND | 75 | 16.0 | 1.6 | | 0.10 | 362 | ND | | 42 | ND | ND | 5.20 | 7.5 | ND | ND | 6.6 | | 4 |
| | 2 | 308 | ND | 35 | ND | 76 | 27.4 | 1.4 | | 0.09 | 366 | ND | | 43 | ND | ND | 4.60 | 7.5 | ND | ND | 13.0 | | ND |
| Dane | D | | | | | | | | 72 | | | | 1.30 | | | | | | | | | | |
| | 1 | 327 | ND | 56 | ND | 110 | 100.0 | ND | | ND | 470 | ND | | 52 | ND | ND | 8.19 | 7.4 | ND | ND | 54.0 | | 26 |
| | 2 | 253 | ND | 14 | ND | 55 | ND | ND | | ND | 260 | ND | | 30 | ND | ND | 4.65 | 7.4 | ND | ND | 4.9 | | 8 |
| Deerfield | D | 327 | | | | 51 | | | 392 | 1.39 | | | 4.39 | | | | | | | | | | |
| | 3 | 321 | ND | 7 | ND | 58 | 1.6 | ND | 340 | 0.11 | 336 | 0.10 | 13.50 | 52 | 9 | ND | ND | 7.6 | ND | 0.10 | 3.1 | | 4 |
| | 4 | 327 | ND | 18 | ND | 48 | ND | ND | ND | 0.11 | 330 | 0.27 | ND | 46 | 12 | ND | ND | 7.5 | ND | ND | 3.4 | 8.8 | |
| DeForest | D (N) | | | | | | | | 271 | 0.80 | | | 2.20 | | | | | | | | | | |
| | D (S) | | | | | | | | 1300 | | | | 0.92 | | | | | | | | | | |
| | 1 | 239 | ND | 84 | ND | 61 | 1.7 | ND | | 0.12 | 272 | ND | | 29 | 21 | ND | ND | 7.5 | ND | ND | 3.2 | | ND |
| | 2 | 248 | ND | 12 | ND | 58 | 5.6 | 1.4 | | 1.07 | 276 | ND | | 32 | ND | ND | 0.46 | 7.5 | ND | ND | 5.5 | | 2 |
| | 3 | 258 | ND | 17 | ND | 59 | 1.2 | 2.2 | | 0.13 | 278 | ND | | 32 | ND | ND | ND | 7.5 | ND | 0.10 | 3.2 | | ND |
| | 4 | 284 | ND | 38 | ND | 80 | 37.4 | ND | | 0.11 | 389 | ND | | 46 | ND | ND | 3.36 | 7.6 | ND | ND | 9.6 | | ND |
| | 5 | 280 | ND | 71 | 0.33 | 66 | 45.0 | ND | ND | ND | 303 | 0.14 | ND | 33 | 13 | ND | 1.80 | 7.4 | ND | ND | 19.5 | 30.0 | |

MCL = Maximum Contaminant Level (NR 809.11)

D = Distribution system sample.

ND = Not detected.

Source: Wisconsin Department of Natural Resources, Bureau of Drinking Water and Groundwater (2014).

## Chemical Analyses for Public Water Supplies in Dane County

| Municipality | Well # | Alkalinity ($CaCO_3$) (mg/l) | Arsenic (ug/l) | Barium (ug/l) | Cadmium (ug/l) | Calcium (mg/l) | Chloride (mg/l) | Chromium (ug/l) | Copper (ug/l) | Fluoride (mg/l) | Hardness ($CaCO_3$) (mg/l) | Iron (mg/l) | Lead (ug/l) | Magnesium (mg/l) | Manganese (ug/l) | Mercury (ug/l) | $NO_3$-$NO_2$ (as $N_2$) (mg/l) | pH (SU) | Selenium (ug/l) | Silver (ug/l) | Sodium (mg/l) | Sulfate (mg/l) | Zinc (ug/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MCL | | | 10 | 2000 | 5 | | | 100 | 1300 | 4 | | | 15 | | | 2 | 10 | | 50 | | | | |
| Fitchburg | D (N) | | | | | | | | 70 | 0.80 | | ND | 0.73 | | | | | | | | | | |
| | D (S) | | | | | | | | 74 | 0.72 | | | 1.70 | | | | | | | | | | |
| | 4 | 280 | ND | 18 | ND | 57 | 2.2 | ND | | 0.10 | 278 | 0.22 | | 33 | 16 | 0.08 | ND | 7.4 | 2.30 | ND | 3.0 | 16.0 | 9 |
| | 5 | 280 | ND | 11 | ND | 59 | 2.9 | ND | | 0.11 | 283 | ND | | 33 | 4 | ND | 0.09 | 7.5 | 2.80 | ND | 2.8 | 14.0 | 1 |
| | 7 | 310 | ND | 22 | ND | 68 | 7.3 | 1.6 | | 0.10 | 318 | ND | | 36 | ND | ND | 2.50 | 7.3 | 3.20 | ND | 3.7 | | 19 |
| | 8 | 300 | ND | 63 | ND | 73 | 12.0 | 1.0 | | 0.10 | 339 | ND | | 38 | ND | ND | 4.70 | 7.4 | 2.30 | ND | 4.9 | | 3 |
| | 10 | 280 | ND | 17 | ND | 54 | 1.3 | ND | | 0.10 | 267 | 0.98 | | 32 | 25 | ND | ND | 7.4 | 2.20 | ND | 2.9 | 16.0 | 7 |
| | 11 | 260 | ND | 14 | ND | 54 | 2.4 | ND | | 0.10 | 258 | 0.21 | | 30 | 14 | ND | ND | 7.7 | 2.00 | ND | 2.3 | 17.0 | ND |
| Madison | D | | ND | 55 | ND | 72 | | ND | 90 | 0.75 | 329 | 0.40 | 1.01 | 36 | 179 | ND | | | ND | ND | 3.3 | | ND |
| | 6 | 315 | 0.2 | 22 | ND | 81 | 30.7 | 2.2 | | 0.83 | 383 | 0.01 | ND | 44 | 1 | ND | 3.21 | 7.5 | 1.03 | ND | 14.7 | 28.5 | 26 |
| | 7 | 314 | 0.5 | 38 | ND | 79 | 5.9 | ND | | 0.71 | 387 | 0.35 | ND | 46 | 26 | ND | ND | 7.6 | ND | ND | 6.8 | 37.2 | 4 |
| | 8 | 300 | 0.8 | 33 | ND | 68 | 22.3 | ND | | 0.93 | 334 | 0.61 | ND | 40 | 53 | ND | ND | 7.9 | 0.50 | ND | 9.3 | 16.5 | 27 |
| | 9 | 340 | ND | 26 | ND | 83 | 30.9 | 1.3 | | 0.76 | 401 | 0.01 | ND | 47 | 1 | ND | 1.81 | 7.6 | 0.49 | ND | 14.8 | 16.7 | 27 |
| | 10 | | 1.7 | 22 | ND | | | 0.4 | | 1.32 | | 0.60 | ND | | 70000 | ND | 1.06 | | ND | | 2.7 | 11.8 | |
| | 11 | 336 | ND | 19 | ND | 83 | 45.2 | 1.3 | | 0.84 | 421 | 0.02 | ND | 52 | 14 | ND | 2.98 | 7.5 | 0.63 | ND | 19.4 | 28.4 | 23 |
| | 12 | 283 | ND | 13 | ND | 62 | 2.6 | 0.9 | | 0.83 | 295 | ND | ND | 34 | 0 | ND | 0.77 | 7.7 | ND | ND | 2.3 | 10.2 | 23 |
| | 13 | 304 | ND | 30 | ND | 66 | 8.5 | 1.1 | | 0.88 | 334 | 0.05 | ND | 41 | 12 | ND | 1.89 | 7.7 | 0.42 | ND | 5.1 | 13.6 | 17 |
| | 14 | 343 | 0.2 | 53 | ND | 97 | 88.1 | 2.1 | | 0.88 | 456 | ND | ND | 52 | ND | ND | 3.70 | 7.6 | 0.89 | ND | 35.9 | 24.3 | ND |
| | 15 | 290 | ND | 9 | ND | 85 | 44.6 | 1.0 | | 0.88 | 380 | 0.01 | ND | 47 | 7 | ND | 2.20 | 7.6 | 0.65 | ND | 19.5 | 31.0 | 14 |
| | 16 | 291 | ND | 18 | ND | 70 | 34.3 | 1.4 | | 0.78 | 344 | 0.00 | ND | 41 | 4 | ND | 2.83 | 7.6 | 0.49 | ND | 17.5 | 10.3 | 26 |
| | 17 | 285 | 0.3 | 26 | ND | 71 | 38.4 | 0.4 | | 0.89 | 371 | 0.10 | ND | 47 | 31 | ND | ND | 7.7 | ND | ND | 19.3 | 55.6 | 27 |
| | 18 | 280 | ND | 15 | ND | 67 | 16.6 | 1.1 | | 0.82 | 332 | ND | ND | 40 | 1 | ND | 1.19 | 7.7 | ND | ND | 6.7 | 16.8 | 18 |
| | 19 | 289 | 0.4 | 17 | ND | 63 | 5.9 | 0.5 | | 0.77 | 297 | 0.19 | ND | 34 | 41 | ND | ND | 7.7 | ND | ND | 3.9 | 7.7 | 25 |
| | 20 | 275 | ND | 9 | ND | 56 | 2.3 | 9.4 | | 0.72 | 280 | ND | ND | 34 | 1 | ND | 0.41 | 7.7 | 0.48 | ND | 2.1 | 7.5 | 24 |
| | 23 | 345 | 0.6 | 53 | ND | 96 | 62.6 | 1.4 | | 0.97 | 454 | 0.07 | ND | 52 | 3 | ND | 3.56 | 7.6 | 0.94 | ND | 23.0 | 26.2 | 35 |
| | 24 | 275 | 0.2 | 13 | ND | 58 | 5.7 | ND | | 0.82 | 293 | 0.18 | ND | 36 | 30 | ND | ND | 7.7 | ND | ND | 5.0 | 14.2 | 18 |
| | 25 | 327 | ND | 8 | ND | 64 | 2.9 | 0.9 | | 0.81 | 345 | 0.09 | ND | 45 | 11 | ND | 0.65 | 7.6 | 0.56 | ND | 3.3 | 7.1 | 16 |
| | 26 | 292 | ND | 17 | ND | 66 | 15.3 | 0.7 | | 0.75 | 313 | 0.03 | ND | 36 | 4 | ND | 1.31 | 7.8 | ND | ND | 5.4 | 12.8 | 38 |
| | 27 | 325 | 0.3 | 26 | ND | 92 | 64.5 | 0.5 | | 0.88 | 436 | 0.10 | ND | 50 | 44 | ND | 0.36 | 7.5 | ND | ND | 16.1 | 39.7 | 21 |
| | 28 | 286 | 0.2 | 15 | ND | 63 | 2.6 | ND | | 0.44 | 301 | 0.19 | ND | 35 | 24 | ND | ND | 7.5 | ND | ND | 2.4 | 20.0 | 23 |
| | 29 | 335 | ND | 52 | ND | 71 | 2.9 | 0.5 | ND | 0.87 | 321 | 0.14 | ND | 35 | 74 | ND | 0.83 | 7.6 | ND | ND | 3.1 | 7.3 | 6 |
| | 30 | 273 | 0.2 | 17 | ND | 58 | 4.4 | ND | ND | 0.82 | 289 | 0.20 | ND | 35 | 14 | ND | ND | 7.7 | ND | ND | 3.8 | 18.5 | 20 |
| | 31 | 342 | ND | 24 | ND | 63 | 2.5 | ND | ND | ND | 348 | 0.24 | 0.50 | 46 | 10600 | ND | ND | 7.6 | ND | ND | 3.4 | 9.2 | 31200 |

MCL = Maximum Contaminant Level (NR 809.11)
D = Distribution system sample.
ND = Not detected.
Source: Wisconsin Department of Natural Resources, Bureau of Drinking Water and Groundwater (2014).

## Chemical Analyses for Public Water Supplies in Dane County

| Municipality | Well # | Alkalinity ($CaCO_3$) (mg/l) | Arsenic (ug/l) | Barium (ug/l) | Cadmium (ug/l) | Calcium (mg/l) | Chloride (mg/l) | Chromium (ug/l) | Copper (ug/l) | Fluoride (mg/l) | Hardness ($CaCO_3$) (mg/l) | Iron (mg/l) | Lead (ug/l) | Magnesium (mg/l) | Manganese (ug/l) | Mercury (ug/l) | $NO_3$-$NO_2$ (as $N_2$) (mg/l) | pH (SU) | Selenium (ug/l) | Silver (ug/l) | Sodium (mg/l) | Sulfate (mg/l) | Zinc (ug/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MCL | | | 10 | 2000 | 5 | | | 100 | 1300 | 4 | | | 15 | | | 2 | 10 | | 50 | | | | |
| Marshall | D | | | | | | | | 1030 | 0.69 | | | 2.40 | | | | | | | | | | |
| | 1 | 283 | ND | 4 | ND | 55 | 1.2 | ND | | 0.09 | 285 | 0.10 | | 36 | 85 | ND | ND | 7.7 | ND | ND | 3.1 | | 3 |
| | 2 | 272 | ND | 54 | ND | 55 | 2.9 | ND | | 1.84 | 277 | 0.10 | | 34 | 190 | ND | ND | 7.6 | ND | ND | 4.2 | | 8 |
| | 3 | 310 | 1.2 | 86 | ND | 57 | ND | ND | 4 | 0.11 | 300 | 0.09 | 0.14 | 39 | 50 | ND | ND | 7.3 | ND | ND | 2.5 | 11.0 | |
| Mazomanie | D | | | | | | | | 308 | 0.72 | | | 3.85 | | | | | | | | | | |
| | 2 | 275 | ND | 37 | ND | 62 | 2.8 | ND | | ND | 300 | 0.42 | | 34 | 18 | 0.20 | ND | 7.0 | 0.20 | ND | 2.4 | | 19 |
| | 3 | 275 | 0.6 | 37 | ND | 72 | 67.3 | ND | | ND | 331 | 0.34 | | 36 | 51 | 0.20 | 1.55 | 7.0 | 0.40 | ND | 30.4 | | 5 |
| McFarland | D | | | | | | | | 1460 | 0.69 | | | 8.90 | | | | | | | | | | |
| | 1 | 319 | ND | 12 | ND | 78 | 22.2 | ND | | 0.13 | 373 | ND | | 44 | ND | ND | 2.68 | 7.4 | ND | ND | 8.3 | | 55 |
| | 3 | 325 | ND | 7 | ND | 63 | 2.1 | ND | | 0.14 | 348 | ND | | 46 | 7 | ND | 0.64 | 7.5 | ND | ND | 2.7 | | 9 |
| | 4 | 319 | ND | 24 | ND | 80 | 14.9 | ND | | 0.13 | 379 | ND | | 43 | 3 | ND | 3.53 | 7.5 | ND | ND | 6.3 | | 5 |
| Middleton | D | | | | | | | | 200 | 0.88 | | | 11.00 | | | | | | | | | | |
| | 2 | | ND | | | | | | | | | | | | | | | | | | | | |
| | 3 | | ND | | | | | | | | | | | | | | | | | | | | |
| | 4 | 293 | 1.4 | 70 | ND | 67 | 1.4 | ND | | 0.13 | 313 | ND | | 35 | 42 | ND | 0.17 | 7.6 | ND | ND | 3.5 | 2.7 | ND |
| | 5 | 290 | ND | 31 | ND | 68 | 4.2 | ND | | 0.07 | 313 | ND | | 35 | 34 | ND | 0.10 | 7.7 | ND | ND | 3.6 | 16.0 | ND |
| | 6 | 278 | ND | 20 | ND | 72 | 22.0 | 1.2 | | 0.77 | 343 | ND | | 40 | 1 | ND | 3.50 | 7.6 | ND | ND | 18.0 | 14.0 | 10 |
| | 8 | 380 | ND | 4 | ND | 59 | ND | ND | 6 | 0.77 | 320 | 0.04 | 0.49 | 41 | 58 | ND | ND | 7.5 | ND | 0.11 | 2.8 | 7.4 | |
| Monona | D | | | | | | | | 152 | 0.81 | | | 6.90 | | | | | | | | | | |
| | 1 | 344 | ND | 55 | ND | 105 | 117.0 | 1.7 | | 0.11 | 477 | ND | | 52 | ND | ND | 4.16 | 7.3 | ND | ND | 45.0 | | 1 |
| | 2 | 359 | ND | 50 | ND | 101 | 89.6 | 1.5 | | 0.11 | 474 | ND | | 54 | ND | ND | 2.19 | 7.3 | ND | ND | 30.2 | | ND |
| | 3 | 289 | ND | 11 | ND | 60 | 2.9 | ND | | 0.10 | 303 | 0.30 | | 37 | 25 | ND | ND | 7.6 | ND | ND | 3.7 | | ND |
| Morrisonville | D | | | | | | | | 229 | 0.80 | | | 11.60 | | | | | | | | | | |
| | 1 | 305 | ND | 108 | 0.42 | 99 | 94.4 | ND | | 0.05 | 456 | 0.80 | | 50 | 2110 | ND | 9.13 | 7.4 | ND | ND | 27.2 | | 36 |
| | 2 | 238 | ND | 4 | ND | 58 | 3.4 | 2.1 | | 0.11 | 275 | ND | | 32 | ND | ND | 3.09 | 7.9 | ND | ND | 3.1 | | 2 |
| Mount Horeb | D | 311 | | | | 69 | | | 1160 | 0.59 | | | 24.60 | | | | | | | | | | |
| | 3 | 313 | ND | 22 | ND | 70 | 41.1 | ND | ND | 0.41 | 375 | ND | ND | 45 | 2 | ND | 2.29 | 7.5 | ND | ND | 27.3 | | 9 |
| | 4 | 293 | ND | 25 | ND | 69 | 48.5 | ND | ND | 0.79 | 376 | ND | ND | 44 | 4 | ND | 3.08 | 7.6 | ND | ND | 23.5 | | 752 |
| | 5 | 288 | ND | 5 | ND | 61 | 1.3 | ND | 2 | 0.59 | 317 | ND | ND | 39 | 8 | ND | ND | 7.6 | ND | 0.10 | 2.6 | | ND |
| | 6 | 264 | ND | 24 | ND | 53 | 3.4 | ND | 45 | 0.64 | 276 | 0.20 | ND | 34 | 14 | ND | ND | 7.8 | ND | ND | 3.6 | 13.0 | 1470 |
| Oregon | D | | | | | | | | 182 | 0.75 | | | 53.40 | | | | | | | | | | |
| | 3 | 275 | ND | 13 | ND | 64 | 3.4 | 1.4 | | 0.82 | 298 | ND | | 34 | ND | ND | 1.83 | 7.7 | ND | ND | 2.8 | | ND |
| | 4 | 274 | ND | 25 | ND | 67 | 8.9 | 1.4 | | 0.97 | 315 | ND | | 36 | ND | ND | 3.47 | 7.8 | ND | ND | 4.0 | | ND |
| | 5 | 277 | ND | 16 | ND | 62 | 3.6 | 1.8 | | 0.10 | 295 | ND | | 34 | ND | ND | 2.06 | 7.7 | ND | ND | 3.0 | | 2 |

MCL = Maximum Contaminant Level (NR 809.11)
D = Distribution system sample.
ND = Not detected.
Source: Wisconsin Department of Natural Resources, Bureau of Drinking Water and Groundwater (2014).

## Chemical Analyses for Public Water Supplies in Dane County

| Municipality | Well # | Alkalinity ($CaCO_3$) (mg/l) | Arsenic (ug/l) | Barium (ug/l) | Cadmium (ug/l) | Calcium (mg/l) | Chloride (mg/l) | Chromium (ug/l) | Copper (ug/l) | Fluoride (mg/l) | Hardness ($CaCO_3$) (mg/l) | Iron (mg/l) | Lead (ug/l) | Magnesium (mg/l) | Manganese (ug/l) | Mercury (ug/l) | $NO_3$-$NO_2$ (as $N_2$) (mg/l) | pH (SU) | Selenium (ug/l) | Silver (ug/l) | Sodium (mg/l) | Sulfate (mg/l) | Zinc (ug/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MCL | | | 10 | 2000 | 5 | | | 100 | 1300 | 4 | | | 15 | | | 2 | 10 | | 50 | | | | |
| Stoughton | D | | | | | | | | 150 | 0.80 | | | 2.50 | | | | | | | | | | |
| | 4 | 320 | ND | 41 | ND | 80 | 37.0 | 0.9 | | 0.13 | 360 | ND | | 40 | ND | ND | 5.00 | 7.7 | ND | ND | 15.0 | 22.0 | 4 |
| | 5 | 280 | ND | 20 | ND | 52 | 2.6 | ND | | 0.60 | 270 | 0.19 | | 34 | 13 | ND | 0.08 | 8.0 | ND | ND | 2.8 | 15.0 | 4 |
| | 6 | 320 | ND | 32 | ND | 62 | 2.6 | ND | | 0.08 | 320 | 0.28 | | 40 | 14 | ND | 0.03 | 7.9 | ND | ND | 3.0 | 14.0 | 12 |
| | 7 | 270 | 0.7 | 21 | ND | 56 | 3.6 | ND | | 2.70 | 270 | 0.28 | | 32 | 16 | ND | ND | 8.0 | ND | ND | 9.0 | 13.0 | 2 |
| Sun Prairie | D | | | | | | | | 41 | 0.69 | | | 5.60 | | | | | | | | | | |
| | 3 | 290 | ND | 16 | ND | 65 | 13.0 | ND | | 0.68 | 310 | ND | | 35 | ND | ND | 3.80 | 7.9 | ND | ND | 6.7 | 14.0 | 4 |
| | 4 | 310 | ND | 33 | ND | 80 | 65.0 | 0.2 | ND | 0.16 | 380 | ND | 0.10 | 44 | ND | ND | 5.60 | 7.3 | ND | ND | 22.0 | 24.0 | 3 |
| | 5 | 310 | ND | 27 | ND | 67 | 10.0 | ND | | 0.10 | 320 | ND | | 37 | ND | ND | 4.00 | 8.0 | ND | ND | 8.7 | 13.0 | 4 |
| | 6 | 300 | ND | 19 | ND | 64 | 9.3 | 0.4 | | 0.10 | 310 | ND | | 36 | ND | ND | 3.30 | 8.0 | ND | ND | 5.6 | 12.0 | 2 |
| | 7 | 320 | ND | 12 | ND | 65 | 8.1 | ND | | 0.09 | 320 | ND | | 39 | 3 | ND | 2.60 | 7.5 | ND | ND | 4.1 | 8.4 | 4 |
| | 8 | 280 | ND | 12 | ND | 56 | 6.6 | ND | ND | 0.10 | 270 | ND | ND | 33 | ND | ND | 0.08 | 7.9 | ND | ND | 3.0 | 5.8 | 4 |
| | 9 | 300 | ND | 21 | ND | 65 | 5.1 | ND | 20 | 0.11 | 316 | 0.01 | 1.00 | 34 | ND | ND | 1.90 | 7.4 | ND | ND | 5.2 | 8.8 | 16 |
| Verona | D | | | | | | | | 188 | 0.76 | | | 4.50 | | | | | | | | | | |
| | 1 | 307 | ND | 47 | ND | 81 | 42.0 | 1.7 | | 0.12 | 379 | ND | | 43 | ND | ND | 5.29 | 7.5 | ND | ND | 12.8 | | ND |
| | 2 | 294 | ND | 15 | ND | 61 | 9.4 | ND | | 0.09 | 320 | ND | | 41 | 5 | ND | 5.91 | 7.8 | ND | ND | 5.5 | | ND |
| | 3 | 316 | ND | 44 | ND | 79 | 29.2 | 1.4 | | 0.10 | 375 | ND | | 44 | ND | ND | 6.49 | 7.5 | ND | ND | 19.1 | | 1 |
| | 4 | 287 | ND | 41 | ND | 74 | 39.2 | 2.0 | | 0.10 | 345 | ND | | 39 | ND | ND | 4.18 | 7.6 | ND | ND | 10.7 | | ND |
| | 5 | | | | | | | | | | | | | | | | 0.35 | | | | | | |
| Waunakee | D | | | | | | | | 134 | 0.83 | | | 0.90 | | | | | | | | | | |
| | 1 | 260 | ND | 11 | ND | 54 | 3.9 | 1.7 | | 0.09 | 260 | ND | | 31 | ND | ND | 3.00 | 7.9 | ND | 0.11 | 3.4 | 6.3 | ND |
| | 2 | 280 | 0.9 | 23 | ND | 63 | 14.0 | 0.8 | | 0.20 | 300 | ND | | 36 | 18 | ND | 3.90 | 8.0 | 2.50 | ND | 8.1 | 10.0 | 3 |
| | 3 | 270 | ND | 7 | ND | 54 | 2.5 | 1.5 | | 0.10 | 260 | ND | | 31 | ND | ND | 1.40 | 8.0 | ND | ND | 2.9 | 5.7 | ND |
| | 4 | 240 | ND | 8 | ND | 51 | ND | 1.0 | | 0.07 | 240 | ND | | 28 | ND | ND | 0.60 | 8.1 | ND | ND | 2.1 | ND | 3 |
| | 5 | 130 | ND | 9 | ND | 51 | ND | 1.7 | ND | 0.07 | 250 | ND | 0.64 | 29 | ND | ND | 0.19 | 7.6 | ND | 0.45 | 2.6 | ND | |
| Westport | D | | | | | | | | 275 | 0.90 | | | 1.80 | | | | | | | | | | |
| | 1 | 252 | ND | 7 | ND | 52 | 1.3 | 2.1 | | 0.19 | 254 | ND | | 30 | ND | ND | ND | 7.7 | ND | ND | 2.9 | | ND |
| | 2 | 259 | ND | 11 | ND | 55 | 1.6 | 1.6 | | 0.07 | 270 | 0.50 | | 32 | 8 | ND | ND | 7.6 | ND | ND | 3.0 | | 3 |
| Windsor | D | | | | | | | | 150 | 0.80 | | | 3.50 | | | | | | | | | | |
| | 1 | 270 | ND | 24 | ND | 63 | 7.6 | 0.7 | | 1.10 | 290 | 0.03 | | 32 | 3 | ND | 1.80 | 8.1 | ND | ND | 4.7 | | 3 |
| | 2 | 260 | ND | 140 | ND | 60 | ND | ND | | 0.13 | 280 | 0.07 | | 30 | 6 | ND | 0.05 | 8.1 | ND | ND | 3.5 | | 3 |

MCL = Maximum Contaminant Level (NR 809.11)
D = Distribution system sample.
ND = Not detected.
Source: Wisconsin Department of Natural Resources, Bureau of Drinking Water and Groundwater (2014).

# Attachment B

# Description of Factors Used to Determine Groundwater Contamination Risk

The conceptual model for the groundwater contamination risk maps is based on two premises. First, it is assumed that the sediments in the unsaturated zone have the potential to attenuate contaminants. The thickness of these sediments is an important factor in determining the susceptibility of the aquifer to contamination. Secondly, it is assumed that position of an area in the groundwater flow system is equally important in determining the contamination risk.

There are three factors that were used to determine the groundwater contamination risk. The first factor evaluates the soil's ability to attenuate contaminants. The second factor, the hydrogeologic setting, combines attributes of the topography, hydrogeology, and geology. The groundwater flow system, the third factor, is the distribution of recharge and non-recharge areas. These three factors were represented as three GIS data layers. It is the combination of the soil, the hydrogeologic setting and the groundwater flow system factors that determine the risk of groundwater contamination.

## Attenuation Potential of the Soil

Soil properties are important in determining whether a contaminant breaks down quickly, is complexed with soil particles, or if it leaches into the groundwater. Because most attenuation and degradation of contaminants occurs in the soil, there is a greater potential for groundwater contamination to occur in areas where soil is thin or permeable. Water and contaminants can move quickly through sandy soils due to the large pore spaces between particles. Sand particles also provide little surface area for sorption of contaminants.

Clay soils have smaller pore sizes and proportionally more mineral surface area and therefore can attenuate contaminates more readily. As the clay content increases, the water-holding capacity and exchange capacity increase. Thus, if a layer containing a large amount of clay exists in the subsurface, it will act as a retarding layer to the vertical flux of contaminants. While held in the soil, contaminants can be degraded by soil bacteria or other microorganisms in the soil. Organic matter generally has exchange properties and proportionally more surface area which make it ideal for adsorption of contaminants. Thus, soil high in organic matter provides an environment for chemical and biological degradation of contaminants.

The soil properties used in the method are listed in Table B–1. Properties for each soil map unit in Dane County were rated from 1 to 10. The ratings for the soil properties within a soil map unit were then added, resulting in a total score.

**Table B–1**
**Ranking System for Evaluating the Attenuation Potential of Soils in Dane County**
**(from Bridson & Others, 1994)**

| Physical/Chemical Characteristics | Classes | Weighted Values |
|---|---|---|
| **Texture of Surface (A or O) Horizon[1]** | l, sil, scl, si | 9 |
| | c, sic, cl, sicl, sc | 8 |
| | lvfs, vfsl, lfs, fsl | 4 |
| | s, ls, sl, organic materials, and all textural classes with coarse fragment class modifiers | 1 |
| **Texture of Subsoil (B) Horizon[1]** | c, sic, sc, sl | 10 |
| | scl, l, sil, cl, sicl | 7 |
| | lvfs, vfsl, lfs, fsl | 4 |
| | s, fs, ls, sl, o | 1 |
| **Organic Matter Content[2] of Surface Horizon** | Mollisol | 8 |
| | Alfisol (Mollisol, eroded) | 5 |
| | Inceptisol, Entisol, Spodosol (Alfisol, eroded) | 3 |
| | Inceptisol, Entisol, Spodosol (eroded) | 1 |
| | Histosols; Aquic suborder; and Lithic, Aquollic, and Aquic subgroups | 1 |
| **pH of Surface (A or O) Horizon** | ≥ 6.6 | 6 |
| | < 6.6 | 4 |
| **Depth of Soil Solum (O, A + B horizons)** | ≥ 60 | 10 |
| | 40–59 | 8 |
| | 30–39 | 5 |
| | <30 | 1 |
| **Permeability of Subsoil Horizon[3]** | moderately low, low to very low | 10 |
| | moderate | 8 |
| | moderate/high | 5 |
| | high | 3 |
| | very high | 1 |
| **Soil Drainage** | well-drained | 10 |
| | well- to moderately well-drained | 7 |
| | moderately well-drained | 4 |
| | somewhat poorly, poorly, and very poorly drained; and excessively well-drained | 1 |

[1]Soil textural classes: 1 = loam, sil = silt loam, scl = sandy clay loam, si = silt, c = clay, sic = silty clay, cl = clay loam, sicl = silty clay loam, sc = sandy clay, lvfs = loamy very fine sand, vfsl = very fine sandy loam, lfs = loamy fine sand, fsl = fine sandy loam, fs = fine sand, s = sand, ls = loamy sand, sl = sandy loam, o = organic material.

[2]Based on the ordinal level of the soil classification system; soils are penalized if they are wet or less than 20 inches thick over bedrock.

[3]Based on the particle-size class at the family level of the soil classification system, type and grade of structure, and consistence. Use 3 if bedrock is found at 20-40 inches, or 1 if bedrock is <20 inches.

Based on the total score, soil map units were divided into three categories: good, fair, and poor potential to attenuate contaminants (Table B–2). Soils in the "good" category have properties that contribute to attenuation. Soils in the "poor" category have little potential to attenuate potential contaminants. The numeric categories (1, 2, or 3) shown in Table B–2 were used to identify the attenuation potential of the soil in the final risk classification and included in the first digit of the 3-digit subclass code (Table B–4). Contaminant attenuation of Dane County soils is listed in Table B–3.

**Table B–2**
**Total Scores and Category Number of a Soil's Potential to Attenuate Contaminants**

| Soil's Potential to Attenuate Contaminants | Total Score | Category |
|---|---|---|
| **Good** | ≥45 | 3 |
| **Fair** | ≥35 and <44 | 2 |
| **Poor** | <34 | 1 |

## Hydrogeologic Setting

Groundwater contamination risk also depends on the hydrogeologic setting and the groundwater flow system. The second data layer, the hydrogeologic setting, evaluates the contamination risk based on the thickness of materials below the soil but above the water table as well as presence (or absence) of an unlithified aquifer. The soil information described above is accurate to approximately five feet below the ground surface. However, the unsaturated zone extends greater than five feet below the ground surface in more than 75% of Dane County. Consequently, an evaluation of the remaining materials in the unsaturated zone had to be developed. The hydrogeologic setting data layer was a combination of the depth to bedrock (or thickness of unlithified materials), depth to the water table and presence of an unlithified aquifer.

The hydrogeologic setting categories were based on the thickness of the unsaturated zone and presence of an unlithified aquifer. Hydrogeologic settings that met the qualifications for category 1 are areas where bedrock is within five feet of the surface, or if an unlithified aquifer is present and the water table is within ten feet of the surface. If bedrock is at or very near the surface there is a possible direct connection between the surface and the underlying aquifer. If bedrock is near the surface, there is also little or no soil layer in which natural degradation of contaminants can occur.

Hydrogeologic settings that did not meet the qualifications for category 1 were then considered for inclusion in category 2, the next most restrictive category. The process continued for categories 3 and 4. Category 4, the least restrictive category, included those settings that were not included in categories 1, 2 or 3. If the water table surface or bedrock surface is greater than 50 feet below the ground surface, travel time is longer and the potential for attenuation and biodegradation is increased. As a result, the potential for groundwater contamination is decreased. The category numbers (1 through 4) used in the hydrogeologic setting data layer were used to identify the hydrogeologic setting in the final risk classification and included as the second digit of the subclass code (Table B–4).

**Table B–3**
**Contaminant Attenuation Potential of Dane County Soils**

| Poor Attenuation (<34 points) | Fair Attenuation (≥35 and <44) | Good Attenuation (≥45) |
|---|---|---|
| Adrian | Basco | Ashdale |
| Alluvial land | Chaseburg | Batavia |
| Boyer | Colwood | Del Ray |
| Brems | Derinda | Dodge |
| Cut and fill land | Dodgeville (12–20% slopes) | Dodgeville (2–12% slopes) |
| Dells | Dresden (6–30% slopes) | Dresden (2–6% slopes) |
| Dickenson | Dunbarton | Gale (2–6% slopes) |
| Dickenson (sandy variant) | Edmund | Grays (0–6% slopes) |
| | Elburn | Griswold |
| Eleva | Elvers | Huntsville |
| Elkmound | Gale | Kegonsa |
| Granby | Grays (6–12% slopes) | Kidder |
| Gravel pit | Hixton | McHenry (2–6% slopes) |
| Hayfield | Kickapoo | Meridian |
| Houghton | McHenry (6–20% slopes) | New Glarus |
| Made land | Military | Pecatonica |
| Marsh | Montgomery | Plano |
| Marshan | Orion | Port Byron |
| Palms | Otter | Radford |
| Plainfield | Rockton (6–30% slopes) | Ringwood |
| Quarry | Sable | Rockton (2–6% slopes) |
| Rodman | Salter | St. Charles |
| Salter (2–12% slopes) | Seaton | Seaton |
| Salter (wet variant) | Virgil | Troxel |
| Sogn | Whalan | Warsaw |
| Spinks | | Westville |
| Stony and rocky land | | |
| Wacousta | | |
| Watseka | | |

## Groundwater Flow System

Based on the results of Bridson and others (1994), a map depicting groundwater contamination risk would potentially be more accurate if the groundwater flow system were incorporated into the methodology. Percolating water has a much greater potential of reaching the water table in shallow water table areas, which are often discharge areas, than in deeper water table areas, which are often recharge areas. Discharge areas, though, have upward hydraulic gradients that would impede the downward migration of contaminants. Contaminants would then be contained near the water table and eventually could enter surface water. Recharge areas are more problematic because the contaminant would enter the water table and move within the groundwater flow system.

The groundwater recharge distribution in the county was estimated by Swanson (1996) using a modular three-dimensional finite difference groundwater flow model, known as MODFLOW (McDonald & Harbaugh, 1988).

The groundwater flow system data layer had two attribute categories: recharge and non-recharge. Category numbers (0 and 1, respectively) were used for identification purposes in the final risk classification and include as the third digit of the subclass code (Table B–4).

## Final Groundwater Contamination Risk Classification for Surface and Subsurface Maps

The three-digit subclass code was used to arrive at a final risk classification for the Surface and Subsurface Groundwater Contamination Risk Maps. Table B–4 represents a summary of possible risk classifications, with the subclass representing numerical expressions of data layers 1, 2, and 3 combined to arrive at a final risk classification code. By assuming a poor soil attenuation layer (category 1), a Subsurface Contamination Risk Map was similarly developed. This results in shifting some areas with either fair or good soils to the next lower risk classification, taking into account the importance of soil attenuation for reducing pollutants. Removing the soil layer changes the first subclass digit to one, resulting in a modified subclass as well as its associated final risk classification.

### Extreme

An area is considered to be of extreme groundwater contamination risk if the aquifer materials (unlithified sediments or bedrock) are close to the land surface irrespective of position in the groundwater flow system and attenuation potential of the soil.

Areas in Dane County that are rated by extreme risk of groundwater contamination are located, for example, in the Driftless Area. Another example of areas that are considered to present extreme groundwater contamination risk are the northeast to southwest trending pre-glacial valleys in the eastern part of the county. The saturated sediments in the valleys are considered to be an unconfined unlithified surficial aquifer. The water table is close to the surface and the soil is poorly drained muck. These valleys are considered areas of extreme contamination risk. The Wisconsin River Valley is also considered to be of extreme risk. The soils in the Wisconsin River Valley are sandy and excessively to moderately well-drained, resulting in a low attenuation potential. These examples are not an exhaustive description; rather, they demonstrate the main characteristics of areas considered to be of extreme groundwater contamination risk

### High

The influence of the attenuation potential of the soil and the thickness of the unsaturated zone is evident in areas that are considered to be of high contamination risk. The combination of the proximity of the aquifer materials to the land surface (bedrock or the water table within 25 feet of the land surface) and the poor attenuation potential of the soil result in a high risk classification, even if an area is considered to be in a non-recharge zone.

Areas that are considered high groundwater contamination risk are located throughout Dane County, either in low-lying areas of the Yahara River Basin, along the moderate to steep slopes in the Driftless Area, or in the glaciated region of Dane County. A large area of former Glacial Lake Middleton in northern Middleton township, for example, is also considered to have a high contamination risk because the soils have a poor attenuation potential and the majority of the area is in a recharge zone.

**Moderate**

Areas considered as moderate contamination risk are located in either recharge or non-recharge areas, depending on the attenuation potential of the soil and the thickness of the unsaturated zone. Bedrock or water table depths range from 5 feet below the land surface to greater than 50 feet below land surface in non-recharge areas. In recharge areas, a greater thickness of unsaturated materials and soils that have a good or fair attenuation potential are necessary for an area to be considered as moderate risk.

Deep, well-drained silt loam soil on gently sloping land or low hills are some of the areas that are considered as moderate contamination risk. In the hummocky moraine zone in Middleton township or drumlinized ground moraine in Cottage Grove township, the depth to bedrock or depth to the water table may be greater than 25 feet. In Middleton township, the depth to bedrock or depth to water table is sometimes greater than 50 feet. Stream valleys in the Driftless Area are considered discharge areas and commonly have deep, poorly drained silt loam soils and are considered, in some places, to be of moderate risk. Portions of Pleasant Valley, Syftestad Creek Valley and Kittleson Valley in southern Perry township, for example, are moderate contamination risk. The model depth to bedrock in these valleys is typically greater than five feet, although there are areas where it is closer to the surface.

**Low**

Only non-recharge areas are considered to have a low groundwater contamination risk relative to other regions in Dane County. Areas have a low risk classification because the attenuation potential of the soil is considered to be fair or good. These soils have physical and chemical characteristics that would be beneficial for attenuation of contaminants. The depth to the bedrock and depth to water table ranges from 25 feet to greater than 50 feet below the land surface.

Low risk areas are located on the hummocky moraine zone, or in places where there are thick accumulations of silt or clay, such as in the Yahara River basin. Although the potential for groundwater contamination is considered to be low in these areas relative to other areas of Dane County, if groundwater contamination were to occur, the low contamination risk areas would be the most difficult to remediate.

**Table B–4**
**Summary of Possible Groundwater Contamination Risk Classifications**

| Subclass | Attenuation Potential of Soil (Data Layer 1) | Hydrogeologic setting (Data Layer 2)* | Groundwater Flow System (Data Layer 3)* | Final Risk Classification |
|---|---|---|---|---|
| 110 | Poor | dol or ss <= 5 ft or WT <= 10 ft in unconfined unlithified aquifer | Recharge | Extreme |
| 111 | Poor | dol or ss <= 5 ft or WT <= 10 ft in unconfined unlithified aquifer | Non-recharge | Extreme |
| 120 | Poor | dol or ss 5-25 ft or WT 10-25 ft in unconfined unlithified aquifer | Recharge | Extreme |
| 210 | Fair | dol or ss <= 5 ft or WT <= 10 ft in unconfined unlithified aquifer | Recharge | Extreme |
| 211 | Fair | dol or ss <= 5 ft or WT <= 10 ft in unconfined unlithified aquifer | Non-recharge | Extreme |
| 220 | Fair | dol or ss 5-25 ft or WT 10-25 ft in unconfined unlithified aquifer | Recharge | Extreme |
| 310 | Good | dol or ss <= 5 ft or WT <= 10 ft in unconfined unlithified aquifer | Recharge | Extreme |
| 311 | Good | dol or ss <= 5 ft or WT <= 10 ft in unconfined unlithified aquifer | Non-recharge | Extreme |
| 121 | Poor | dol or ss 5-25 ft or WT 10-25 ft in unconfined unlithified aquifer | Non-recharge | High |
| 130 | Poor | dol or ss 25-50 ft or WT 25-50 ft in any unlithified aquifer | Recharge | High |
| 140 | Poor | dol or ss > 50 ft or WT > 50 ft | Recharge | High |
| 230 | Fair | dol or ss 25-50 ft or WT 25-50 ft in any unlithified aquifer | Recharge | High |
| 320 | Good | dol or ss 5-25 ft or WT 10-25 ft in unconfined unlithified aquifer | Recharge | High |
| 131 | Poor | dol or ss 25-50 ft or WT 25-50 ft in any unlithified aquifer | Non-recharge | Moderate |
| 141 | Poor | dol or ss > 50 ft or WT > 50 ft | Non-recharge | Moderate |
| 221 | Fair | dol or ss 5-25 ft or WT 10-25 ft in unconfined unlithified aquifer | Non-recharge | Moderate |
| 231 | Fair | dol or ss 25-50 ft or WT 25-50 ft in any unlithified aquifer | Non-recharge | Moderate |
| 240 | Fair | dol or ss > 50 ft or WT > 50 ft | Recharge | Moderate |
| 321 | Good | dol or ss 5-25 ft or WT 10-25 ft in unconfined unlithified aquifer | Non-recharge | Moderate |
| 330 | Good | dol or ss 25-50 ft or WT 25-50 ft in any unlithified aquifer | Recharge | Moderate |
| 340 | Good | dol or ss > 50 ft or WT > 50 ft | Recharge | Moderate |
| 241 | Fair | dol or ss > 50 ft or WT > 50 ft | Non-recharge | Low |
| 331 | Good | dol or ss 25-50 ft or WT 25-50 ft in any unlithified aquifer | Non-recharge | Low |
| 341 | Good | dol or ss > 50 ft or WT > 50 ft | Non-recharge | Low |

*dol = dolomite, ss = sandstone, WT = water table.

# Attachment C

Solid Waste Disposal Sites in Dane County

| Map No. | Site Name | PLSS | Township | Years of Operation | Type of Waste[1] | DNR Assessment Date | Source of Information[2] |
|---|---|---|---|---|---|---|---|
| 1 | AUGUST SHEMANEK | S S22 09N 06E | Mazomanie | ? | U | 1/24/2001 | Post-Reg. |
| 2 | PRAIRIE DU SAC VIL | NW SE S13 09N 06E | Mazomanie | ? | ? | 6/5/2008 | Public |
| 3 | ROXBURY TN | NW SW S16 09N 07E | Roxbury | pre-1970-1991 | T,G,M | 4/14/2004 | 113114870 |
| 4 | DANE TN LF | NE S04 09N 08E | Dane | 1965-1969 | U | 1/29/2004 | Pre-Reg. |
| 5 | DANE TN | NW SE S35 09N 08E | Dane | 1970-1992 | G | 11/22/2000 | 113113660 |
| 6 | DANE VIL OLD LF | SE SW S13 09N 08E | Dane | 1958-1974 | W,T,G | 10/13/2005 | DCRPC Solid Waste Plan |
| 7 | DANE VIL | SE NW S24 09N 08E | Dane | ? - 1990 | W,T,G | 12/13/2000 | 113117180 |
| 8 | VIENNA TN | NW NW S23 09N 09E | Vienna | 1970-1986 | D,W,T,G | 3/11/2004 | 113115530 |
| 9 | DEFOREST VIL | SW SW S01 09N 09E | Vienna | 1971-1991 | W,T,G | 6/9/2004 | 113117510 |
| 10 | DEFOREST VIL | S18 09N 10E | Windsor | ? | ? | 11/23/2005 | Post-Reg. |
| 11 | WINDSOR TN | SW SW S08 09N 10E | Windsor | 1971-1972 | W,T,G | 11/23/2005 | DCRPC Solid Waste Plan |
| 12 | DEFOREST VIL | NW NW S17 09N 10E | Windsor | ?-1971 | W,T,G | 11/23/2005 | DCRPC Solid Waste Plan |
| 13 | WINDSOR TN | SW NE S16 09N 10E | Windsor | 1972-1991 | W,T,G | 3/11/2004 | 113115750 |
| 14 | BRISTOL TN | NE SW S05 09N 11E | Bristol | 1968-1991 | T,G | 6/1/2000 | 113113110 |
| 15 | ECKEL SANITARY SERVICE 69-70 | NE S34 09N 11E | Bristol | 1969-1970 | T,G | 3/10/2011 | Pre-Reg. |
| 16 | YORK TN | NW SW S14 09N 12E | York | pre-1969-1990 | W,T,G | 4/20/2004 | 113115860 |
| 17 | MAZOMANIE TN LF | SE SE S06 08N 06E | Mazomanie | 1949-1971 | W,T,G | 3/22/2004 | 113343450 |
| 18 | MAZOMANIE VIL | SE NE S18 08N 06E | Mazomanie | ? | W | 10/14/2005 | Post-Reg. |
| 19 | WICK BLD SYSTEMS (DEMO) | NE NE S17 08N 06E | Mazomanie | 1967-1973 | W, D | 8/9/2005 | 113186700 |
| 20 | MAZO LAND DISPOSAL | SE SE S03 08N 06E | Mazomanie | 1971-1983 | H,D,W,T,G | 8/14/2000 | 113111130 |
| 21 | BLACK EARTH VIL | NE SE S26 08N 06E | Black Earth | ? | ? | 11/23/2005 | Pre-Reg. |
| 22 | BERRY TN | SE SE S22 08N 07E | Berry | 1971-1992 | W,T,G | 6/28/2000 | 113113000 |
| 23 | CROSS PLAINS VIL | NE SW S26 08N 07E | Berry | 1968-1990 | D,W,T,G | 6/28/2000 | 113116960 |
| 24 | CROSS PLAINS VIL | SE SE 26 S26 08N 07E | Berry | 1956-1968 | W,T | | Pre-Reg. DCRPC |
| 25 | BERRY TN | SW SW S25 08N 07E | Berry | ?-1971 | D,W,T,G | 10/13/2005 | Temp. 285 |
| 26 | GEORGE PULVERMACHER | NW SE S07 08N 08E | Springfield | ? | U | 3/23/2004 | Post-Reg. |
| 27 | JEROME DEDRICH | SE NW S04 08N 08E | Springfield | ?-1972 | T | 10/21/2005 | 113110360 |
| 28 | FRED DUHR | SW NE S04 08N 08E | Springfield | 1969-1973 | U | 9/8/2005 | DNR Madison Area Files |
| 29 | SPRINGFIELD TN | SW NW S02 08N 08E | Springfield | 1972-1988 | T | 6/22/2005 | 113115200 |
| 30 | SPRINGFIELD TN | SW SW S35 08N 08E | Springfield | ?-1972 | T,G | 6/15/2005 | DCRPC Solid Waste Plan |
| 31 | WAUNAKEE VIL | NE S12 08N 08E | Springfield | ?-1953 | U | | Pre-Reg. DCRPC |
| 32 | WAUNAKEE CTY 1950'S | NE S05 08N 09E | Westport | 1950s | U | 6/18/2008 | Pre-Reg. |
| 33 | SCIENTIFIC PROTEIN LAB | NW NW S04 08N 09E | Westport | 1976-1977 | U | 3/14/2004 | DNR Madison Area Files |
| 34 | DANE COUNTY (PROPOSED) WESTPORT LF #3 | S02 08N 09E | Westport | | | 11/14/2005 | 113175590 |
| 35 | WESTPORT TN | SE SE S10 08N 09E | Westport | 1966-1987 | D,W,T,G | 8/24/2000 | 113115640 |
| 36 | HAROLD ZEIGLER | SW NE S22 08N 09E | Westport | 1976 | D | 4/11/2006 | Post-Reg. |
| 37 | METROPOLITAN REFUSE DIST, INC | W1/2 S30 08N 09E | Westport | 1961- | W,T,G | 11/30/2005 | 113111240 |
| 38 | HERBRAND SAND & GRAVEL | SW NE S31 08N 09E | Westport | 1972-1978 | H,W | 9/10/2004 | 113109810 |
| 39 | U W MADISON BURNING PIT | NE NE S31 08N 09E | Westport | 1972-1981 | H | 6/23/2005 | Post-Reg. |
| 40 | WESTPORT SAND & GRAV (DEMO) | NW SW S29 08N 09E | Westport | ? | D | 8/26/2010 | Post-Reg. |

Solid Waste Disposal Sites in Dane County

| Map No. | Site Name | PLSS | Township | Years of Operation | Type of Waste[1] | DNR Assessment Date | Source of Information[2] |
|---|---|---|---|---|---|---|---|
| 41 | RAMESH PIT (DEMO) | W1/2 NW S29 08N 09E | Westport | ? | D | | Post-Reg. Dane Co.Files |
| 42 | UNNAMED SITE | NE S32 08N 09E | Westport | ? | ? | | Gr.Mad. Board Realtrs |
| 43 | WESTPORT TN | SW SW S28 08N 09E | Westport | 1960s | T,G | | Pre-Reg. DCRPC |
| 44 | WESTPORT TN 1940'S | SE S28 08N 09E | Westport | 1940s | T,G | 7/24/2007 | Pre-Reg. |
| 45 | MENDOTA STATE HOSPITAL | NE S32 08N 09E | Westport | ? | U | 10/8/2004 | 113023570 |
| 46 | MADISON CTY - LAKEVIEW SAN | NE SW S25 08N 09E | Westport | 1920-1960? | U | 5/26/2005 | Pre-Reg. |
| 47 | MAPLE BLUFF VIL | SW SE S18 08N 10E | Burke | 1954-1993 | W | 6/28/2005 | 113117730 |
| 48 | FINDORFF DEMO LF | NE S19 08N 10E | Burke | ? | D,W | 11/16/2004 | 113339380 |
| 49 | DANE CNTY TRUAX FIELD (FMLY CTY MAD) | NE S31 08N 10E | Burke | 1948-1972 | W,T,G,H | 4/21/2004 | 113183620 |
| 50 | C. MADISON-OSCAR MAYER RDF RECEIVING FACILITY | SE SW S31 08N 10E | Burke | 1977- | T | | DNR 2872? |
| 51 | MADISON CRUSHING & EXCAVATION | SE SW S33 08N 10E | Burke | pre-1972 | D | 6/28/2005 | 113110580 |
| 52 | GILOMEN TRUCK & EQUIPMENT | SW SE S33 08N 10E | Burke | ? | D,T | 2/3/2004 | Post-Reg. |
| 53 | MADISON CTY - SYCAMORE SITE | NW SW S34 08N 10E | Burke | 1972-1977 | D,W,T,G | 7/6/2004 | 113108710 |
| 54 | H SAMUELS-MIDWEST STEEL | SE NE S33 08N 10E | Burke | ? | Auto shredder | 4/13/2006 | 113111460 |
| 55 | MADISON CTY - SYCAMORE BRUSH | SW NW S34 08N 10E | Burke | 1963-1975 | W | 9/8/2004 | 113108600 |
| 56 | RUSS DARROW INC | SW SE S28 08N 10E | Burke | 1976-1977 | F | 8/1/2005 | 113112450 |
| 57 | RTRV PARTNERSHIP LANDFILL | SE S28 08N 10E | Burke | 1977-1992 | F | 5/9/2001 | 113112340 |
| 58 | MRS LEONA GERKE | SE SE S27 08N 10E | Burke | ? | D | 6/28/2005 | 113111680 |
| 59 | BURKE TN | NE SE S23 08N 10E | Burke | 1975-1991 | D,W,T,G | 5/4/2000 | 113113220 |
| 60 | OTTO ZERWICK | NW NE S21 08N 10E | Burke | ? | ? | 4/10/2006 | Post-Reg. |
| 61 | MADISON PRAIRIE LF - BFI | NW NE S23 08N 10E | Burke | 1981- | D, W, T, G, F | 11/15/2005 | 113195280 |
| 62 | MADISON PRAIRIE DEMOLITION LF | NE NE S23 08N 10E | NEW | 1981-2001 | Demo | 11/15/2005 | 113110910 |
| 63 | J P WEST (EARLY 1950'S) | SW S18 08N 11E | Sun Prairie | Early 1950s | Organic wastes | 5/22/2008 | Pre-Reg. |
| 64 | HERBERT HELLENBRAND | SE SE S07 08N 11E | Sun Prairie | ? | D | 6/13/2006 | 113109700 |
| 65 | MARVIN STARKS | SE SE S07 08N 11E | Sun Prairie | ?-1975 | D | 7/10/2006 | 113111020 |
| 66 | SUN PRAIRIE CTY - BIRD ST SITE | SW SW S08 08N 11E | Sun Prairie | ?-1992 | D,W | 8/18/2010 | 133006390 |
| 67 | SUN PRAIRIE CTY | SW NE S08 08N 11E | Sun Prairie | 1971-1974 | W | 4/22/2004 | 133006060 |
| 68 | SUN PRAIRIE CTY - ANGEL PK | NE S08 08N 11E | Sun Prairie | ? | U | 4/22/2004 | Post-Reg. |
| 69 | C. SUN PRAIRIE-TRANSFER RECEIVING FACILITY | SW SE S05 08N 11E | Sun Prairie | 1980- | W,T,G | | DNR 2823? |
| 70 | WISCONSIN CHEESEMAN INCINERATOR | SW S06 08N 11E | Sun Prairie | 1972- | T | | DNR 1856? |
| 71 | DON SIMON REALTORS | NW NW S06 08N 11E | Sun Prairie | ? | U | 3/17/2004 | Post-Reg. |
| 72 | SUN PRAIRIE TN | SW NE S13 08N 11E | Sun Prairie | 1970-1990 | W,T,G | 3/11/2004 | 113115310 |
| 73 | PHILLIP FREIDEL | NE SE S10 08N 12E | Medina | ? | ? | 11/8/2004 | Post-Reg. |
| 74 | MARSHALL VIL | SW SE S13 08N 12E | Medina | 1970-1988 | W,T,G | 3/11/2004 | 113117950 |
| 75 | MEDINA TN | NW SW S24 08N 12E | Medina | 1970-1990 | W,T | 6/6/2001 | 113114100 |

Solid Waste Disposal Sites in Dane County

| Map No. | Site Name | PLSS | Township | Years of Operation | Type of Waste[1] | DNR Assessment Date | Source of Information[2] |
|---|---|---|---|---|---|---|---|
| 76 | CROSS PLAINS TN | NE SW S20 07N 07E | Cross Plains | ? | D,W,T | 5/4/2000 | 113113550 |
| 77 | TRANSPORT GAS STATION | | Cross Plains | 1956-1963 | T,G | 1/29/2004 | Pre-Reg. |
| 78 | VALLEY ST BREWERY | NE S03 07N 07E | Cross Plains | ? | ? | 3/21/2004 | Pre-Reg. |
| 79 | REFUSE HIDEAWAY LANDFILL | SW NW S08 07N 08E | Middleton | 1973-1988 | D,W,T,G,H | 11/16/2000 | 113112010 |
| 80 | HEATHERCREST FARMS | NW NW S21 07N 08E | Middleton | ?-1973 | T | 11/14/2005 | Post-Reg. |
| 81 | RAY WEITZEL | SE S28 08N 09E | Middleton | ? | ? | 1/21/2004 | Post-Reg. |
| 82 | PLEASANT VIEW GOLF | NW NW S15 07N 08E | Middleton | ? | T | 5/18/2005 | DNR Southern District Files |
| 83 | PREFINISHED MILLWORK CORP | NE SE S10 07N 08E | Middleton | ? | ? | 11/8/2000 | 113124550 |
| 84 | MIDDLETON CTY ?-1967 | NW S11 07N 08E | Middleton | ? | ? | 6/11/2008 | Pre-Reg. |
| 85 | DENNIS HOWARD | SW SE S14 07N 08E | Middleton | ?-1977 | W,T | 10/11/2004 | Post-Reg. |
| 86 | MADISON CTY (MINERAL PT) | NE SW S24 07N 08E | Middleton | 1965-1971 | H,T,G | 7/6/2004 | 113185050 |
| 87 | HERMAN SCHNOOR | NW SE S25 07N 08E | Middleton | ?-1973 | D | 2/4/2004 | DNR Southern District Files |
| 88 | MADISON CTY - GREENTREE HILLS | SE NE S36 07N 08E | Middleton | 1973-1982 | W,T,G | 9/8/2004 | 113108160 |
| 89 | MADISON CTY - Odana Golf Course | NE NE S31 07N 09E | Madison | ? | ? | 9/9/2004 | Public |
| 90 | MADISON CTY - OLD BRICKYARD | SW SE S17 07N 09E | Madison | 1938-1941 | U | 9/9/2004 | 113339490 |
| 91 | SHOREWOOD VIL | SE SW S17 07N 09E | Madison | ? | ? | 11/28/2000 | 113063610 |
| 92 | SHOREWOOD VIL - DOCTORS PK | SE SW S16 07N 09E | Madison | ? | W | 7/12/2006 | Pre-Reg. |
| 93 | UNIV WISC-UNIV BAY 1968-71 | SW NE S16 07N 09E | Madison | 1968(?)-1971 | D, Ash | 6/1/2004 | DCRPC Solid Waste Plan |
| 94 | UNIV OF WISC-PICNIC PT | NE NE S16 13N 09E | Madison | ? | D,W | 3/17/2004 | Pre-Reg. |
| 95 | MADISON CTY - ST MARY'S PK LOT | NE S27 07N 09E | Madison | ? | U | 10/5/2004 | 113339600 |
| 96 | MADISON CTY FIORE PLAT | NW SW S26 07N 09E | Madison | 1932-1935 | U | 9/22/2004 | 113340260 |
| 97 | MADISON CTY - BOWMAN FIELD | NW NW S35 07N 09E | Madison | ? | U | 5/30/2001 | 113125980 |
| 98 | ICKE CONST. (ASH SITE) | NW SW S36 07N 09E | Madison | ?-1983 | D, Ash | 12/6/2000 | 113119380 |
| 99 | COYLE INC | NE NW S36 07N 09E | Madison | ? | U | 1/26/2004 | Post-Reg. |
| 100 | LENNES SCHLOBOHM (DEMO) | NE NW S36 07N 09E | Madison | ? | D | 1/22/2004 | Post-Reg. |
| 101 | MADISON CTY - OLIN AV LF | NW SW S25 07N 09E | Madison | 1945-1976 | U | 6/13/2000 | 113108380 |
| 102 | MADISON CTY LAKESIDE | NW NW S25 07N 09E | Madison | 1937-1939 | U | 9/23/2004 | Pre-Reg. |
| 103 | MADISON CTY LAW PK 41-46 | NW S24 07N 09E | Madison | 1941-1946 | U | 9/9/2004 | 113340150 |
| 104 | MADISON CTY 1953-69 | SW SW S13 07N 09E | Madison | 1953-1969 | ? | 9/13/2004 | Pre-Reg. |
| 105 | MADISON GAS & ELECTRIC RDF STORAGE FACILITY | S 1/2 S13 07N 09E | Madison | ? | T,RDF | | DNR 2769? |
| 106 | MADISON GAS & E 1941-44 | SE SE S12 07N 09E | Madison | 1941(?)-1944 | U | 12/2/2004 | 113339160 |
| 107 | MADISON CTY BURR JONES FIELD | NW NW S07 07N 10E | Blooming Grove | 1927-1930 | U | 6/30/2000 | 113317160 |
| 108 | MADISON CTY (DEMETRAL 1952-67) | NE NW S06 07N 10E | Blooming Grove | 1952-1967 | T,G | 9/8/2004 | 113189560 |
| 109 | GARVER SUPPLY LF | NW SE S05 07N 10E | Blooming Grove | ? | D | 9/14/2004 | DNR Southern District Files |
| 110 | MADISON CTY OLBRICH PK | SW SE S05 07N 10E | Blooming Grove | 1946-1951 | U | 6/5/2000 | 113068120 |

Solid Waste Disposal Sites in Dane County

| Map No. | Site Name | PLSS | Township | Years of Operation | Type of Waste[1] | DNR Assessment Date | Source of Information[2] |
|---|---|---|---|---|---|---|---|
| 111 | NUTRI-FEED CORP | SW S31 07N 10E | Blooming Grove | ? | ? | 3/10/2011 | 113111790 |
| 112 | MADISON CTY | S31 07N 10E | Blooming Grove | ? | ? | 9/8/2004 | Temp. 306 |
| 113 | CRVI-LIBBY PROPOSED LF | NE SE S31 07N 10E | Blooming Grove | | | 11/14/2005 | 113175920 |
| 114 | MADISON METROPOLITAN SEWERAGE DIST LAGOONS | SE S30 07N 10E | Blooming Grove | — | Sludge | 9/10/2004 | 113192970 |
| 115 | GISHOLT FOUNDRY 1971-72 | NE NW S29 07N 10E | Blooming Grove | 1971-1972 | F | 6/28/2005 | DNR Madison Area Files |
| 116 | MONONA CTY | NW NW S28 07N 10E | Blooming Grove | 1963-1972 | W,G | 5/30/2001 | 113236200 |
| 117 | HARP & KETTLE CHEESEHOUSE | NW S28 07N 10E | Blooming Grove | ? | D | 10/6/2004 | Post-Reg. |
| 118 | L S LUNDER CONST CO | NW NE S28 07N 10E | Blooming Grove | ? | ? | 8/3/2005 | Temp. 407 |
| 119 | GOBEN CARS INC | SW SE S21 07N 10E | Blooming Grove | ? | D,W | 10/6/2004 | 113339710 |
| 120 | L. A. O. MACHINE SHOP | SE SW S22 07N 10E | Blooming Grove | ? | ? | 5/26/2005 | Post-Reg. |
| 121 | CRVI-VONDRON PROPOSED LF | E NE S22 07N 10E | Blooming Grove | | | 11/14/2005 | 113193960 |
| 122 | HY-HO SILVER INC | NW NW S22 07N 10E | Blooming Grove | ? | ? | 10/7/2004 | WID980610596 |
| 123 | MIDWEST STEEL DIVISION | NE SW S15 07N 10E | Blooming Grove | 1976-1980 | Auto Shredder | 7/30/2005 | 113111570 |
| 124 | TERRA ENGR & CONSTR CORP | SE SE S15 07N 10E | Blooming Grove | 1972- | D,W | 12/2/2004 | 113112890 |
| 125 | MONONA CTY | S26 07N 10E | Blooming Grove | ? | ? | 10/4/2010 | Post-Reg. |
| 126 | BLOOMING GROVE TN | NE SW S12 07N 10E | Blooming Grove | 1961-1991 | W,T,G | 11/21/2000 | 113114650 |
| 127 | BLOOMING GROVE TN 1954-60 | NW NW S13 07N 10E | Blooming Grove | 1954-1960 | U | 3/8/2004 | 113343230 |
| 128 | D & M CONSTRUCTION | NW S13 07N 12E | Blooming Grove | ? | D,G | 5/28/2008 | Post-Reg. |
| 129 | MADISON CTY - Yahara Hills Golf Crse | NE SW S25 07N 10E | Blooming Grove | ? | ? | 9/9/2004 | Public |
| 130 | DANE CNTYLANDFILL #2-RODEFELD | NE S25 07N 10E | Blooming Grove | 1985- | D,W,T,G | 4/21/2004 | 113127300 |
| 131 | LLOYD DOWNING | SW SW S31 07N 11E | Pleasant Springs | ?-1973 | T | 4/11/2006 | DNR Southern District Files |
| 132 | COTTAGE GROVE TN | NW NE S28 07N 11E | Cottage Grove | 1969-1988 | D,W,T,G | 5/4/2000 | 113113440 |
| 133 | FRED SCHROEDER | SW SW S16 07N 11E | Cottage Grove | ?-1974 | T,F | 3/8/2011 | Post-Reg. |
| 134 | HYDRITE CHEM CO | NW NE S16 07N 11E | Cottage Grove | ? | ? | 3/15/2004 | WID000808824 |
| 135 | IRVING SMITH FILL | NW NE S04 07N 11E | Cottage Grove | ? | D,W | 11/10/2004 | Pre-Reg. |
| 136 | TALIAFERRE TIRE STORAGE SITE | NE S24 07N 11E | Cottage Grove | ?-1973 | Tires | | DNR Madison Area Files |
| 137 | DEERFIELD VIL | SW SW S22 07N 12E | Deerfield | ?-1981 | D,W | 6/25/2001 | 113117290 |
| 138 | DEERFIELD TN | SW SE S27 07N 12E | Deerfield | 1970-1991 | W,T,G | 6/7/2001 | 113119710 |
| 139 | THOMPSON STATE CAMP | SE SW S35 07N 12E | Deerfield | 1969-1970 | T,G | 8/12/2003 | Temp. 492 |
| 140 | ZICKERT FARM | NE SW S14 07N 12E | Deerfield | ? | ? | 3/17/2011 | Post-Reg. |
| 141 | UNAMMED SITE | NW S13 07N 12E | Deerfield | ? | ? | | Gr.Mad. Board Realtrs |
| 142 | BLUE MOUNDS STATE PARK | SE NE S01 06N 05E | Blue Mounds | ? | ? | 11/23/2005 | Pre-Reg. |
| 143 | BRIGHAM FARM | SW SW S05 06N 06E | Blue Mounds | ?-1976 | D,W | 11/8/2004 | Post-Reg. |
| 144 | MT HOREB VIL | SW S10 06N 06E | Blue Mounds | Pre-1943 | U | 4/14/2004 | Pre-Reg. |
| 145 | MOUNT HOREB VIL | SE SE S14 06N 06E | Blue Mounds | 1943-1975 | D,W,T,G | 4/14/2004 | 113118280 |
| 146 | EDGAR MARKWARDT PROPERTY | SW NW S01 06N 07E | Springdale | 1960s | H | 11/22/2000 | 113151830 |
| 147 | SPRINGDALE TN (EARLY 1960'S) | SE SE S25 06N 07E | NEW | ? | ? | 10/6/2005 | Pre-Reg. |
| 148 | VERONA TN | SW SW S09 06N 08E | Verona | pre-1968-1990 | W,T,G | 3/22/2004 | 113115420 |
| 149 | VERONA CTY 1968-71 | NE SE S16 06N 08E | Verona | 1968-1971 | W,T | 10/4/2010 | DCRPC Solid Waste Plan |
| 150 | VERONA VIL | NW SW S22 06N 08E | Verona | 1940-1950 | T,G | 6/27/2000 | 313005110 |

Solid Waste Disposal Sites in Dane County

| Map No. | Site Name | PLSS | Township | Years of Operation | Type of Waste[1] | DNR Assessment Date | Source of Information[2] |
|---|---|---|---|---|---|---|---|
| 151 | DANE CNTY LANDFILL #1-VERONA | NE NE S14 06N 08E | Verona | 1977-1986 | D,W,T,G | 7/30/2004 | 113097930 |
| 152 | FITCHBURG CTY | NE SW S18 06N 09E | Fitchburg | ? | U | 11/30/2005 | Pre-Reg. |
| 153 | KIETH HAMMERSLEY JR | SW SW S07 06N 09E | Fitchburg | 1970-1980 | D,W,T | 7/27/2010 | 113109480 |
| 154 | WISC BRICK & BLOCK (DEMO) | NE SW S07 06N 09E | Fitchburg | ? | D,W,T,G,Tires | 8/9/2005 | 113134450 |
| 155 | HAMMERSLY STONE DEMO | NE NE S07 06N 09E | Fitchburg | | D | 2/5/2004 | Demo |
| 156 | OREGON STATE FARM | NE SW S35 06N 09E | Fitchburg | ?-1972 | G | 12/11/2000 | 113064710 |
| 157 | WISC SCHOOL FOR GIRLS | NE SE S26 06N 09E | Fitchburg | 1969-1971 | T,G | 12/11/2000 | 113233780 |
| 158 | NEVIN HATCHERY DNR | SE NE S10 06N 09E | Fitchburg | 1974 | D | 4/14/2004 | 113339270 |
| 159 | HAMMERSELY CONST CO | SE SW S02 06N 09E | Fitchburg | 1977 | D | 8/3/2010 | One-Time |
| 160 | STEWART WATSON (DEMO) | NW S02 06N 09E | Fitchburg | ? | D | 3/8/2011 | Post-Reg. |
| 161 | SCHUEPBACH LF | SE NW S01 06N 09E | Fitchburg | ?-1973 | D,W | 12/13/2000 | 113151720 |
| 162 | MADISON CRUSHING CO. | SE NW S01 06N 09E | Fitchburg | 1971-1973 | D,F | 8/3/2005 | Post-Reg. |
| 163 | HOLTZMAN CO | SE SE S06 06N 10E | Dunn | pre-1971-1992 | Lab animals | 8/9/2005 | 113109920 |
| 164 | WASTE MGT OF WI-CITY DISPOSAL | SE NE S30 06N 10E | Dunn | 1966-1977 | H,D,W,T,G | 3/31/2000 | 113118830 |
| 165 | ARLO LADELL (T & H) | NW NW S29 06N 10E | Dunn | ? | ? | 10/19/2005 | WID980610125 |
| 166 | DUNN TN | NW NE S21 06N 10E | Dunn | 1970-1991 | T,G | 4/14/2004 | 113113880 |
| 167 | CRESENT DRIVE SITE | SW S9 06N 10E | Dunn | ? | ? | | Gr.Mad. Board Realtrs |
| 168 | MCFARLAND VIL | SW SW S02 06N 10E | Dunn | 1972-1975 | W | 5/30/2001 | 113118170 |
| 169 | DONALD BARBER LF | SW NW S26 06N 10E | Dunn | ? | ? | 5/29/2001 | Post-Reg. |
| 170 | PLEASANT SPRINGS TN | E 1/2 NW S31 05N 09E | Pleasant Springs | 1940-1966 | ? | | Gr.Mad. Board Realtrs |
| 171 | CLIFFORD SAGEN | SW S17 05N 09E | Pleasant Springs | ? | D | 3/8/2011 | Post-Reg. |
| 172 | OLD TIME AUTO PARTS - I90 RUBBLE | NE SW S09 07N 11E | Pleasant Springs | ? | ? | | Gr.Mad. Board Realtrs |
| 173 | PLEASANT SPRINGS TN | SW NW S36 06N 11E | Pleasant Springs | 1972-1989 | D,W,T,G | 10/13/2005 | 113114320 |
| 174 | PLEASANT SPRINGS TN | NE SW S25 06N 11E | Pleasant Springs | 1967-1972 | W,T,G | 9/27/2005 | Temp. 7 |
| 175 | CAMBRIDGE TN OLD DUMP | NW S29 06N 12E | Christiana | ?-1970 | U | 10/26/2005 | Pre-Reg. |
| 176 | CHRISTIANA TN | SW NE S08 06N 12E | Christiana | ?-1986 | W,T | 1/5/2004 | 113113330 |
| 177 | BOB BIRKREM | NE SE S05 06N 12E | Christiana | ? | D,G | 3/8/2011 | Post-Reg. |
| 178 | MELSTER CANDY KITCHENS LF | NW NE S12 06N 12E | Christiana | ? | U | 8/12/2010 | Post-Reg. |
| 179 | PERRY TN | NE NE S18 05N 06E | Perry | 1970-1991 | D,W,T | 6/6/2001 | 113114210 |
| 180 | PRIMROSE TN | NE SW S09 05N 07E | Primrose | 1970-1974 | T,G | 3/10/2004 | 113343340 |
| 181 | BELLEVILLE VIL | SE SE S34 05N 08E | Montrose | 1972-1988 | D,W | 4/14/2004 | 113116410 |
| 182 | MONTROSE TN | SE SW S01 05N 08E | Montrose | ?-1973 | D,W,G | 3/10/2004 | 113343890 |
| 183 | OREGON TN | NE NW S17 05N 09E | Oregon | ?-1974 | W | 9/13/2000 | 113114430 |
| 184 | DANE CNTY HWY DEPT-ACES' PIT | SE NW S17 05N 09E | Oregon | ?-1974 | D,W,T | 7/31/2004 | 113107060 |
| 185 | OREGON VIL - SENIOR CITZEN CENTER | NW S12 05N 09E | Oregon | ? | ? | | Pre-Reg. |
| 186 | OREGON VIL | NE NW S12 05N 09E | Oregon | ? | ? | 7/6/2005 | Pre-Reg. |
| 187 | OREGON KAR BODY | NW S07 05N 10E | Rutland | ?-1973 | D | 1/16/2003 | 113334760 |
| 188 | DUMP SITE | SW NW S31 05N 10E | Rutland | ? | ? | 8/30/2007 | Pre-Reg. |
| 189 | BROOKLYN VIL | SW SW S31 05N 10E | Rutland | 1969-1988 | D,W | 5/30/2001 | 113116630 |
| 190 | RUTLAND TN | SE NE S17 05N 10E | Rutland | 1974-1992 | W,T,G | 1/9/2002 | 113115090 |

Solid Waste Disposal Sites in Dane County

| Map No. | Site Name | PLSS | Township | Years of Operation | Type of Waste[1] | DNR Assessment Date | Source of Information[2] |
|---|---|---|---|---|---|---|---|
| 191 | OREGON RACE TRACK | SW SW S09 05N 10E | Rutland | ?-1973 | T | 7/8/2005 | Post-Reg. |
| 192 | RUTLAND TN | NW NW S02 05N 10E | Rutland | 1970-1974 | W,T,G | 9/12/2005 | 113114980 |
| 193 | EVERY FARM | SE NE S02 05N 10E | Rutland | 1963-1966 | H | 5/18/2007 | 113179330 |
| 194 | RUTLAND TN | S36 05N 10E | Rutland | 1950s | U | 8/16/2005 | Pre-Reg. |
| 195 | PETTY REALTY | NE NE S06 05N 11E | Dunkirk | ? | ? | 1/22/2004 | Post-Reg. |
| 196 | STOUGHTON CTY | SW SW S05 05N 11E | Dunkirk | ? | U | 8/5/2005 | Pre-Reg. |
| 197 | STOUGHTON CTY | SW NE S08 05N 11E | Dunkirk | ? | U | 8/5/2005 | Pre-Reg. |
| 198 | STOUGHTON CTY (AMUNDSON PK) | NW SW S04 05N 11E | Dunkirk | 1953-1978 | H | 8/5/2005 | 113005950 |
| 199 | DUNKIRK TN | SE SE S9 05N 11E | Dunkirk | ?-1986 | W,T,G | 6/7/2001 | 113113770 |
| 200 | THOMAS MATSON (DEMO) | NW SW S10 05N 11E | Dunkirk | ? | U,D | 1/13/2003 | 113334870 |
| 201 | ORRIN HAGEN FARM | NE SW S10 05N 11E | Dunkirk | Late 1950s-early '60s | H | 9/14/2004 | 113176030 |
| 202 | ALBION TN OLD DUMP | NE NE S23 05N 12E | Albion | 1967-1972 | G | 11/29/2005 | Pre-Reg. |
| 203 | GUS OBERG'S BAR | NW SE S25 05N 12E | Albion | ? | D,W,T | 8/24/2005 | 113109370 |
| 204 | ALBION TN | SE 1/2 S35 05N 12E | Albion | 1973-1986 | D,W,T | 12/1/2000 | 113114540 |

Note: All landfills are closed or inactive, except for Map #61 and #130

[1]Type of Waste

U = Undifferentiated

W = Wood and brush

T = Trash

G = Garbage (discarded materials from food processing and consumption)

D = Construction and demolition waste

F = Foundry waste

H = Hazardous waste

[2]Source of Information:

DNR Solid and Hazardous Waste Information System (SHWIMS) database, unless otherwise noted.

Temp: Indicates that a temporary permit or license has been issued.

Post-Reg or Pre-Reg: Indicates whether disposal occurred previous to or following the 1969 requirements that landfills be licensed by the state.

Demo: Demolition sites requiring permits are noted by “one-time” or “Demo.”

WID: EPA Comprehensive Environmental Response, Compensation, and Liability Information System (CERLIS) archive.

This table and associated map indicate the general location of waste disposal sites identified by the DNR and other governmental units and private entities. In many cases, the exact boundaries and precise contents of the sites are not known.

# Attachment D

# State and Federal Groundwater Agencies

The following summarizes Wisconsin state and federal agencies that have groundwater databases and conduct groundwater protection activities.

## Department Of Agriculture, Trade, And Consumer Protection

### Agrichemical Resources Management Division

- Regulate pesticide use
- Regulate bulk pesticide and fertilizer storage
- Conduct groundwater studies and testing
- Certify pesticide applicators
- Track agrichemical spills and remediation
- Regulate installation and maintenance of underground storage tanks
- Testing of petroleum products

### Food Safety Division

- Conduct inspections of food processors (including water bottlers)
- Conduct sampling of Grade A dairy wells

## Department Of Health Services (DHS)

### Bureau of Community Health and Prevention

- Recommend enforcement standards for substances related to health concerns
- Investigate health effects from contamination incidents
- Develop groundwater standards
- Develop groundwater public health policy

### Bureau of Environmental Health

- Inspect restaurant, hotel, motel and campground water supplies

## Department Of Safety and Professional Services (DSPS)

### Division of Safety and Buildings

- Regulate private sewage systems
- Approve home water treatment devices
- Approve plats for unsewered subdivisions

## Department Of Natural Resources (DNR)

### Bureau of Watershed Management

- Approve sewage lagoons, municipal and industrial wastewater systems
- License large-scale on-site waste disposal systems
- License wastewater sludge disposal
- License septage disposal

**Bureau of Waste Management**

- Track operating and abandoned landfill
- Monitor hazardous waste treatment, storage, and disposal
- Administer recycling program
- Administer pollution prevention
- Approve mining operation
- Approve environmental restoration and response program

**Bureau for Remediation and Redevelopment**

- Remediate environmental contamination (soil, groundwater, etc.)
- Administer Brownfields program
- Redevelopment of contaminated areas
- Respond to spill incidents
- Administer Leaking Underground Storage Tanks program
- Administer Superfund program
- Administer state-funded response actions
- Administer the Petroleum Environmental Cleanup Fund Award (FECFA)

**Bureau of Drinking Water and Groundwater**

- Set and enforce public and private drinking water standards
- Monitor public drinking water wells
- Approve public and high-capacity wells
- License well drillers and pump installers
- Conduct well driller education
- Implement the Safe Drinking Water Act
- Administer the Wellhead protection
- Administer Injection Well program
- Conduct water quality planning and education/Wellhead protection
- Facilitate groundwater coordination
- Set and enforce groundwater quality standards
- Monitor groundwater quality and quantity

## University Of Wisconsin (UW)

**Central Wisconsin Groundwater Center**
**University of Wisconsin-Extension**

- Conduct drinking water and groundwater education programs
- Provide technical assistance to local governments
- Develop materials regarding groundwater Best Management Practices
- Collect and analyze groundwater resource data
- Produce educational materials and county groundwater reports
- Conduct research

**Wisconsin Geological and Natural History Survey**

- Map and inventory groundwater resources and geologic conditions
- Write technical reports and assist regulating agencies

- Monitor groundwater levels and water quality
- Provide education and public information
- Conduct research

**UW Water Resources Center**

- Coordinate and administer water resources research in UW system
- Operate designated federal water resource center
- Develop curriculum for children
- Produce research publications

## United States Geological Survey (USGS)

- Collect data and conduct studies regarding:
- streamflow at gaging stations and other sites
- stage and contents of lakes and reservoirs
- chemical, physical and biological characteristics of surface water
- groundwater levels in observation wells
- Conduct geologic mapping
- Conduct research

## United States Department Of Agriculture (USDA)

**Natural Resources Conservation Service**

- Maintain and interpret soil property databases
- Produce digital soil maps
- Rate soils for potential pesticide leaching and runoff
- Provide technical assistance for soil and water
- Provide resource planning and management
- Develop farming practice standards for groundwater protection
- Rate soils for potential nitrogen and phosphorus leaching

# Attachment E

**Summary of State Regulatory Controls of Groundwater Pollution Sources and Withdrawals**

| Activity | Regulator | Adm. Code | Focus of Regulation |
|---|---|---|---|
| **WASTE DISPOSAL** | | | |
| **Municipal & Industrial Landfills** | DNR | 185<br>500 | Licensing of all sites; standards for location, design, operation, construction, monitoring and abandonment. |
| **Environmental Repair Fund (ERF)** | DNR | 710 | Focuses on development of an environmental response plan; inventory sites that might pollute; develops a hazard ranking system; identifies remedial actions to be taken. Also applies to hazardous waste disposal facilities. |
| **Municipal & Industrial Wastewater** | DNR | 110<br>206<br>214 | DNR regulates through WPDES permit process. NR 110 sets design standards for municipal sewerage systems; NR 206 land disposal of municipal and domestic wastewater; and NR 214 land disposal of industrial wastewater. |
| **Sanitary Sewers** | DSPS<br>DNR | 382<br>110 | DSPS regulates laterals.<br>Sets design standards for municipal pumping, interceptors and collector systems. |
| **Private Wastewater Systems** | DSPS | 383<br>385 | DSPS regulates siting, design, installation, and inspection of systems and licensing of installers and evaluators. Large-scale systems (>12,000 gals/day) requires a DNR WPDES permit. DNR can also prohibit tanks in areas where they could cause a water quality problem. |
| **Municipal Sludge** | DNR | 204<br>214<br>518 | Regulates sewage sludge disposal and recycling.<br>Regulates landspreading of industrial sludge.<br>Regulates landspreading of solid waste |
| **Septage** | DNR | 113 | Regulates septage disposal, recycling and licenses septage pumping businesses. |
| **AGRICULTURE** | | | |
| **Animal Waste Management** | DNR | 243 | Require operators to obtain WPDES permit and require monitoring wells in situations to achieve compliance with livestock performance standards and prohibitions. |
| | DNR | 812 | DNR regulates the distance of wells from concentrated feeding operations. |
| | | 151 | Establishes Agricultural Performance Standards and Prohibitions |
| | DATCP | 51 | Establishes state standards and procedures local governments must use if they choose to require conditional use permits for siting new and expanded livestock operations |
| **Nonpoint Source Pollution** | DNR | 120 | Sets up Nonpoint Source Pollution Program cost/share funding for best management practices including storage manure facility requirements, critical site designation, BMPs, etc. |
| | DATCP | 50 | Implements Wisconsin's Soil and Water Resource Management Program. |

**Summary of State Regulatory Controls of Groundwater Pollution Sources and Withdrawals**

| Activity | Regulator | Adm. Code | Focus of Regulation |
|---|---|---|---|
| **Pesticide Use & Control** | DATCP | 29 | Rules require good handling practices and prohibit direct (or possible indirect) entry of pesticides into the groundwater; also has aldicarb restrictions and groundwater sampling requirements. |
| **Pesticide Product Restrictions** | DATCP | 30 | Rules restrict the use of specific pesticide products, including the Atrazine Rule (ATCP 30.31) |
| **Groundwater Protection Program** | DATCP | 31 | Establishes standards for groundwater test reporting and the regulatory and enforcement actions to prevent and control groundwater pollution from agricultural activities. |
| **Fertilizer Bulk Storage** | DATCP | 33 | Rules apply to fertilizer and pesticide bulk storage by manufacturers and distributors. |
| **Agricultural Chemical Cleanup Program** | DATCP | 35 | Rules for administering the Agricultural Chemical Cleanup Program |
| **HAZARDOUS MATERIALS & WASTE** | | | |
| **Hazardous Waste Requirements** | DNR | 600+ | State regulatory program exceeds minimum RCRA Federal standards. |
| | | 700+ | Comprehensive code: procedures and standards for cleaning up hazardous waste contamination sites including leaking underground storage tanks, environmental repair sites, and hazardous substance discharges. |
| **PCBs** | DNR | 157 | Establishes procedures for collection, storage, transport, and disposal of PCBs and products containing PCBs. |
| **Chemical Storage Tanks** | DATCP | 93 | Leak detection program, plan review, tank inspection and approval, design and construction standards, and recordkeeping. |
| **Used Oil** | DNR | 679 | Creates comprehensive rule for management of used oil, including standards for burning, storage, transportation and reporting. |
| **WATER QUALITY & OTHER ACTIVITIES** | | | |
| **Groundwater Standards** | DNR | 140 | Sets up a two-tiered system of numerical standards for polluting substances enforced by DNR, and establishes groundwater quality standards for harmful substances. |
| **Drinking Water Standards** | DNR | 809 | DNR sets drinking water standards and public water supply monitoring requirements. |
| **Well Construction & Abandonment** | DNR | 141 | Rule establishes requirements for groundwater monitoring, well construction and abandonment. |
| | | 811<br>812 | Specifies well design and construction, sets minimum separating distances between wells and potential pollution sources, and requires proper abandonment of all wells. DNR licenses well drillers and pump installers. |
| | | 845 | Provides for county administration of NR 812. |
| **Well Compensation** | DNR | 123 | Program lets DNR provide partial reimbursement to replace contaminated wells. |
| | DATCP | 31 | DATCP rule establishes the regulatory and enforcement actions which the DATCP will take to protect groundwater against pollution from agricultural activities. |

**Summary of State Regulatory Controls of Groundwater Pollution Sources and Withdrawals**

| Activity | Regulator | Adm. Code | Focus of Regulation |
|---|---|---|---|
| **Highway Salt Storage** | DOT | 277 | TRANS 277: Provides DOT response when preventative action limit for chloride has been exceeded at a storage facility and sets requirements for remedial action. |
| **GROUNDWATER QUANTITY** | | | |
| **Water Supply and Environmental Protection** | DNR | 800+ | Comprehensive code addressing water use, permitting, well construction, water supply systems, and groundwater quantity protection. |
| | | 820 | Establishes review criteria applicable to high capacity well applications involving wells situated near springs, trout streams, outstanding and exceptional resource waters, and also groundwater withdrawals involving high water loss. Also establishes special protection efforts in two Groundwater Management Areas in the state experiencing water level drawdowns in excess of 150 feet (Lower Fox River Valley and Southeast Wisconsin). |
| | | 852 | Establishes a statewide water conservation and efficiency program for withdrawals in the Great Lakes Basin and water loss approvals statewide. |
| | | 854 | (proposed) Establishes a statewide water supply service area planning process for public water supply systems. |
| | | 856 | Establishes requirements for registering water withdrawals and collecting and reporting accurate water withdrawal data to support management efforts. |
| | | 860 | Establishes the process, requirements, and criteria for water use permitting. |
| | | 142 | Wisconsin Water Management and Conservation, established to protect and promote the conservation of the waters of the state. |