REGIONAL CLIMATE VULNERABILITY ASSESSMENT

Part 1: Localized Flood Risk
Chapter 4: Water Supply

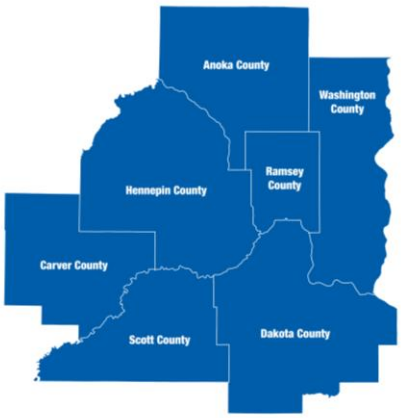
METROPOLITAN COUNCIL

June 2020

The Council's mission is to foster efficient and economic growth for a prosperous metropolitan region

Metropolitan Council Members

Charlie Zelle	Chair	Raymond Zeran	District 9
Judy Johnson	District 1	Peter Lindstrom	District 10
Reva Chamblis	District 2	Susan Vento	District 11
Christopher Ferguson	District 3	Francisco J. Gonzalez	District 12
Deb Barber	District 4	Chai Lee	District 13
Molly Cummings	District 5	Kris Fredson	District 14
Lynnea Atlas-Ingebretson	District 6	Phillip Sterner	District 15
Robert Lilligren	District 7	Wendy Wulff	District 16
Abdirahman Muse	District 8		



The Metropolitan Council is the regional planning organization for the seven-county Twin Cities area. The Council operates the regional bus and rail system, collects and treats wastewater, coordinates regional water resources, plans and helps fund regional parks, and administers federal funds that provide housing opportunities for low- and moderate-income individuals and families. The 17-member Council board is appointed by and serves at the pleasure of the governor.

On request, this publication will be made available in alternative formats to people with disabilities. Call Metropolitan Council information at 651-602-1140 or TTY 651-291-0904.

Table of Contents

Chapter 3: Water Supply

Localized Versus Riverine Flooding

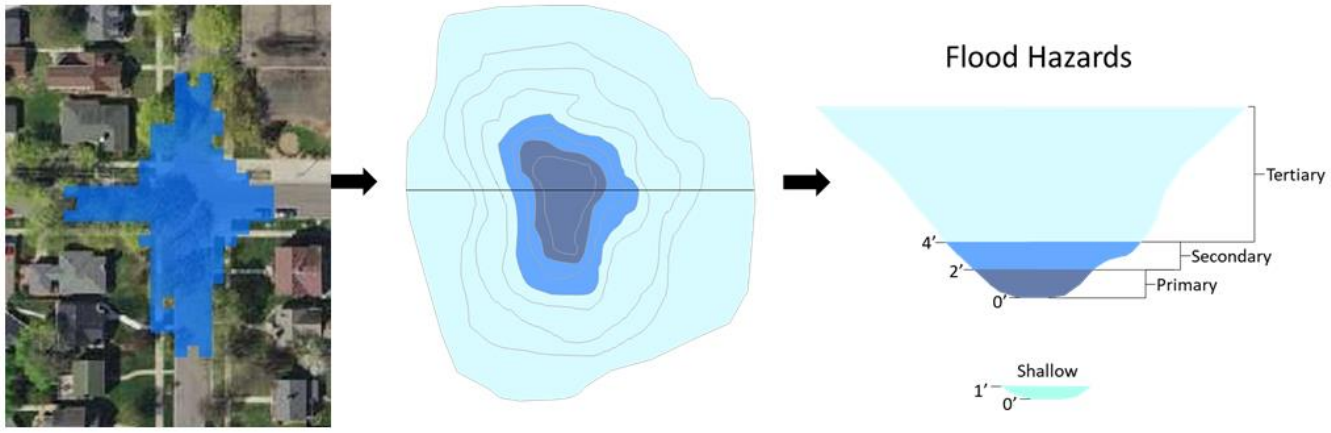
Riverine flooding occurs when extended rainfall or snowmelt causes a river to exceed its capacity. Localized flooding occurs when high intensity rainfall creates a flooded area independent of an overflowing water body. Riverine flooding areas are generally known and regulated by relevant stakeholders, be it local floodplain managers or state agency staff. It is advisable that riverine flooding be considered with the latest modelling data and *Atlas 14 precipitation estimates* to ensure that all floodplain mapping is up to date and as accurate as possible.

The localized flooding data layer does not replace the FEMA flood information. Instead, this data allows for a localized screening of areas that could be prone to surface water flooding that can occur outside the influence of streams and rivers. In recent years, cities have seen much more surface or localized flooding from short, intense rain events. While communities plan for such occurrences, in some instances stormwater infrastructure can become overwhelmed or blocked. The localized flooding data shows potential flood risks to water supply in the event of stormwater infrastructure failure.

Localized Flood Hazard Categorization

Figure 1 shows an aerial map view and a cross-section of a generalized localized flooding area, referred to as a 'Bluespot.' This visualization can help stakeholders understand that the Primary Flood Impact Zones are the first areas to fill with water, and Tertiary Flood Impact Zones are the last to fill with water. The third image in Figure 1 shows how Primary, Secondary, and Tertiary categorizations make up the contiguous Flood Impact Zone (FIZ), while Shallow areas are isolated localized flooding areas of 3 in to 1 ft in depth.

Figure 1. Map view of a Bluespot and a Bluespot Cross-section using Council Categorization



Water Supply analysis of exposure to potential flood impact zones was assessed in terms of acreage and, secondarily, the number of impacted domestic wells, Emergency Response Areas (ERAs) and Inner Wellhead Management Zones (IWMZs) for public water supply wells. The Methodology sections of this chapter, for each water supply asset and area, detail exposure at different localized flood depths. The section beginning on page 4 details a regional overview of water supply exposure to potential localized flooding hazards.

Community Use of the Data

The *Localized Flood Map for Climate Vulnerability Screening* is available at high resolution. Local communities and other stakeholders may conduct similar analyses to assess conditions and vulnerabilities that may inform adaptive strategies for local system assets. *The Localized Flood Map Screening Tool* is also available for stakeholders that do not have access to GIS software.

The Minnesota Pollution Control Agency's (MPCA) *What's in My Neighborhood* map provides a wide variety of environmental information about communities across the state. It identifies potentially contaminated sites, sites that have already been cleaned up, and sites that are currently under investigation or are in the process of being cleaned up. This information can assist private and public water suppliers in identifying potential risks to water supply by acknowledging potential contaminants in the vicinity of wells.

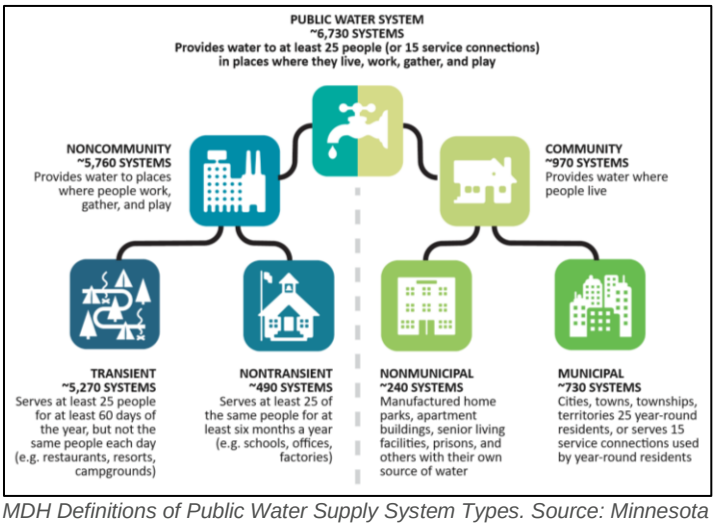
As stated by the federal Safe Drinking Water Act, the Minnesota Department of Health (MDH) is required to work with public water suppliers to produce *Source Water Assessments* for all Minnesota public water systems. These assessments provide information about the water sources used by public drinking water systems including potential risks for contamination and strategies implemented by the public water supplier to mitigate these risks. As part of the wellhead protection planning process, MDH also requires public water suppliers to identify and manage potential contaminant sources within the delineated Drinking Water Supply Management Area (DWSMA) and particularly within 200 feet of the public water supply well(s).

Overview of Regional Water Supply Assessment

To analyze the potential localized flood impacts to private domestic and public (municipal and non-municipal) water supply wells, the Council has produced an overview of systemwide exposure to localized flooding hazards. It should be emphasized that this analysis was conducted in 2018, so as infrastructure is constructed, adapted, or removed, and drinking water management areas are updated, the analysis should be revisited as required.

Water supply wells and management areas vary in type, water source, and location, but are extensive throughout the region and subject to potential localized flooding. This analysis identified where Flood Impact Zones (FIZ) impacted three areas:

1) areas within 50 feet of a private domestic (residential well),
2) areas designated by MDH as Inner Wellhead Management Zones (IWMZs) around public transient, noncommunity wells (e.g. restaurants, resorts, campgrounds), and
3) areas designated by MDH as Emergency Response Areas (ERAs) around public non-transient, noncommunity and community wells (e.g. schools, offices, factories, manufactured home parks, apartment buildings, prisons, cities and towns).



MDH Definitions of Public Water Supply System Types. Source: Minnesota Department of Health

Table 1 provides an overview of potential localized flooding impacts to water supply wells and identified management areas. Water supply wells and management areas vary in type, water source, and location, but are extensive throughout the region and subject to potential localized flooding.

The potential impact is detailed across these three analysis areas. For private domestic wells, only 7.6% of the total acreage intersects with FIZs. 13.1% of IWMZs intersect with FIZs, and 16.3% of ERAs intersect with FIZs. Of the potentially impacted wells and identified management areas, between 37.2% (private domestic wells) and 46.2% (ERAs) are within Primary Flood Impact Zones.

Table 1. Overview of Water Supply Analysis

			Flood Impact Zone % for Analysis Layers in a FIZ			
Analysis Layer	**Total (Acres)**	**Total Analysis Layer in FIZ***	**Primary**	**Secondary**	**Tertiary**	**Shallow**
Domestic Wells (50ft Buffer)	12,054	7.6%	37.2%	19.2%	29.4%	14.2%
Inner Wellhead Management Zone (200ft Buffer Around Public Well)	2,539	13.1%	40.8%	19.5%	25.4%	14.3%
Emergency Response Areas (1-year Time-of-Travel to Public Well)	39,562	16.3%	46.2%	18.5%	22.6%	12.7%

It is important to note that Table 1 shows regional percentages. Asset-based and site-specific analysis (assessment of a certain Emergency Response Area, for example) should be conducted to clearly identify and prioritize areas of water supply vulnerability and subsequent site-specific strategies to increase resilience of water supply assets and resource management areas. For this assessment, it is also important to note that risk is not assigned to different Flood Impact Zones (Primary, Secondary, Tertiary, and Shallow). The analysis details where and to what degree the FIZ intersect with water supply areas.

A Private Well. Source: Minnesota Department of Health Well Management Section

The sections that follow will describe the water supply assessment, including the methodology for evaluating exposure by asset, subsequent analysis, considerations for planning and response, and strategies for addressing exposure.

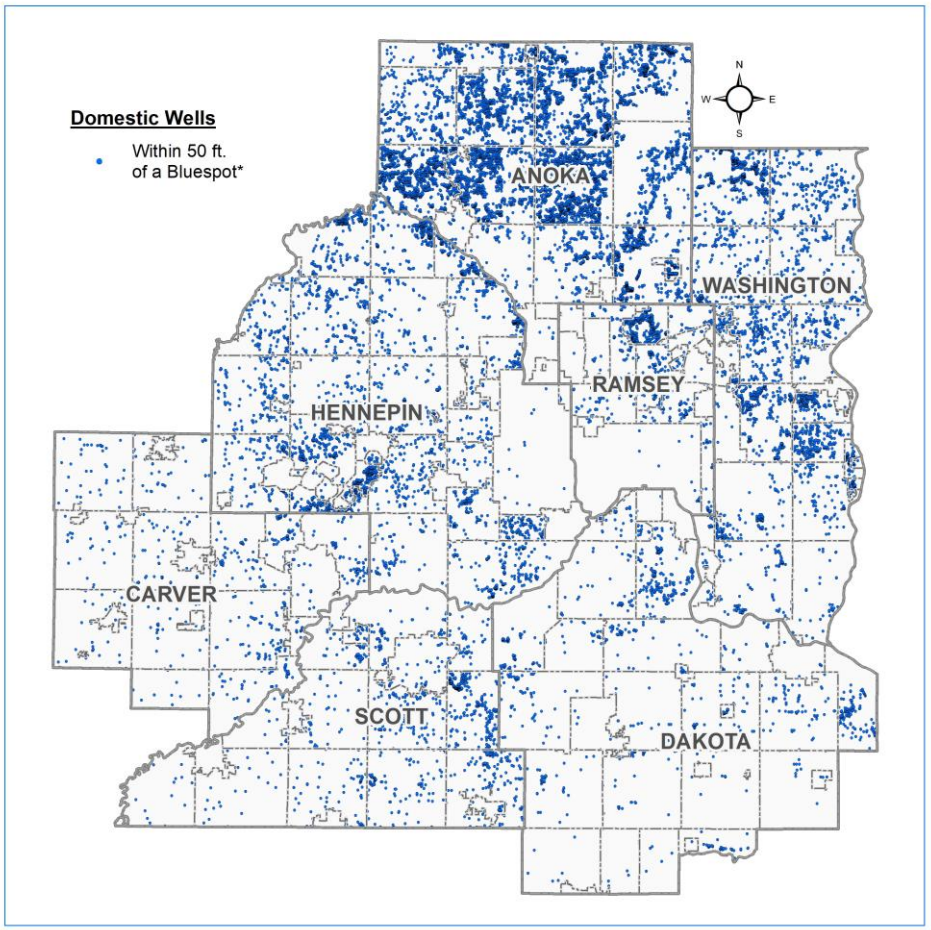
Domestic Private Water Supply

Rationale

Many residents throughout the metropolitan area get their drinking water from private water supply, or domestic wells. Although there is a high variability in the type, depth, and location of private wells, it is important to consider the potential impacts of localized flooding on all private domestic wells.

Private domestic wells are particularly vulnerable to water quality impacts from potential contaminants near the well site, such as those created by localized flooding. The State of MN, through the *Minnesota Department of Health,* stipulates well isolation distances for activities near domestic wells, with most activities relegated to a 50 foot distance to protect domestic water quality. We therefore used a 50 ft buffer to evaluate domestic wells.

Figure 2. Metro-wide Domestic Private Wells



Flood waters pose different threats to well water based on the flooding proximity to the well and well construction. Direct flood water contamination, through the top of the well, can be reduced with watertight well caps. Flood waters that reach the well wall, but do not over-top the well, may still pose a threat. The *Minnesota Department of Health* recommends having well water tested, even if flood water does not reach the well but comes within 50 feet of the well.

Methodology

Since both direct and indirect flooding can impact water quality, this analysis considered any potential localized flooding within 50 feet of a private domestic well a potential impact. To determine the number of potentially impacted wells and the associated acreage around them (50-foot buffer areas), well data from the seven-county metropolitan area was compiled and classified by respective county and community. Using the *Minnesota Well Index* data, A 50-foot buffer was created around each well, then intersected with the Localized Flood Map data layer ('Bluespot' layer). Known water bodies (i.e. lakes,

rivers, and streams) were excluded from the results using the erase tool. The resulting data maps the potential localized flooding impacts within 50 feet of all domestic wells. This data was summarized by the acreage of each Flood Impact Zone (FIZ). The calculated (potentially impacted) acreages were compared to the total 50 ft buffer acreage to determine the percentage of domestic well areas potentially influenced by FIZs. The localized flooding exposure posed by each flood hazard is displayed in Table 2

Girl Drinks Water from a Glass. Source: Metropolitan Council Digital Image Library

Additionally, analysis was performed to identify domestic wells directly within potential localized flood zones (Appendix I). This was done by performing an intersection of the well location points, which included a 50 foot buffer, with the Localized Flood Map data layer.

Analysis

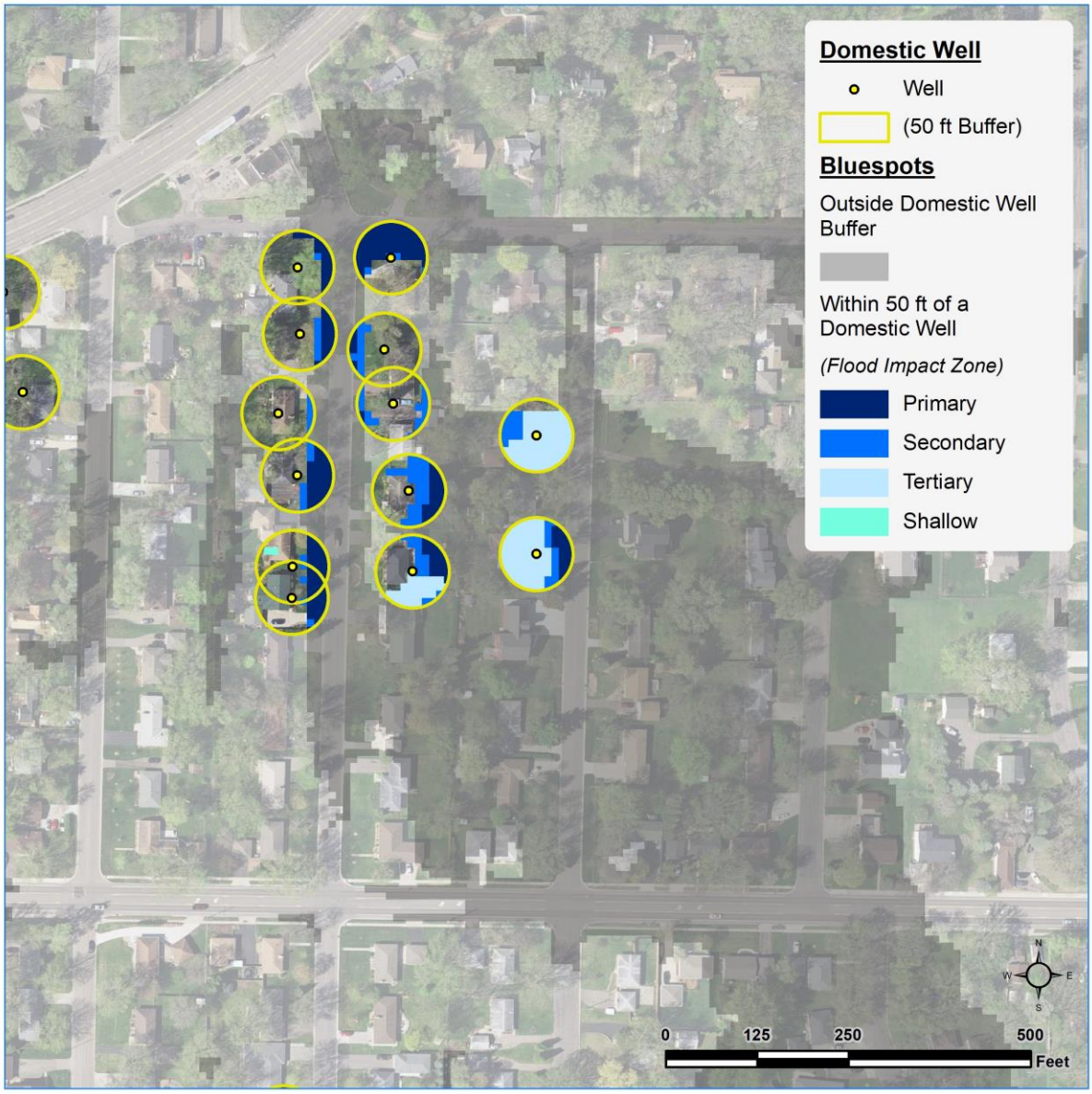
Table 2 details that 7.6% of active private domestic wells recorded in the Minnesota Well Index, including the 50-foot buffers around each one, intersects with a Flood Impact Zone. Breaking down the potential exposure of the 7.6% of wells by FIZ is important to help stakeholders understand the overall exposure of domestic wells to potential localized flooding hazards. Of the wells and 50-foot buffer areas located within a Flood Impact Zone, 37.2% are located within a Primary FIZ - the most common flood hazard that may affect domestic wells. As Primary FIZ are the first to fill with flood water, and deepest area of any localized flooding 'Bluespot', these wells should be further studied to verify on-site conditions that may increase localized flood risk. Secondary FIZ has 19.2% of potentially impacted wells, Tertiary has 29.4%, and Shallow has 14.2%. These FIZ will likely not reach flood levels high enough to overflow a well but are within the 50-foot buffer used to determine potential impacts, and still pose a contamination risk.

Table 2. Summary of Private Domestic Wells Analysis

			Flood Impact Zone % for Analysis Layers in a FIZ			
Analysis Layer	**Total (Acres)**	**Total Analysis Layer in FIZ***	**Primary**	**Secondary**	**Tertiary**	**Shallow**
Domestic Wells (50ft Buffer)	12,054	7.6%	37.2%	19.2%	29.4%	14.2%

Figure 3 displays a local example of domestic wells potentially at risk for localized flooding, displaying the 50-foot buffer around wells and intersected Flood Impact Zones. This example shows the variability in exposure both to the well itself, and to the buffer zone. The darker gray area in the background of the map displays the FIZ outside of the 50-foot domestic well buffers. Many of the wells in this example do not directly intersect with a Flood Impact Zone but are still at risk from contamination due to flooding. This analysis demonstrates the importance of including the areas around wells (buffer zones or management area) when analyzing localized flooding potential. It also indicates that localized, more specific, analysis would be beneficial to understanding the potential impact to domestic wells.

Figure 3. Localized Example of Potential Impact to Domestic Wells



Considerations

The analysis of domestic (private) wells is limited to the potential localized flooding exposure of each well. Given that the impact of localized flooding on drinking water resources and infrastructure is complex and event-specific, no measure of vulnerability is assigned for this analysis. Instead, the Flood Impact Zones are simply identified and quantified as they relate to domestic wells and the buffer zones; therefore, as a next step in analysis, it is important to combine this information with site-specific variables such as well age and depth, existing or proposed development, and local hydrological information. Some of this information can be found online at the MN Department of Health's *Minnesota Well Index*. For domestic wells, it is also important to note that private owners have discretion in implementing any precautionary measures, and such measures may vary based on well location and drinking water source.

Existing Strategies

The Minnesota Department of Health operates the *Well Management Program*, which provides well construction and sealing standards, well inspections, and responds to groundwater contamination events across the state. This program helps protect against floodwater contamination by conducting routine inspections of the construction and sealing of wells and borings. Additionally, in the case of property transfers, the Well Management Program follows up with property owners to seal unused wells. MDH also helps reduce the financial burden of well sealing by providing private owners with information on financial assistance programs offered by various government agencies across the state.

According to Minnesota Administrative Rule *4725.4350*, domestic wells are required to be constructed to prevent the entry of flood water into the well. This includes extending the casing at least five feet above the regional flood level, installing a watertight seal and extending the casing ten feet above the established ground surface, installing an outer, neat-cement grouted protective casing, and extending the casing a minimum of two feet above the established ground surface.

Additional strategies have been identified by metro counties. For example, *Dakota County* supports testing private wells impacted by flooding, and *Washington County* offers assistance to seal abandoned wells, which can create a pathway for potential contaminants from the land surface down into groundwater supplies.

Proposed Strategies

Through its *Well Protection Program*, The Minnesota Department of Health advises well owners that wells contaminated with flood water can pose a health risk. MDH recommends that well owners take precautions before possible flooding and take corrective actions should a well be flooded. MDH offers specific recommendations regarding *Flood Precautions for Private Wells* on their website.

The Metropolitan Council identifies and communicates about parts of the metro that have been designated Drinking Water Supply Management Areas and are therefore eligible for grants for well sealing, if the Wellhead Protection Plan identifies this as a priority and financial resources are available.

Metropolitan Council may consider working with partners to encourage private well owners to implement the following:

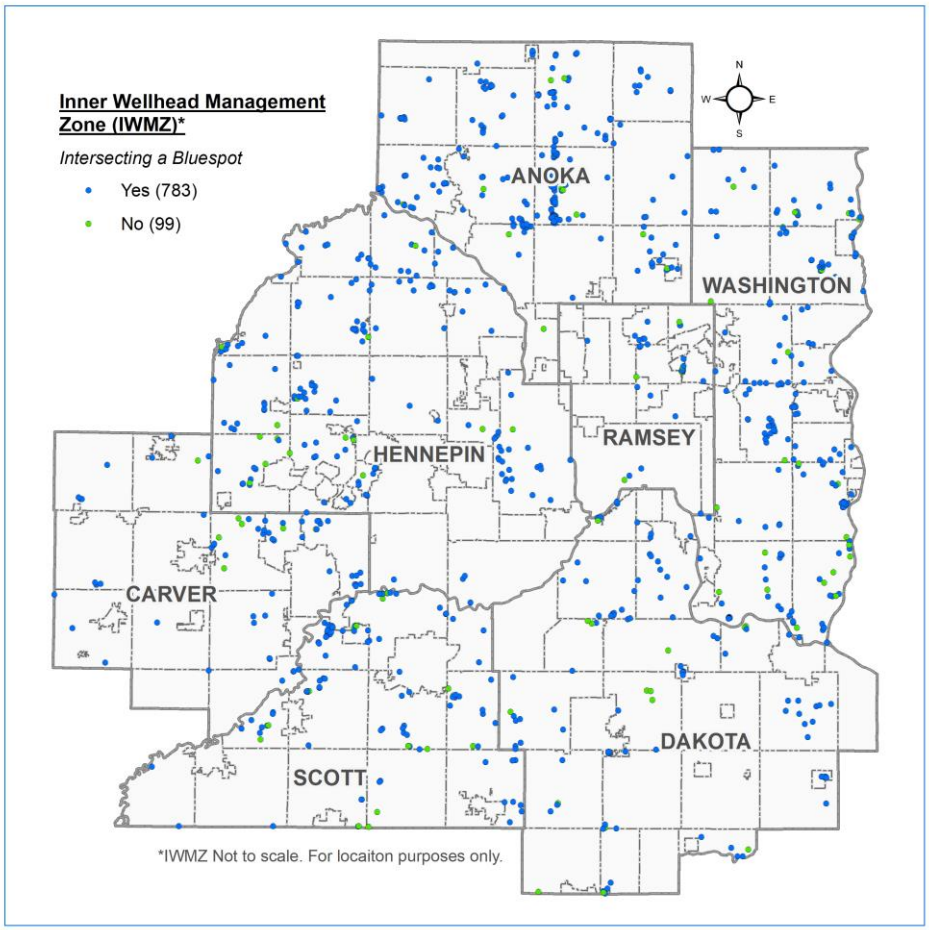
- ☐ Work with MDH and other agencies to identify wells that intersect with Flood Impact Zones (FIZ) and develop educational materials that can help well owners protect their drinking water resources.
- ☐ Convene a water supply stakeholder group comprised of both public water suppliers and property owners and industry experts to discuss the localized flooding data in relation to drinking water protection guidance, programming and other relevant applications across the region.

Transient Public Water Supply (MDH Inner Wellhead Management Zones)

Rationale

Wells also provide water to the public in places other than their homes – where people work, gather and play. In the Twin Cities metro area, there are around 885 wells that serve at least 25 people for 60 or more days per year such as restaurants, resorts and campgrounds. The owners of these wells are required to identify and manage areas adjacent to them. The purpose of managing these areas is to minimize risk of contamination, monitor known pollution sources, and implement protection measures. Potential localized flooding is important to consider because it may pose a contamination threat to wells and drinking water resources. Some Inner Wellhead Management Zones (IWMZs) are at risk of contamination throughout the metropolitan region; however, levels of exposure can differ by location.

Figure 4. Metro-wide Inner Wellhead Management Zones



Methodology

Inner Wellhead Management Zones (IWMZs) are areas within a 200-foot radius of a well that supplies water to the public. The zones are in place to protect public drinking water in compliance with the *Federal Safe Drinking Water Act*. The IWMZs for transient, non-community wells were identified. These IWMZs were then intersected with the Localized Flood Map data layer, using ArcGIS to identify zones with potential localized flooding impacts. Known water bodies (i.e. lakes, rivers, and streams) were removed from this analysis using the erase tool. The resulting map layer identifies localized flood data within 200 feet of a transient, non-community well. The acreage of IWMZs that intersects with potential localized flooding impact areas was calculated and compared with the total IWMZ acreage. The total number of IWMZs that intersect potential localized flooding areas was also calculated.

Analysis

Of the total 2,539 acres of the IWMZs, 13.1% intersect a potential Flood Impact Zone (FIZ). However, despite the low percentage of intersecting acreage, Figure 4 shows that at least a portion of nearly all metro area IWMZs intersect potential localized flooding areas. Only 99 of 783 IWMZs do not intersect a Flood Impact Zone.

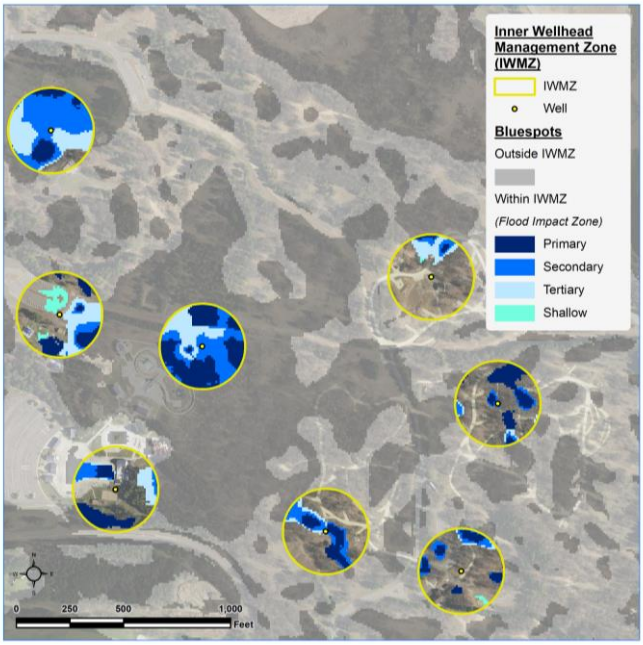
The breakdown of Flood Impact Zone coverage for IWMZ is shown in Table 3. Of the 13.1% IWMZ acres that intersect FIZs, 40.8% are in the Primary Flood Impact Zones. This is important to note, as previously mentioned, because Primary Flood Impact Zones are the first to fill during a localized flooding event, which means that the Primary FIZ are also the deepest portion of any contiguous localized flooding area.

Table 3. Summary of Inner Wellhead Management Zone Analysis

			Flood Impact Zone % for Analysis Layers in a FIZ			
Analysis Layer	**Total (Acres)**	**Total Analysis Layer in FIZ***	**Primary**	**Secondary**	**Tertiary**	**Shallow**
Inner Wellhead Management Zone	2,539	13.1%	40.8%	19.5%	25.4%	14.3%

Figure 5 shows a local example of multiple IWMZs with potential exposure to localized flooding. The example shows high variability in exposure, depending on location of the IWMZ. It also shows that one contiguous localized flooding area may impact many IWMZs. This interrelatedness of potential risk across IWMZs may be important in determining strategies to reduce flood risk for IWMZs that intersect with the same, contiguous localized flooding area. The example in Figure 5 displays an area within the region that contains a high density of potential FIZ. This example is not representative of the entire region but demonstrates the high degree of variability of potential risk across a diversity of locations. In this example, 3 of the 8 wells within IWMZs are not directly in a FIZ. Although these wells are unlikely to be overtopped by contaminated floodwater, they still face contamination to drinking water resources through infiltration, demonstrating the importance of identifying the 200-foot buffer zone around public wells.

Figure 5. Localized Examples of Potential Impact to IWMZs



Considerations

More analysis of the relationship between localized flooding and public water supply infrastructure and resources can help inform further analysis of the IWMZs and subsequent policies and strategies needed to reduce localized flooding potential in and near IWMZs.

Existing Strategies

The State *Well Code* (Minnesota Administrative Rules, Chapter 4725.4450) requires public water suppliers who participate in the *Minnesota Department of Health's* IWMZ survey to maintain isolation distances for potential sources of contamination. These public water suppliers are also required to monitor existing potential sources of contamination that do not meet the required isolation distances.

Proposed Strategies

Metropolitan Council Environmental Services may consider the following:

- ☐ Work with MDH and other agencies to identify wells that intersect with Flood Impact Zones (FIZ) and develop educational materials that can help well owners protect their drinking water resources.
- ☐ Propose a revision to the isolation distance requirements that limits the construction of new wells within a certain distance of an area identified as at risk of localized flooding.
- ☐ Work with water suppliers, MnTAP, and local experts to conduct studies that help determine the vulnerability of identified IWMZs to localized flooding.
- ☐ Encourage water suppliers to use MDH's *Drinking Water Risk Communication Toolkit* to communicate potential contaminant issues from localized flooding risk.
- ☐ Encourage stakeholders to review the EPA resource: *Flood Resilience: A Basic Guide for Water and Wastewater Utilities*.
- ☐ Encourage communities to examine community-centered public utility flooding guidance on the *MDH's Community Public Water System Flooding Guidance webpage.*

Inside the Clarifier at St. Paul Regional Water Services Treatment Plant. Source: Metropolitan Council Digital Image Library

Public Water Supply (MDH Emergency Response Areas)

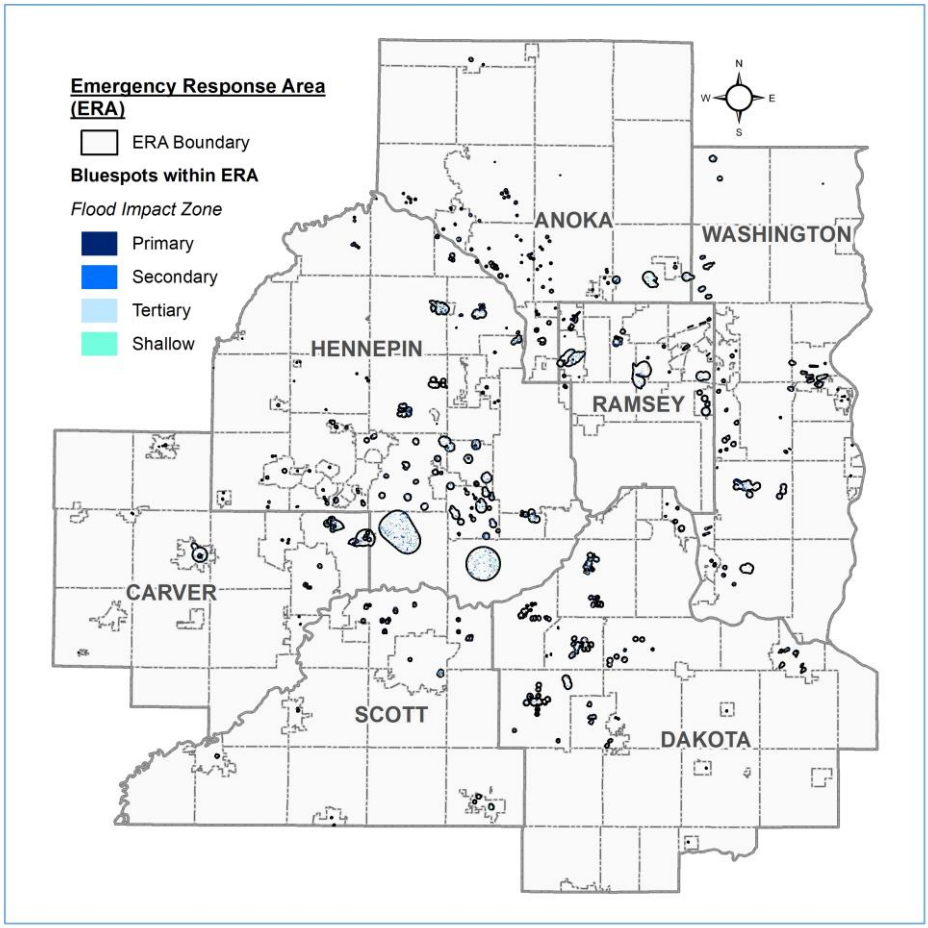
Rationale

Emergency Response Areas (ERAs) are vital components of drinking water resource protection and wellhead protection planning. ERAs are demarcated areas where groundwater can reach a public water supply well within 1-year.

Emergency Response Areas are identified when public water suppliers develop wellhead protection plans. These areas are vital to the protection of drinking water supplies from contamination and pollutants.

Identifying Emergency Response Areas that may be subject to localized flooding exposure helps communities proactively plan to reduce contamination risk to public water supplies and is important for engaging stakeholders in the development of regional policies that protect drinking water resources and infrastructure.

Figure 6. Metro-wide Emergency Response Areas



Methodology

In order to identify ERAs that may experience localized flooding, the ERA data layer was intersected with the Localized Flood Map data layer in ArcGIS. Known water bodies (i.e. lakes, rivers, and streams) were removed from this analysis using the erase tool. The resulting map layer identifies areas within ERAs potentially impacted by localized flooding.

The percentage of the total ERA acreage that intersects with the Flood Impact Zone layer was calculated. Additionally, a count of all ERAs intersecting the Flood Impact Zone layer was performed and classified by community and county.

Analysis

There are 39,562 acres of Emergency Response Area throughout the metro region, displayed in Figure 6. Of this total, 16.3% (6,448 acres) of all ERAs intersect with Flood Impact Zones. As shown in Table 4, close to a majority of the Flood Impact Zones are Primary FIZ, 46.2%, which are the first areas to fill with flood water and the deepest portion of any localized flooding area or 'bluespot'.

Table 4. Summary of Emergency Response Area Analysis

			Flood Impact Zone % for Analysis Layers in a FIZ			
Analysis Layer	**Total (Acres)**	**Total Analysis Layer in FIZ***	**Primary**	**Secondary**	**Tertiary**	**Shallow**
Emergency Response Areas	39,562	16.3%	46.2%	18.5%	22.6%	12.7%

The remaining acreage of ERAs affected by potential localized flooding is split between Secondary, Tertiary, and Shallow flood hazards. These percentages are relatively small, given the total acreage covered by Emergency Response Areas, but these areas should also be considered given the significance of the ERAs in protecting water quantity and quality throughout the region. Further analysis will likely need to determine if shallow flooding, for example, has potential risk associated with ground water contamination. Movement of water through the ground is highly complex and localized. Therefore, the specific contamination risk posed to a well should be assessed locally.

Table 5 shows the ERA percentages potentially affected by localized flooding broken down by county, displaying the affected acreage and associated percentages. This table illuminates the variability in potential flood exposure within ERAs across the region.

Table 5. Percentage of Emergency Response Areas covered by FIZ, by County

County	Emergency Response Areas (Acres)	FIZ in ERA (Acres)	Percentage FIZ
Anoka	2,830.21	499.53	17.65%
Carver	3,128.70	389.60	12.45%
Dakota	6,710.97	984.21	14.67%
Hennepin	17,878.21	3136.20	17.54%
Ramsey	3,856.09	522.07	13.54%
Scott	1,288.57	272.83	21.17%
Washington	3,857.64	656.93	17.03%

Figure 7. Localized Example of Potential Impact to an ERA

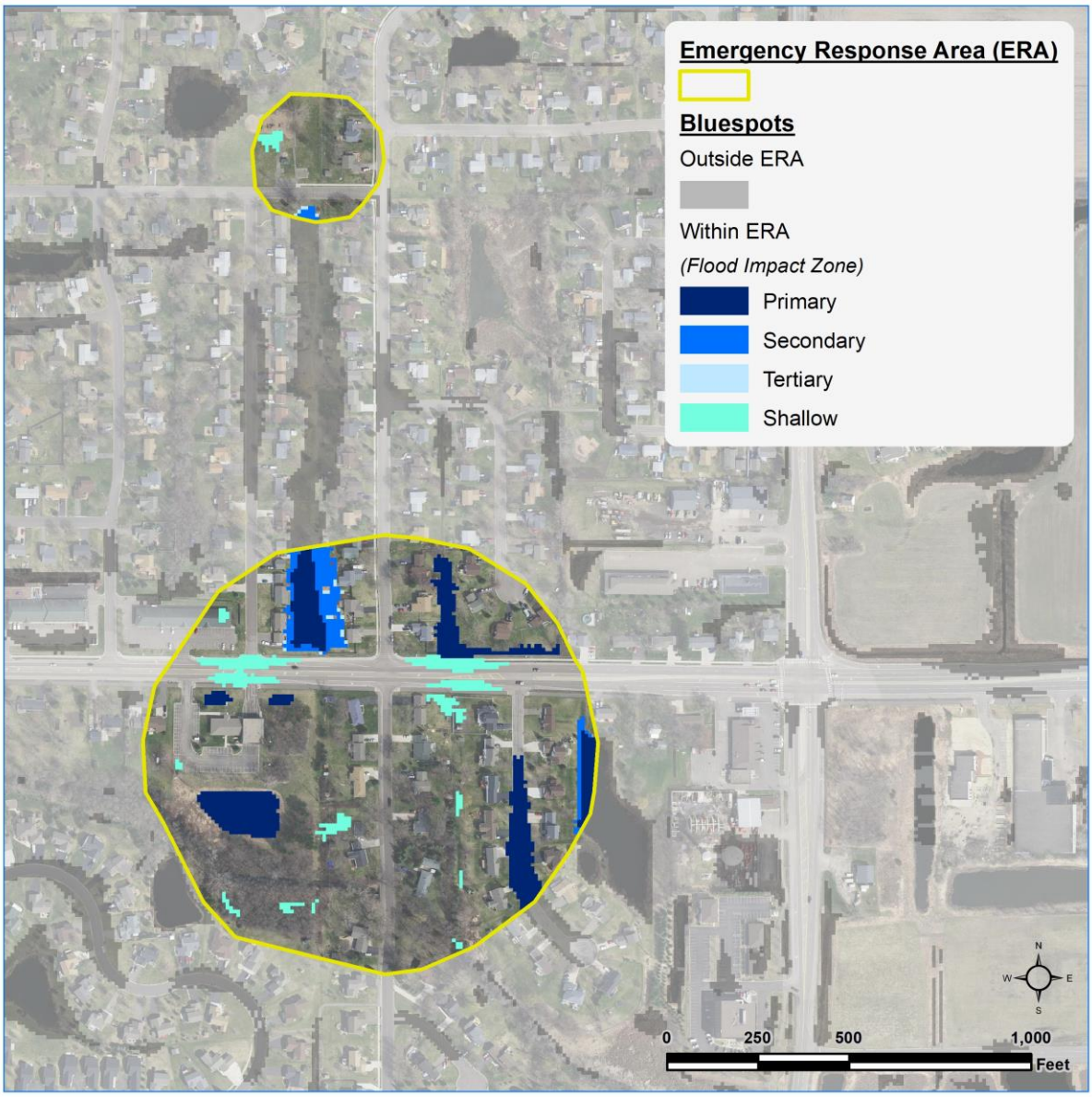


Figure 7 shows a local example of two ERAs intersecting localized flooding areas. This example shows each ERA's relationship with potential flood hazards. Shallow flood hazards along roadways are visible, as well as local streets potentially subject to Primary FIZs. Other Flood Impact Zones are located within, what appear to be, functioning stormwater ponds. Localized flooding near roads and near or within functioning stormwater features will likely cause different impacts to water quantity and quality.

Considerations

It is important to consider the wellhead protection planning process and the role of ERAs within a community's designated wellhead protection area (WHPA). Both areas are determined through complex groundwater flow modeling and defined by the amount of the time it takes water to reach public water supply wells. WHPAs are areas where it takes water ten years to reach a well, whereas ERAs are areas where it takes one year for water to reach a well. The determination of ERAs helps communities with public water supplies manage the potential for acute contamination events. ERAs were used in this analysis because flooding events are typically acute, but recurring events may be considered a chronic risk. Assessment of the flooding risk to specific wells would benefit from in-depth local information and analysis.

The largest water supply planning areas are called Drinking Water Supply Management Areas (DWSMAs). The Drinking Water Supply Management Areas have not been specifically assessed within this analysis. DWSMAs are defined by property lines surrounding the WHPA because sound drinking water management must account for land uses and property ownership.

Existing Strategies

Minnesota Administrative Rule *4725.5850* requires community public water supply wells to comply with several flood protection requirements. These include sloping well site ground surface to drain away from the well and establishing ground surface that is at least two feet above the highest known elevation of bodies of water within 50-feet of the site.

The Minnesota Department of Health works with the public water supply to conduct routine inspections, provide technical assistance and plan review, and coordinate mandatory certification and training for water operators. Additionally, MDH's Source Water Protection program requires public water suppliers to identify and manage risk in order to supply safe and affordable drinking water to their customers. MDH partners at the Minnesota Department of Agriculture have also developed an *Interactive Map of Source Water Protection Areas* to demonstrate the vulnerability of DWSMAs across the state.

The Metropolitan Council is required by Minnesota Statute 473.1565 to address the water supply planning needs of the region. The Council develops and updates the metropolitan area *Master Water Supply Plan* and makes recommendations for local and regional water supply planning. The Council also provides technical assistance to communities in the region. This includes reviewing the planning portion of Wellhead Protection Plans for metropolitan area communities.

Proposed Strategies

Metropolitan Council Environmental Services may consider the following:

- ☐ Work with MDH and other agencies to identify wells that intersect with Flood Impact Zones (FIZ) and develop educational materials that can help well owners protect their drinking water resources.
- ☐ Promote training to water operators and public works directors on localized flooding assessment and related tools as part of the *Water Operator Certification and Training* through MDH.
- ☐ Encourage water suppliers to use MDH's *Drinking Water Risk Communication Toolkit* to communicate potential contaminant issues from localized flooding risk.
- ☐ Encourage communities to join *MnWarn*, a statewide water/wastewater agency response network.
- ☐ Encourage stakeholders to review the EPA resource: *Flood Resilience: A Basic Guide for Water and Wastewater Utilities*.
- ☐ Encourage communities to examine community-centered public utility flooding guidance found on the *MDH's Community Public Water System Flooding Guidance webpage.*

Summary of Proposed Council Strategies

Table 6. Summary of Proposed Council Strategies

Potential Strategy	Applies to Domestic Well Owners	Applies to Non-municipal Well Owners (IWMZs)	Applies to Municipal Well Owners (ERAs)
Work with MDH and other agencies to identify wells that intersect with Flood Impact Zones (FIZ) and develop educational materials that can help private well owners protect their drinking water resources.	✓	✓	✓
Convene a water supply stakeholder group comprised of both public water suppliers and property owners and industry experts to discuss the localized flooding data in relation to drinking water protection guidance, programming and other relevant applications across the region.	✓		
Propose a revision to the isolation distance requirements that limits the construction of new wells within a certain distance of an area identified as at risk of localized flooding.		✓	
Work with private water suppliers, MnTAP, and local experts to conduct studies that help determine the vulnerability of identified IWMZs to localized flooding.		✓	
Encourage water suppliers to use MDH's *Drinking Water Risk Communication Toolkit* to communicate potential contaminant issues from localized flooding risk.		✓	✓
Encourage stakeholders to review the EPA resource: *Flood Resilience: A Basic Guide for Water and Wastewater Utilities*.		✓	✓
Encourage communities to examine community-centered public utility flooding guidance on the *MDH's Community Public Water System Flooding Guidance webpage.*		✓	✓
Promote training to water operators and public works directors on localized flooding assessment and related tools as part of the *Water Operator Certification and Training* through MDH.			✓
Encourage communities to join *MnWarn*, a statewide water/wastewater response network.			✓

Acronyms

CVA – Climate Vulnerability Assessment
DWSMA – Drinking Water Supply Management Area
ERA – Emergency Response Area
EPA – Environmental Protection Agency
FEMA – Federal Emergency Management Administration
FIZ – Flood Impact Zone
GIS – Geographic Information Systems
IWMZ – Inner Wellhead Management Zone
LGU – Local Governmental Unit
MCES – Metropolitan Council Environmental Services
MDH – Minnesota Department of Health
SOP – Standard Operating Procedure

Appendix I: Domestic Wells within 50 Feet of Flood Impact Zones by Community

Community	Domestic Wells	Domestic Wells within 50 ft. of a FIZ	Percentage
Afton	621	95	15.30%
Andover	2,798	1,089	38.92%
Anoka	57	19	33.33%
Apple Valley	69	28	40.58%
Arden Hills	75	18	24.00%
Bayport	22	3	13.64%
Baytown Twp.	446	176	39.46%
Belle Plaine	8	0	0.00%
Belle Plaine Twp.	198	22	11.11%
Benton Twp.	224	35	15.63%
Bethel	122	63	51.64%
Birchwood Village	3	1	33.33%
Blaine	644	264	40.99%
Blakeley Twp.	103	13	12.62%
Bloomington	726	231	31.82%
Brooklyn Center	149	57	38.26%
Brooklyn Park	512	215	41.99%
Burnsville	409	70	17.11%
Camden Twp.	191	34	17.80%
Carver	62	16	25.81%
Castle Rock Twp.	138	47	34.06%
Cedar Lake Twp.	716	102	14.25%
Centerville	302	122	40.40%
Champlin	426	186	43.66%
Chanhassen	420	68	16.19%
Chaska	126	19	15.08%
Circle Pines	3	0	0.00%
Coates	23	10	43.48%
Cologne	7	2	28.57%
Columbia Heights	8	1	12.50%
Columbus	973	407	41.83%

Coon Rapids	220	65	29.55%
Corcoran	1,215	254	20.91%
Cottage Grove	480	113	23.54%
Credit River Twp.	1,194	307	25.71%
Crystal	124	23	18.55%
Dahlgren Twp.	416	85	20.43%
Dayton	977	277	28.35%
Deephaven	753	252	33.47%
Dellwood	221	70	31.67%
Denmark Twp.	397	36	9.07%
Douglas Twp.	115	12	10.43%
Eagan	112	45	40.18%
East Bethel	3,266	1,250	38.27%
Eden Prairie	393	75	19.08%
Edina	471	123	26.11%
Elko New Market	59	15	25.42%
Empire Twp.	84	21	25.00%
Eureka Twp.	156	38	24.36%
Excelsior	2	1	50.00%
Falcon Heights	16	4	25.00%
Farmington	41	13	31.71%
Forest Lake	1,923	663	34.48%
Fort Snelling (unorg.)	18	5	27.78%
Fridley	24	6	25.00%
Gem Lake	50	17	34.00%
Golden Valley	307	44	14.33%
Grant	837	275	32.86%
Greenfield	680	110	16.18%
Greenvale Twp.	26	6	23.08%
Greenwood	197	42	21.32%
Grey Cloud Island Twp.	45	15	33.33%
Ham Lake	4382	1,755	40.05%
Hamburg	0	0	NA
Hampton	7	2	28.57%
Hampton Twp.	150	13	8.67%

Hancock Twp.	83	11	13.25%
Hanover	96	22	22.92%
Hastings	35	8	22.86%
Helena Twp.	393	71	18.07%
Hilltop	1	0	0.00%
Hollywood Twp.	245	42	17.14%
Hopkins	29	3	10.34%
Hugo	791	266	33.63%
Independence	924	157	16.99%
Inver Grove Heights	527	193	36.62%
Jackson Twp.	131	38	29.01%
Jordan	14	5	35.71%
Lake Elmo	1,198	376	31.39%
Lake St. Croix Beach	115	55	47.83%
Lakeland	293	104	35.49%
Lakeland Shores	35	12	34.29%
Laketown Twp.	405	67	16.54%
Lakeville	254	68	26.77%
Landfall	0	0	NA
Lauderdale	2	0	0.00%
Lexington	0	0	NA
Lilydale	3	0	0.00%
Lino Lakes	1,529	693	45.32%
Linwood Twp.	1,550	648	41.81%
Little Canada	187	71	37.97%
Long Lake	4	0	0.00%
Loretto	0	0	NA
Louisville Twp.	238	50	21.01%
Mahtomedi	74	25	33.78%
Maple Grove	520	107	20.58%
Maple Plain	10	5	50.00%
Maplewood	473	124	26.22%
Marine on St. Croix	104	17	16.35%
Marshan Twp.	255	68	26.67%
May Twp.	678	193	28.47%
Mayer	4	0	0.00%

Medicine Lake	93	24	25.81%
Medina	572	80	13.99%
Mendota	10	5	50.00%
Mendota Heights	151	26	17.22%
Miesville	23	3	13.04%
Minneapolis	43	14	32.56%
Minnetonka	790	179	22.66%
Minnetonka Beach	3	1	33.33%
Minnetrista	911	152	16.68%
Mound	6	1	16.67%
Mounds View	5	2	40.00%
New Brighton	6	4	66.67%
New Germany	3	1	33.33%
New Hope	61	2	3.28%
New Market Twp.	863	143	16.57%
New Prague	5	0	0.00%
New Trier	2	1	50.00%
Newport	98	15	15.31%
Nininger Twp.	160	31	19.38%
North Oaks	894	383	42.84%
North St. Paul	7	1	14.29%
Northfield	3	0	0.00%
Norwood Young America	8	3	37.50%
Nowthen	1215	318	26.17%
Oak Grove	2223	873	39.27%
Oak Park Heights	20	2	10.00%
Oakdale	70	24	34.29%
Orono	1642	298	18.15%
Osseo	5	3	60.00%
Pine Springs	92	32	34.78%
Plymouth	587	125	21.29%
Prior Lake	270	50	18.52%
Ramsey	2,835	1,209	42.65%
Randolph	4	1	25.00%
Randolph Twp.	88	35	39.77%
Ravenna Twp.	473	123	26.00%

Richfield	397	155	39.04%
Robbinsdale	11	5	45.45%
Rockford	5	0	0.00%
Rogers	763	241	31.59%
Rosemount	159	58	36.48%
Roseville	220	60	27.27%
San Francisco Twp.	264	49	18.56%
Sand Creek Twp.	271	39	14.39%
Savage	227	46	20.26%
Scandia	910	276	30.33%
Sciota Twp.	40	5	12.50%
Shakopee	368	80	21.74%
Shoreview	291	91	31.27%
Shorewood	1,007	233	23.14%
South St. Paul	7	1	14.29%
Spring Lake Park	2	0	0.00%
Spring Lake Twp.	906	157	17.33%
Spring Park	1	1	100.00%
St. Anthony	32	4	12.50%
St. Bonifacius	1	0	0.00%
St. Francis	620	235	37.90%
St. Lawrence Twp.	99	14	14.14%
St. Louis Park	105	31	29.52%
St. Marys Point	90	19	21.11%
St. Paul	137	20	14.60%
St. Paul Park	27	10	37.04%
Stillwater	206	39	18.93%
Stillwater Twp.	522	130	24.90%
Sunfish Lake	59	15	25.42%
Tonka Bay	11	8	72.73%
Vadnais Heights	284	96	33.80%
Vermillion	41	26	63.41%
Vermillion Twp.	238	54	22.69%
Victoria	341	68	19.94%

Waconia	16	1	6.25%
Waconia Twp.	298	54	18.12%
Waterford Twp.	42	8	19.05%
Watertown	20	3	15.00%
Watertown Twp.	300	45	15.00%
Wayzata	63	4	6.35%
West Lakeland Twp.	1,083	235	21.70%
West St. Paul	30	3	10.00%
White Bear Lake	46	10	21.74%
White Bear Twp.	128	46	35.94%
Willernie	0	0	NA
Woodbury	564	162	28.72%
Woodland	70	19	27.14%
Young America Twp.	150	30	20.00%
Total	**66,852**	**19,994**	**29.91%**

Appendix II: Acres of Inner Wellhead Management Zones (IWMZ) Intersecting Flood Impact Zones by Community

Community	Inner Wellhead Management Zones (Acres)	Inner Wellhead Management Zones in FIZ (Acres)	Percentage
Afton	61.11	9.53	15.60%
Andover	46.89	11.74	25.04%
Anoka	0.94	0.11	12.27%
Apple Valley	11.51	0.75	6.49%
Arden Hills	2.88	0.04	1.31%
Bayport	0.00	0.00	NA
Baytown Twp.	14.98	4.93	32.90%
Belle Plaine	0.00	0.00	NA
Belle Plaine Twp.	3.50	0.19	5.55%
Benton Twp.	2.88	0.07	2.40%
Bethel	11.51	3.94	34.19%
Birchwood Village	0.00	0.00	NA
Blaine	5.76	0.42	7.30%
Blakeley Twp.	5.18	0.04	0.69%
Bloomington	8.64	2.57	29.80%
Brooklyn Center	0.00	0.00	NA
Brooklyn Park	23.03	3.51	15.23%
Burnsville	0.00	0.00	NA
Camden Twp.	8.64	0.39	4.48%
Carver	0.00	0.00	NA
Castle Rock Twp.	20.48	2.82	13.75%
Cedar Lake Twp.	12.80	0.55	4.26%
Centerville	26.84	3.86	14.38%
Champlin	8.64	2.49	28.78%
Chanhassen	40.78	5.99	14.70%
Chaska	2.88	0.05	1.76%
Circle Pines	0.00	0.00	NA
Coates	14.39	3.18	22.08%
Cologne	0.00	0.00	NA
Columbia Heights	0.00	0.00	NA
Columbus	22.51	4.05	17.98%
Coon Rapids	29.94	8.89	29.69%
Corcoran	48.90	2.31	4.73%
Cottage Grove	57.57	8.77	15.23%

Credit River Twp.	37.42	2.36	6.30%
Crystal	0.00	0.00	NA
Dahlgren Twp.	17.27	5.21	30.16%
Dayton	26.56	3.13	11.80%
Deephaven	26.20	6.65	25.40%
Dellwood	2.88	0.10	3.32%
Denmark Twp.	56.81	2.03	3.57%
Douglas Twp.	2.88	0.44	15.38%
Eagan	35.21	10.75	30.53%
East Bethel	96.30	13.64	14.16%
Eden Prairie	2.88	0.05	1.77%
Edina	0.00	0.00	NA
Elko New Market	2.26	0.14	6.06%
Empire Twp.	14.39	1.00	6.93%
Eureka Twp.	14.40	0.50	3.45%
Excelsior	0.00	0.00	NA
Falcon Heights	0.00	0.00	NA
Farmington	2.88	0.00	0.02%
Forest Lake	23.03	2.13	9.24%
Fort Snelling (unorg.)	0.00	0.00	NA
Fridley	2.88	0.00	0.00%
Gem Lake	25.85	3.76	14.53%
Golden Valley	9.75	1.34	13.74%
Grant	32.32	4.99	15.43%
Greenfield	23.03	0.90	3.90%
Greenvale Twp.	3.05	0.00	0.00%
Greenwood	5.20	0.03	0.62%
Grey Cloud Island Twp.	0.00	0.00	NA
Ham Lake	189.20	21.71	11.48%
Hamburg	0.00	0.00	NA
Hampton	0.00	0.00	NA
Hampton Twp.	0.00	0.00	NA
Hancock Twp.	2.76	0.01	0.40%
Hanover	5.76	0.12	2.16%
Hastings	5.76	0.34	5.82%
Helena Twp.	11.51	0.20	1.75%
Hilltop	0.00	0.00	NA
Hollywood Twp.	11.51	2.28	19.81%
Hopkins	0.00	0.00	NA
Hugo	10.14	3.34	32.91%
Independence	34.54	4.88	14.13%

Inver Grove Heights	25.91	4.84	18.68%
Jackson Twp.	24.88	3.18	12.79%
Jordan	0.00	0.00	NA
Lake Elmo	69.00	9.54	13.83%
Lake St. Croix Beach	0.00	0.00	NA
Lakeland	2.88	0.35	12.24%
Lakeland Shores	0.00	0.00	NA
Laketown Twp.	35.84	3.19	8.89%
Lakeville	28.79	1.31	4.56%
Landfall	0.00	0.00	NA
Lauderdale	0.00	0.00	NA
Lexington	0.00	0.00	NA
Lilydale	5.74	0.51	8.85%
Lino Lakes	27.86	2.85	10.22%
Linwood Twp.	23.03	1.99	8.63%
Little Canada	6.17	1.05	16.97%
Long Lake	0.00	0.00	NA
Loretto	0.00	0.00	NA
Louisville Twp.	44.76	4.29	9.59%
Mahtomedi	2.73	2.06	75.51%
Maple Grove	26.07	3.69	14.14%
Maple Plain	0.00	0.00	NA
Maplewood	2.88	0.65	22.74%
Marine on St. Croix	23.03	0.38	1.66%
Marshan Twp.	28.79	5.77	20.03%
May Twp.	63.54	13.09	20.60%
Mayer	0.00	0.00	NA
Medicine Lake	1.22	0.00	0.00%
Medina	48.81	2.50	5.13%
Mendota	8.61	1.44	16.72%
Mendota Heights	0.04	0.00	0.00%
Miesville	14.39	0.59	4.09%
Minneapolis	67.97	11.33	16.66%
Minnetonka	0.00	0.00	NA
Minnetonka Beach	0.00	0.00	NA
Minnetrista	36.37	2.90	7.98%
Mound	0.00	0.00	NA
Mounds View	0.00	0.00	NA
New Brighton	0.00	0.00	NA
New Germany	0.00	0.00	NA
New Hope	0.00	0.00	NA

New Market Twp.	20.84	0.34	1.63%
New Prague	0.00	0.00	NA
New Trier	0.00	0.00	NA
Newport	2.88	0.10	3.32%
Nininger Twp.	11.51	0.20	1.71%
North Oaks	16.97	4.29	25.27%
North St. Paul	0.00	0.00	NA
Northfield	0.19	0.00	0.00%
Norwood Young America	0.00	0.00	NA
Nowthen	25.91	5.67	21.89%
Oak Grove	46.01	8.71	18.93%
Oak Park Heights	0.00	0.00	NA
Oakdale	2.88	1.35	46.97%
Orono	27.43	0.71	2.57%
Osseo	0.00	0.00	NA
Pine Springs	0.00	0.00	NA
Plymouth	7.42	0.45	6.07%
Prior Lake	5.75	0.20	3.52%
Ramsey	74.84	13.51	18.05%
Randolph	0.00	0.00	NA
Randolph Twp.	14.39	3.24	22.49%
Ravenna Twp.	0.00	0.00	NA
Richfield	0.00	0.00	NA
Robbinsdale	0.00	0.00	NA
Rockford	0.00	0.00	NA
Rogers	28.14	3.09	10.97%
Rosemount	10.85	0.47	4.36%
Roseville	0.00	0.00	NA
San Francisco Twp.	11.63	2.29	19.67%
Sand Creek Twp.	28.79	1.47	5.10%
Savage	8.64	0.60	6.97%
Scandia	57.57	4.55	7.91%
Sciota Twp.	0.00	0.00	NA
Shakopee	48.38	6.89	14.25%
Shoreview	0.83		0.00%
Shorewood	8.42	0.58	6.93%
South St. Paul	2.88	2.71	94.30%
Spring Lake Park	0.00	0.00	NA
Spring Lake Twp.	33.27	2.99	9.00%
Spring Park	0.00	0.00	NA
St. Anthony	0.00	0.00	NA

St. Bonifacius	0.00	0.00	NA
St. Francis	2.88	0.08	2.67%
St. Lawrence Twp.	25.91	2.31	8.93%
St. Louis Park	0.00	0.00	NA
St. Marys Point	2.88	0.03	1.06%
St. Paul	11.51	0.40	3.52%
St. Paul Park	2.88	0.17	5.95%
Stillwater	8.64	0.09	1.05%
Stillwater Twp.	11.51	0.77	6.66%
Sunfish Lake	8.64	1.31	15.21%
Tonka Bay	0.00	0.00	NA
Vadnais Heights	8.41	0.86	10.19%
Vermillion	0.00	0.00	NA
Vermillion Twp.	0.00	0.00	NA
Victoria	18.94	1.68	8.86%
Waconia	2.79	0.00	0.02%
Waconia Twp.	2.88	0.13	4.40%
Waterford Twp.	16.75	0.38	2.27%
Watertown	2.88	0.08	2.75%
Watertown Twp.	8.64	0.19	2.25%
Wayzata	2.41	0.07	2.99%
West Lakeland Twp.	17.37	5.13	29.54%
West St. Paul	0.00	0.00	NA
White Bear Lake	5.02	1.14	22.72%
White Bear Twp.	8.87	0.69	7.82%
Willernie	0.00	0.00	NA
Woodbury	17.27	1.53	0.00%
Woodland	0.00	0.00	NA
Young America Twp.	7.97	0.62	7.75%
TC Metro Region	**2,538.53**	**332.76**	**13.11%**

Appendix III: Acres of Emergency Response Areas (ERA) Intersecting Flood Impact Zones by Community

Community	Emergency Response Areas (Acres)	Bluespots in FIZ (Acres)	Percentage
Afton	0.00	0.00	NA
Andover	218.19	63.86	29.27%
Anoka	100.86	36.82	36.50%
Apple Valley	1,130.43	200.61	17.75%
Arden Hills	0.00	0.00	NA
Bayport	18.78	2.36	12.59%
Baytown Twp.	0.14	0.01	7.15%
Belle Plaine	39.43	5.50	13.96%
Belle Plaine Twp.	0.00	0.00	NA
Benton Twp.	0.00	0.00	NA
Bethel	0.00	0.00	NA
Birchwood Village	0.00	0.00	NA
Blaine	178.02	34.25	19.24%
Blakeley Twp.	0.00	0.00	NA
Bloomington	3,372.04	455.26	13.50%
Brooklyn Center	217.16	58.00	26.71%
Brooklyn Park	466.25	98.82	21.19%
Burnsville	801.25	61.87	7.72%
Camden Twp.	0.00	0.00	NA
Carver	8.53	0.23	2.66%
Castle Rock Twp.	0.00	0.00	NA
Cedar Lake Twp.	0.00	0.00	NA
Centerville	28.93	3.80	13.12%
Champlin	326.79	72.35	22.14%
Chanhassen	2,089.43	250.19	11.97%
Chaska	162.49	31.86	19.61%
Circle Pines	101.49	30.60	30.15%
Coates	0.00	0.00	NA
Cologne	0.00	0.00	NA
Columbia Heights	20.84	0.20	0.96%
Columbus	0.00	0.00	NA
Coon Rapids	611.35	104.86	17.15%
Corcoran	0.00	0.00	NA
Cottage Grove	457.32	42.58	9.31%
Credit River Twp.	0.00	0.00	NA

Crystal	0.00	0.00	NA
Dahlgren Twp.	0.00	0.00	NA
Dayton	0.61	0.08	13.85%
Deephaven	0.00	0.00	NA
Dellwood	0.00	0.00	NA
Denmark Twp.	0.00	0.00	NA
Douglas Twp.	0.00	0.00	NA
Eagan	1530.88	360.93	23.58%
East Bethel	0.00	0.00	NA
Eden Prairie	5,482.46	897.33	16.37%
Edina	2,128.72	363.03	17.05%
Elko New Market	172.67	22.02	12.75%
Empire Twp.	13.53	0.90	6.67%
Eureka Twp.	0.00	0.00	NA
Excelsior	59.84	10.79	18.03%
Falcon Heights	0.00	0.00	NA
Farmington	285.84	41.69	14.58%
Forest Lake	233.75	54.09	23.14%
Fort Snelling (unorg.)	0.00	0.00	NA
Fridley	277.54	19.72	7.11%
Gem Lake	0.00	0.00	NA
Golden Valley	26.25	5.66	21.58%
Grant	40.50	3.29	8.12%
Greenfield	1.57	0.05	3.42%
Greenvale Twp.	0.00	0.00	NA
Greenwood	0.00	0.00	NA
Grey Cloud Island Twp.	0.00	0.00	NA
Ham Lake	0.28	0.00	0.00%
Hamburg	0.51	0.00	0.00%
Hampton	4.25	0.15	3.52%
Hampton Twp.	0.00	0.00	NA
Hancock Twp.	0.00	0.00	NA
Hanover	0.00	0.00	NA
Hastings	441.65	67.90	15.37%
Helena Twp.	0.00	0.00	NA
Hilltop	0.00	0.00	NA
Hollywood Twp.	0.00	0.00	NA
Hopkins	178.23	36.95	20.73%
Hugo	426.11	73.43	17.23%
Independence	0.06	0.00	0.00%
Inver Grove Heights	24.98	1.66	6.65%

Jackson Twp.	0.00	0.00	NA
Jordan	39.67	10.31	25.99%
Lake Elmo	105.32	25.72	24.42%
Lake St. Croix Beach	0.00	0.00	NA
Lakeland	13.67	3.53	25.81%
Lakeland Shores	0.00	0.00	NA
Laketown Twp.	0.00	0.00	NA
Lakeville	1,699.02	150.72	8.87%
Landfall	0.00	0.00	NA
Lauderdale	0.00	0.00	NA
Lexington	7.62	1.05	13.72%
Lilydale	0.00	0.00	NA
Lino Lakes	1,118.01	172.83	15.46%
Linwood Twp.	0.00	0.00	NA
Little Canada	334.96	39.37	11.75%
Long Lake	70.08	15.19	21.67%
Loretto	5.98	0.02	0.31%
Louisville Twp.	0.00	0.00	NA
Mahtomedi	70.23	7.02	9.99%
Maple Grove	486.99	139.75	28.70%
Maple Plain	16.03	3.36	20.93%
Maplewood	5.44	0.13	2.44%
Marine on St. Croix	0.00	0.00	NA
Marshan Twp.	0.00	0.00	NA
May Twp.	0.00	0.00	NA
Mayer	6.51	0.63	9.68%
Medicine Lake	0.00	0.00	NA
Medina	29.84	3.75	12.57%
Mendota	0.00	0.00	NA
Mendota Heights	0.00	0.00	NA
Miesville	0.00	0.00	NA
Minneapolis	124.13	22.22	17.90%
Minnetonka	981.50	178.85	18.22%
Minnetonka Beach	10.00	0.78	7.84%
Minnetrista	49.08	13.61	27.72%
Mound	68.03	3.75	5.52%
Mounds View	264.05	36.35	13.77%
New Brighton	1,180.88	162.76	13.78%
New Germany	0.00	0.00	NA
New Hope	0.00	0.00	NA
New Market Twp.	3.68	0.28	7.54%

New Prague	15.21	1.33	8.72%
New Trier	0.00	0.00	NA
Newport	76.11	27.31	35.88%
Nininger Twp.	0.00	0.00	NA
North Oaks	24.52	4.32	17.62%
North St. Paul	432.09	24.85	5.75%
Northfield	0.00	0.00	NA
Norwood Young America	0.00	0.00	NA
Nowthen	0.00	0.00	NA
Oak Grove	0.00	0.00	NA
Oak Park Heights	174.90	37.62	21.51%
Oakdale	304.83	42.83	14.05%
Orono	86.07	3.39	3.94%
Osseo	166.13	30.47	18.34%
Pine Springs	0.00	0.00	NA
Plymouth	1,559.56	273.61	17.54%
Prior Lake	161.53	72.86	45.11%
Ramsey	81.13	18.46	22.75%
Randolph	4.32	0.29	6.63%
Randolph Twp.	0.00	0.00	NA
Ravenna Twp.	0.00	0.00	NA
Richfield	365.41	108.22	29.62%
Robbinsdale	59.75	4.83	8.08%
Rockford	0.00	0.00	NA
Rogers	90.90	32.29	35.52%
Rosemount	498.98	80.82	16.20%
Roseville	25.02	5.62	22.48%
San Francisco Twp.	0.00	0.00	NA
Sand Creek Twp.	0.00	0.00	NA
Savage	274.23	49.18	17.94%
Scandia	0.13	0.01	9.53%
Sciota Twp.	0.00	0.00	NA
Shakopee	582.15	111.35	19.13%
Shoreview	450.57	118.00	26.19%
Shorewood	136.09	24.20	17.78%
South St. Paul	269.92	15.57	5.77%
Spring Lake Park	27.96	1.84	6.59%
Spring Lake Twp.	0.00	0.00	NA
Spring Park	5.32	0.81	15.23%
St. Anthony	52.06	2.43	4.67%
St. Bonifacius	12.61	0.43	3.40%

St. Francis	57.99	11.25	19.41%
St. Lawrence Twp.	0.00	0.00	NA
St. Louis Park	1094.45	244.57	22.35%
St. Marys Point	0.00	0.00	NA
St. Paul	0.00	0.00	NA
St. Paul Park	78.88	3.26	4.14%
Stillwater	427.92	63.15	14.76%
Stillwater Twp.	0.00	0.00	NA
Sunfish Lake	0.00	0.00	NA
Tonka Bay	10.74	4.46	41.55%
Vadnais Heights	704.72	69.13	9.81%
Vermillion	5.92	1.10	18.51%
Vermillion Twp.	0.00	0.00	NA
Victoria	28.55	1.45	5.07%
Waconia	688.32	100.22	14.56%
Waconia Twp.	125.83	4.18	3.33%
Waterford Twp.	0.00	0.00	NA
Watertown	18.35	0.79	4.33%
Watertown Twp.	0.18	0.05	26.65%
Wayzata	137.48	26.89	19.56%
West Lakeland Twp.	0.00	0.00	NA
West St. Paul	0.00	0.00	NA
White Bear Lake	375.69	53.37	14.21%
White Bear Twp.	83.17	8.17	9.82%
Willernie	0.00	0.00	NA
Woodbury	1,415.38	270.74	19.13%
Woodland	0.00	0.00	NA
Young America Twp.	0.00	0.00	NA
TC Metro Area Region	**39,561.74**	**6,461.38**	**16.33%**

References

2019 Minnesota Statutes. 473.1565 Metropolitan Area Water Supply Planning Activities; Advisory Committees. Retrieved from *https://www.revisor.mn.gov/statutes/cite/473.1565*

EPA. (2014). Flood Resilience: A Basic Guide for Water and Wastewater Utilities. Retrieved from *https://www.epa.gov/sites/production/files/2015-08/documents/flood_resilience_guide.pdf*

EPA. Safe Drinking Water Act (SDWA). (2020). Retrieved from *https://www.epa.gov/sdwa*

Metropolitan Council. (2014). Thrive MSP 2040 – One Vision, One Metropolitan Region. Retrieved from *https://metrocouncil.org/Planning/Projects/Thrive-2040.aspx*

Metropolitan Council. (2015). Master Water Supply Plan. Retrieved from *https://metrocouncil.org/Wastewater-Water/Planning/Water-Supply-Planning/Master-Water-Supply-Plan.aspx*

Metropolitan Council Environmental Services (MCES). (2016, May). 2015 Performance Report. (May 2016). Retrieved from *https://metrocouncil.org/Wastewater-Water/Publications-And-Resources/MCES-INFORMATION/MCES-Performance-Report.aspx*

Metropolitan Council. (2020). Localized Flood Map Screening Tool. Retrieved from *https://metrocouncil.maps.arcgis.com/apps/webappviewer/index.html?id=100fa3012dcc4e288a74cbf4d95027bf*

Minnesota Administrative Rule 4725.4350. (2008). Water-supply Well Distance from Water Bodies; Protections in Flood Areas. Retrieved from *https://www.revisor.mn.gov/rules/4725.4350/*

Minnesota Administrative Rule 4725.4450. (2014). Water-supply Well Distances from Contamination. Retrieved from *https://www.revisor.mn.gov/rules/4725.4450/*

Minnesota Administrative Rule 4725.5850. (2008). Community Public Water-Supply Wells. Retrieved from *https://www.revisor.mn.gov/rules/4725.5850/*

Minnesota Department of Agriculture (2020). Source Water Protection Areas. Retrieved from *https://mnag.maps.arcgis.com/apps/webappviewer/index.html?id=7105310e562041749a240ebad844538b*

Minnesota Department of Health. (2020). About Us: Well Management Program. Retrieved from *https://www.health.state.mn.us/communities/environment/water/wells/aboutus.html*

Minnesota Department of Health. (2020). Community Public Water System Flooding Guidance. Retrieved from *https://www.health.state.mn.us/communities/environment/water/com/flood.html*

Minnesota Department of Health. (2020). Drinking Water Risk Communication Toolkit: Well-known Issue Communications. Retrieved from *https://www.health.state.mn.us/communities/environment/water/toolkit/classic.html#commplantool*

Minnesota Department of Health. (2020). Inner Wellhead Management Zone (IWMZ) Requirements. Retrieved from *https://www.health.state.mn.us/communities/environment/water/swp/reqrec.html#IWMZ*

Minnesota Department of Health. (2020). Protecting Your Well: Well Management Program. Retrieved from *https://www.health.state.mn.us/communities/environment/water/wells/construction/protect.html*

Minnesota Department of Health. (2020). Requirements and Recommendations for Public Water Suppliers: Source Water Protection. Retrieved from *https://www.health.state.mn.us/communities/environment/water/swp/reqrec.html#IWMZ*

Minnesota Department of Health. (2020). Source Water Assessments: Source Water Protection. Retrieved from *https://www.health.state.mn.us/communities/environment/water/swp/swa*

Minnesota Department of Health (2020). Water Operator Certification and Training. Retrieved from *https://www.health.state.mn.us/communities/environment/water/wateroperator/index.htm*

Minnesota Department of Natural Resources. (2020). NOAA Atlas 14 - Precipitation Frequency Estimates. Retrieved from *https://www.dnr.state.mn.us/climate/noaa_atlas_14.html*

Minnesota Geospatial Commons. (2017). Localized Flood Map for Climate Vulnerability Screening. Retrieved from *https://gisdata.mn.gov/dataset/us-mn-state-metc-env-local-flood-screening*

Minnesota Pollution Control Agency. (2020). What's in my Neighborhood? Retrieved from *https://mpca.maps.arcgis.com/apps/webappviewer/index.html?id=9d45793c75644e05bac197525f633f87*

Minnesota Department of Health. (2020). Flood Precautions for Private Water Wells: Well Management Program. Retrieved from *https://www.health.state.mn.us/communities/environment/water/wells/natural/floodprecautions.html*

MnWarn. (2020). Retrieved from *www.mnwarn.org/*

390 Robert Street North
Saint Paul, MN 55101-1805

651.602.1000
TTY 651.291.0904
public.info@metc.state.mn.us
metrocouncil.org

Follow us on:
twitter.com/metcouncilnews
facebook.com/MetropolitanCouncil
youtube.com/MetropolitanCouncil