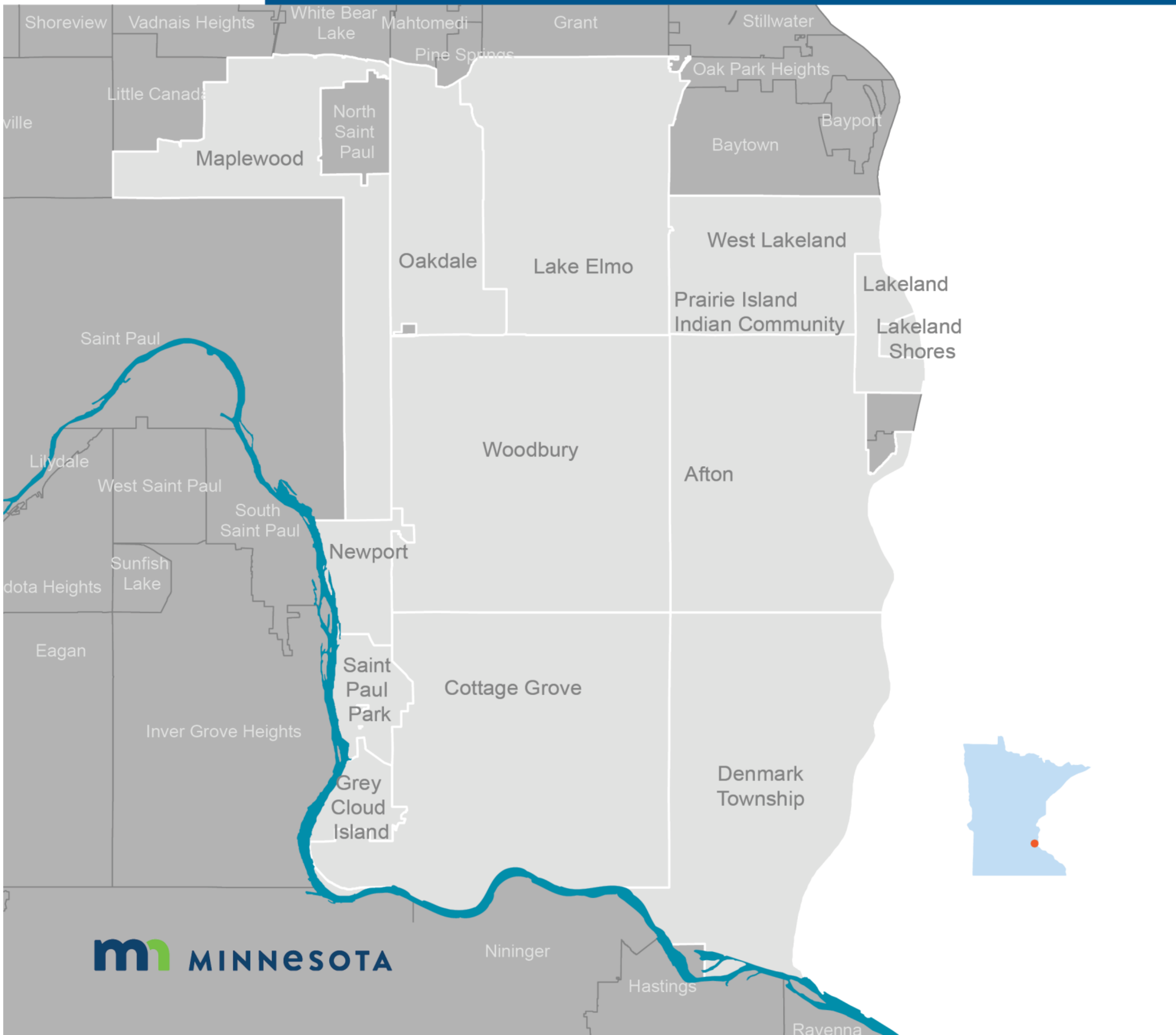
Conceptual Drinking Water Supply Plan

Long-term options for the East Metropolitan Area



MINNESOTA

Authors

Elizabeth Kaufenberg, Minnesota Pollution Control Agency (MPCA)
Andri Dahlmeier, MPCA
Michele Mabry, MPCA
Abt Associates (Abt)
Wood Environment & Infrastructure Solutions, Inc. (Wood)

Contributors/Acknowledgments

Kirk Koudelka, MPCA Assistant Commissioner
Jess Richards, Minnesota Department of Natural Resources (DNR) Assistant Commissioner
Steve Colvin, DNR
Kathy Sather, MPCA
Gary Krueger, MPCA
Susan Johnson, MPCA
Rebecca Higgins, MPCA
Jeanne Giernet, MPCA
Jason Moeckel, DNR
John Seaberg, DNR
Karla Peterson, MDH
Lucas Martin, MDH
Corey Mathison, MDH

Government and 3M Working Group Members

Bill Palmquist, Afton
Ron Moorse, Afton
Jennifer Levitt, Cottage Grove
Kathy Higgins, Denmark Township
Ray Kaiser, Grey Cloud Island Township
Kristina Handt, Lake Elmo
Craig Morris, Lakeland and Lakeland Shores
Edward Shukle, Lakeland
Andy Erickson, Lakeland
Brian Zeller, Lakeland Shores
Shann Finwall, Maplewood
Michael Martin, Maplewood
Dan Lund, Newport
Kevin Chapdelaine, Newport
Christina Volkers, Oakdale
Paul Reinke, Oakdale
Jessica Stolle, Prairie Island Indian Community
Kevin Walsh, St. Paul Park
Jeff Dionisopoulos, St. Paul Park
Daniel Kyllo, West Lakeland Township
Marian Appelt, West Lakeland Township
Clint Gridley, Woodbury
Chris Hartzell, Woodbury
Lowell Johnson, Washington County
David Brummel, Washington County
Jim Kotsmith, 3 M Company (3M)
Karie Blomquist, 3M

Minnesota Pollution Control Agency

520 Lafayette Road North | Saint Paul, MN 55155-4194
651-296-6300 | 800-657-3864 | Or use your preferred relay service. | Info.pca@state.mn.us

Minnesota Department of Natural Resources

500 Lafayette Road North | Saint Paul, MN 55155-4194
651-296-6157 | 888-646-6367 | Or use your preferred relay service.

This report is available in alternative formats upon request.
Document number: xxx-xx-xxxxx

Citizen-Business Group

Julie Bunn, Lake Elmo
Betsy Daub, Friends of the Mississippi
David Filipiak, Woodbury
Charlotte Flint, West Lakeland Township
Bob Fossum, Lake Elmo
Jeff Holtz, Lake Elmo
Mark Jenkins, Maplewood
Bruce Johnson, Oakdale
David Johnson, Local Chamber of Commerce
Steven Johnson, West Lakeland Township
Katie Johnston-Goodstar, Maplewood
Jack Lavold, Cottage Grove
Michael Madigan, Woodbury
Barbara Ronningen, Afton
Dave Schulenberg, Cottage Grove
Monica Stiglich, Oakdale (Government-3M Working Group Liaison)
Amy Schall, St. Paul Park
Kevin Chapdelaine, Newport (Government-3M Working Group Liaison)

Drinking Water Supply Technical Subgroup Members

Greg Johnson, Afton
John Christensen, Afton
Ryan Burfeind, Cottage Grove
Jennifer Levitt, Cottage Grove
Kathy Higgins, Denmark Township
Ray Kaiser, Grey Cloud Island Township
Richard Adams, Grey Cloud Island Township
Jack Griffin, Lake Elmo
Kristina Handt, Lake Elmo
Dave Simons, Lakeland
Steve Love, Maplewood
Molly Wellens, Maplewood
Jon Herdegen, Newport
Brian Miller, Newport
Brian Bachmeier, Oakdale
Shawn Nelson, Oakdale
Dan DeRudder, Prairie Island Indian Community
Greg Johnson, St. Paul Park
Jon Christensen, St. Paul Park
Marian Appelt, West Lakeland Township
Ryan Stempski, West Lakeland Township
Jim Westerman, Woodbury
Chris Hartzell, Woodbury
Stephanie Souter, Washington County
Sam Paske, Metropolitan Council
Brian Davis, Metropolitan Council
Tony Runkel, Minnesota Geological Survey
Kurt Haakinson, Minnesota Rural Water Association
Richard Thron, Minnesota Water Well Association
Karen Kill, Browns Creek Watershed District
Matt Downing, Middle St. Croix Watershed Management Organization
Stu Grubb, Middle St. Croix Watershed Management Organization
Tina Carstens, Ramsey-Washington Metro Watershed District
Matt Moore, South Washington Watershed District
John Hanson, Valley Branch Watershed District
Erik Anderson, Washington Conservation District
Jim Kotsmith, 3M
Chris Bryan, 3M
Gary Krueger, MPCA
Karla Peterson, Minnesota Department of Health (MDH)
Lucas Martin, MDH

Minnesota Pollution Control Agency

520 Lafayette Road North | Saint Paul, MN 55155-4194
651-296-6300 | 800-657-3864 | Or use your preferred relay service. | Info.pca@state.mn.us

Minnesota Department of Natural Resources

500 Lafayette Road North | Saint Paul, MN 55155-4194
651-296-6157 | 888-646-6367 | Or use your preferred relay service.

This report is available in alternative formats upon request.
Document number: xxx-xx-xxxxx

Editing and Graphic Design

Jeanne Giernet
Scott Andre, MPCA
Abt
Wood
Administrative staff

The MPCA is reducing printing and mailing costs by using the Internet to distribute reports and information to a wider audience. Visit our website for more information.

MPCA reports are printed on 100% post-consumer recycled content paper manufactured without chlorine or chlorine derivatives.

Minnesota Pollution Control Agency

520 Lafayette Road North | Saint Paul, MN 55155-4194
651-296-6300 | 800-657-3864 | Or use your preferred relay service. | Info.pca@state.mn.us

Minnesota Department of Natural Resources

500 Lafayette Road North | Saint Paul, MN 55155-4194
651-296-6157 | 888-646-6367 | Or use your preferred relay service.
This report is available in alternative formats upon request.
Document number: xxx-xx-xxxxx

Contents

1. Glossary

Alignment – Location of water lines relative to other infrastructure, typically roadways.

Aquifer – An underground layer of water-bearing permeable rock; rock fractures; or loose, unpacked materials (gravel, sand, or silt). In a water-table (unconfined) aquifer, the water table (upper water surface) rises and falls with the amount of water in the aquifer. In a confined aquifer, layers of impermeable material both above and below cause the water to be under pressure, so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer (artesian condition).

Aquitard – An underground layer that has low permeability and limits, but does not completely prevent the flow of water to or from an adjacent aquifer.

Booster pump station – A pump station located within the water supply system that is designed to boost the pressure of water within a long pipeline.

Capital costs – One-time costs to build or rebuild infrastructure, including treatment plants, wells, distribution systems, and other facilities.

Centralized system – A centralized water treatment approach, referred to here as a centralized system, for a given service that treats water at a single treatment facility in a central location and then distributes the water via a dedicated water distribution network across the service area.

Citizen-Business Group – One of two work groups to help the Minnesota Pollution Control Agency (MPCA) and the Minnesota Department of Natural Resources (DNR) identify and recommend priorities and projects to be funded from the Grant. This group is composed of the MPCA; the DNR; and about 15 citizen, business, and nongovernmental representatives who live or work in the East Metropolitan Area. One representative from the Government and 3M Working Group serves as a liaison to this group.

Conceptual Drinking Water Supply Plan (Conceptual Plan) – This plan, developed from a strategic planning effort as a step toward addressing the goal of Priority 1 of the 2018 Settlement, which is to ensure safe drinking water in sufficient supply to residents and businesses in the East Metropolitan Area to meet current and future needs. The Conceptual Plan presents a recommendation consisting of sets of conceptual projects (called scenarios) that, when combined, address drinking water quality and quantity issues for the 14 communities currently known to be affected by per- and polyfluoroalkyl substances (PFAS) contamination in the East Metropolitan Area. This Conceptual Plan will be used to guide the development and implementation of projects to be funded under the Grant.

Conceptual projects – Project ideas developed by the work groups, Subgroup 1, members of the public, and the Co-Trustees to address PFAS-related drinking water quality and quantity issues in the East Metropolitan Area. These conceptual projects are consistent with the water supply improvement options, but provide more detail, such as information on project location(s), project components(s), and PFAS treatment technologies.

Conceptual site model (CSM) – A simplified set of assumptions, data, and information that was used to develop a picture of how the groundwater system functions as the basis for developing the more detailed groundwater model.

Co-Trustees – The MPCA and DNR. Under the Minnesota Environmental Response and Liability Act (MERLA), the State on Minnesota (State) is the Trustee for all natural resources in the State, including air, water, and wildlife. The Governor's Executive Order 19-29 (inclusive of 11-09) designated the Commissioners of the MPCA and DNR as Co-Trustees for natural resources under MERLA and other laws.

Decentralized system – A decentralized water treatment approach, referred to here as a decentralized system, differs from a centralized system as it may rely on multiple treatment facilities at various locations to serve communities/neighborhoods in a given service area. Typically these treatment facilities are far enough apart such that it mitigates the cost and/or water quality concerns of a centralized treatment facility. On a much smaller scale, a decentralized system may also rely on point-of-entry treatment systems (POETS) or point-of-use treatments (POUTs) that are installed at individual homes or businesses to achieve potable water.

Distribution line – A smaller diameter line, typically between 6 and 16 inches, which supplies water to consumers.

Distribution system – The portion of a water supply network that conveys potable water from transmission lines to water consumers and provides for residential, commercial, industrial, and fire-fighting water demand requirements. A distribution system can contain distribution lines, booster pump stations, pressure-reducing valves, and storage facilities such as water storage tanks or towers.

Drinking water distribution model – A comprehensive representation of the current and planned drinking water supply infrastructure in the East Metropolitan Area used to support the evaluation of scenarios in this Conceptual Plan. The model includes information on drinking water supply infrastructure (e.g., connections, demand, water usage, available water supply, system pressures, layouts and locations of infrastructure) as well as private and non-community public supply well data.

Drinking Water Supply Technical Subgroup (Subgroup 1) – A subgroup composed of technical experts formed to analyze options, deliver assessments, and provide advice for long-term options for drinking water supply and treatment to the Government and 3M Working Group, and the Citizen-Business Group.

East Metropolitan Area – Communities to the East of the Minneapolis/St. Paul Metropolitan Area that have been affected by PFAS releases from the 3M Company (3M) source areas. Currently comprised of the cities of Afton, Cottage Grove, Lake Elmo, Lakeland, Lakeland Shores, Maplewood, Newport, Oakdale, St. Paul Park, and Woodbury; the townships of Denmark, Grey Cloud Island, and West Lakeland; and the Prairie Island Indian Community.

Government and 3M Working Group– One of two work groups to help the MPCA and DNR identify and recommend priorities and projects to be funded under the Grant. The formation of a working group consisting of representatives from the MPCA, the DNR, the East Metropolitan Area communities, and 3M to identify and recommend projects was a requirement of the 2018 Agreement and Order. One representative from the Citizen-Business Group serves as a liaison to this group.

Granular activated carbon (GAC) – GAC is made from raw organic materials (such as coconut shells or coal) that are high in carbon. Heat, in the absence of oxygen, is used to increase (activate) the surface area of the carbon, which is why these filters are sometimes referred to as "charcoal" filters. The activated carbon removes certain chemicals that are dissolved in water passing through a filter containing GAC by trapping (adsorbing) the chemical in the GAC.

Groundwater Management Area – A designation created by the Minnesota legislature as a tool for the DNR to address difficult groundwater-related resource challenges. Within these areas, the DNR may limit total annual water appropriations and uses to ensure sustainable use of groundwater that protects ecosystems, water quality, and the ability of future generations to meet their own needs. Washington County, along with Ramsey County and portions of Anoka and Hennepin counties, fall within the North and East Metropolitan Groundwater Management Area.

Groundwater model – A numerical, three-dimensional representation of the groundwater aquifers in the East Metropolitan Area used to support the evaluation of scenarios in this Conceptual Plan. The purpose of the groundwater model is to provide insight into the current groundwater flow system, and predict impacts to flow paths and groundwater resources through the year 2040 from the proposed scenarios. These flow paths and quantity estimates are based on projected groundwater recharge/precipitation rates, surface water elevations, and pumping volumes of the proposed scenarios.

Health advisories – Non-enforceable and non-regulatory technical guidance for state agencies and other public health officials on health effects, analytical methodologies, and treatment technologies associated with drinking water contamination. Health advisories are based on non-cancer health effects for different lengths of exposure (1 day, 10 days, or a lifetime). In 2016, the U.S. Environmental Protection Agency (EPA) released health advisory values for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS).

Health-based value (HBV) – A health-based water guidance value developed by the Minnesota Department of Health (MDH) using the same scientific methods as health risk limits (HRLs), including peer review. Like an HRL, it is the concentration of a water contaminant, or a mixture of contaminants that, based on current knowledge, can be consumed with little or no risk to health by the most exposed and sensitive individuals in a population. HBVs are developed to provide water guidance between rule-making cycles for chemicals that may have been recently detected in the water or for which new health information has become available.

Health risk index (HRI; health index, HI) – An indicator of the combined risk of exposure to multiple chemicals that cause the same health effects. It is determined by calculating the concentration of each chemical divided by its HRL or HBV, and adding the resulting ratios. A HI greater than one indicates possible combined effects. The HRI is referred to interchangeably throughout the document as the health risk index, the health index, the HI, or the HRI.

Health risk limit (HRL) – A health-based water guidance value developed by MDH that has been promulgated through the Minnesota rule-making process, which includes peer review and public input. It is the concentration of a groundwater contaminant, or a mixture of contaminants, which, based on current knowledge, can be consumed with little or no risk to health by the most exposed and sensitive individuals in a population.

High-service pump – Pumps located at the water treatment facility that deliver large volumes of treated, potable water to the water supply system.

Horizontal directional drilling – A minimal impact trenchless method of installing underground utilities such as pipe, conduit, or cables in a relatively shallow arc or radius along a prescribed underground path using a surface-launched drilling rig.

Ion exchange (IX) – IX processes are reversible chemical reactions for removing dissolved ions from a solution and replacing them with other similarly charged ions. In water treatment, it is primarily used for softening where calcium and magnesium ions are removed from water; however, it is being used more frequently for the removal of other dissolved ionic species.

Jack and bore – A method of horizontal boring construction for installing casing or steel pipes under roads or railways. Construction crews drill a hole underground horizontally between two points (the sending and receiving pits) without disturbing the surface in-between. This is accomplished by using an auger boring machine that inserts casing pipe as it moves through the earth while simultaneously removing the soil from within the casing pipe.

Maximum contaminant level (MCL) – The maximum level of a contaminant allowed in water delivered from a public water supply. MCLs are set by EPA through a scientific process that evaluates the health impacts of the contaminant; and the technology and cost required for the prevention, monitoring, and/or treatment. States are allowed to enforce lower (i.e., more strict) standards than MCLs, but are not allowed to enforce higher (i.e., less strict) standards.

Metropolitan Council – The regional policy-making body, planning agency, and provider of essential services (including transportation, wastewater, water supply planning, growth planning, parks and trails, and affordable housing) for the Twin Cities metropolitan region. The Minnesota Legislature established the Metropolitan Council in 1967, which has 17 members who are appointed by the Governor.

Municipal supply well – A drinking water well that serves as a source of water for a municipal water system.

Municipal water system – Refers to an existing municipality’s drinking or potable water treatment and distribution system.

Non-community public supply well – A well that provides water to the public in places other than their homes – where people work, gather, and play (e.g., schools, offices, factories, child care centers, or parks) – and is part of a non-community public water system (see definition below).

Non-community public water system – A drinking water system that supplies water from private water supply well(s) on a year-round basis to:

- A residential development with six or more private residences (e.g., apartment buildings, private subdivisions, condominiums, townhouse complexes, mobile home parks), or
- A mobile home park or campground with six or more sites with a water service hookup.

Non-municipal well – A well that is considered under this Conceptual Plan excludes municipal supply wells and includes domestic, irrigation, commercial, and non-community public water supply wells.

Operations and maintenance (O&M) – All work activities necessary to operate and maintain all water treatment and supply facilities from the source of water through the distribution systems.

Per- and polyfluoroalkyl substances (PFAS) – A family of synthetic chemicals, initially developed by 3M, used to make products that resist heat, oil, stains, grease, and water. They are extremely resistant to breakdown in the environment, accumulate in humans and animals, and are “emerging contaminants” that are the focus of active research and study. Specific chemicals within the PFAS family include PFOA, PFOS, perfluorohexane sulfonate (PFHxS), perfluorobutane sulfonate (PFBS), and perfluorobutanoic acid (PFBA).

Point-of-entry treatment System (POETS) – Water treatment systems installed on the water line as it enters an individual home, business, school, or other building. These systems treat all the water entering the building.

Point-of-use treatment (POUT) – Water treatment systems installed on the water line at the point of use, such as a faucet.

Pressure-reducing stations – Locations within the water supply system where a pressure-reducing valve has been installed.

Pressure-reducing valves – A valve fitted in a pipe system, which in spite of varying pressures on the inlet side (inlet pressure), ensures that a certain pressure on the outlet side (outlet pressure) is not exceeded, thus protecting the components and equipment on the outlet side.

Priority 1 – The first priority of the Grant is to enhance the quality, quantity, and sustainability of drinking water in the East Metropolitan Area. The goal of this highest-priority work is to ensure safe drinking water in sufficient supply to residents and businesses in the East Metropolitan Area to meet their current and future water needs. Examples of projects in this first priority may include, but are not limited to, the development of alternative drinking water sources for municipalities and individual households (including, but not limited to, creation or relocation of municipal wells), the treatment of existing water supplies, water conservation and efficiency, open space acquisition, and groundwater recharge (including projects that encourage, enhance, and assist groundwater recharge). For individual households, projects may include, but are not limited to, connecting those residences to municipal water supplies, providing individual treatment systems, or constructing new wells.

Priority 2 – The second priority for Grant spending is to restore and enhance aquatic resources, wildlife, habitat, fishing, resource improvement, and outdoor recreational opportunities in the East Metropolitan Area and in downstream areas of the Mississippi and St. Croix rivers. The MPCA and DNR have immediate access to $20 million in Grant funds for projects in this priority category. After the safe drinking water goals of the first priority are reasonably achieved, all remaining Grant money is then available for natural resource restoration and enhancement projects.

Priority 3 – If there are funds remaining after the first two priority goals have been met, the Grant can be used for statewide environmental improvement projects. Only projects in categories such as statewide water resources, habitat restoration, open space preservation, recreation improvements, or other sustainability projects would be eligible.

Private well – A domestic drinking water well that is not part of a public water system. The quality and safety of water from private wells are not regulated by the Federal Safe Drinking Water Act and, in most cases, by state laws.

Public supply well – A drinking water well that serves as a source of water for a public water system.

Public water system – A regulatory term under the federal Safe Drinking Water Act for a drinking water supply system that serves at least 15 homes or 25 people for at least 60 days a year.

Recharge – Water added to the aquifer from the surface through the unsaturated (dry or vadose) zone in the uppermost soils through processes called infiltration and percolation following any precipitation (rain or snow) event.

Regional water supply system – A water system that supplies potable water to more than one community or water system.

Scenarios – Sets of conceptual projects that consider water supply, distribution, and demand; and are evaluated in this Conceptual Plan using drinking water distribution and groundwater models.

Small community water system – A private and voluntary water system that serves neighborhood-sized clusters of residences.

Special Well and Boring Construction Area (SWBCA) – A mechanism that provides for controls on the drilling or alteration of wells in an area where groundwater contamination has, or may, result in risks to public health. The purposes of an SWBCA are to inform the public of potential health risks in areas of groundwater contamination, provide for the construction of safe water supplies, and prevent the spread of contamination due to the improper drilling of wells or borings.

Sustainability – Responsible interaction with the environment to avoid depletion or degradation of natural resources. Minnesota Statutes § 103G.287, subd. 5, describes groundwater sustainability as the development and use of groundwater resources to meet current and future beneficial uses without causing unacceptable environmental or socioeconomic consequences.

3M Grant for Water Quality and Sustainability Fund (Grant) – Under terms of the Agreement, an $850 million Grant was provided by 3M to the State to be used to enhance the quality, quantity, and sustainability of the drinking water in the East Metropolitan Area; to restore and enhance natural resources and outdoor recreational opportunities; and to reimburse the State for certain other expenses.

Transmission line – A large-diameter pipeline designed to convey large volumes of water at higher pressures from a source (typically a water treatment facility) to a distribution system for use. Water transmission lines are typically larger in diameter (greater than 16 inches) and consumers are not typically placed on transmission lines because of their high velocities and pressures.

2007 Consent Order – An agreement between 3M and the MPCA requiring 3M to investigate and take remedial actions to address releases and threatened releases of PFAS from the 3M Cottage Grove Site, the 3M Oakdale Disposal Site, and the 3M Woodbury Disposal Site; and to reimburse the MPCA for its costs to oversee the remediation actions taken under the Consent Order to help provide safe drinking water to affected homes and communities (e.g., installation of temporary or permanent treatment).

2018 Agreement and Order (Settlement) – An agreement to settle the State's Natural Resources Damage lawsuit against 3M for $850 million. Minnesota's Attorney General sued 3M in 2010, alleging that the company's disposal of PFAS had damaged and continues to damage drinking water and natural resources in the East Metropolitan Area. After legal and other expenses were paid, about $720 million is available to finance drinking water and natural resource projects in this region. The MPCA and DNR are Co-Trustees of these funds.

Watershed districts – Special government entities that monitor and regulate the use of water within certain watersheds in Minnesota, rather than political boundaries, which were first authorized by the legislature in 1955.

Water storage tank – A water storage facility consisting of a cylindrical tank that has a base elevation at the existing ground surface. Storage facilities provide sufficient water volume to meet peak hour water demands.

Water storage tower – An elevated water storage facility (also referred to as a water tower) that supports a water storage tank with a base elevation above the existing ground surface to provide sufficient pressure to the water distribution system, and to provide emergency storage for fire protection.

Water supply improvement options – A reasonable range of options that could improve drinking water quality and quantity, including both centralized and decentralized systems, which are evaluated against a set of screening criteria in this Conceptual Plan to determine their relevance to the individual communities in the East Metropolitan Area.

Water supply system – A system for the treatment, transmission, storage, and distribution of water from source to consumers (e.g., homes, commercial establishments, industry, irrigation facilities, and public agencies for water).

Well advisory – Notice from MDH that a drinking water supply has exceeded health-based guidance values developed by MDH.

Work groups – Three groups formed by the MPCA and DNR to help identify and recommend priorities and projects to be funded under the Grant: the Government and 3M Working Group, the Citizen-Business Group, and the Drinking Water Supply Technical Subgroup.

2. Acronyms and abbreviations

1	AACE	Association for the Advancement of Cost Engineering
2	Abt	Abt Associates
3	ADD	average daily demand
4	CAD	computer-aided design
5	Conceptual Plan	Conceptual Drinking Water Supply Plan
6	CSM	conceptual site model
7	DNR	Minnesota Department of Natural Resources
8	EPA	United States Environmental Protection Agency
9	GAC	granular activated carbon
10	GIS	geographic information system
11	Grant	3M Grant for Water Quality and Sustainability Fund
12	GWTP	groundwater treatment plant
13	HBV	health-based value
14	HI	health index (used interchangeably with HRI)
15	HRI	health risk index (used interchangeably with HI)
16	HRL	health risk limit
17	IX	ion exchange
18	LGU	local government unit
19	MCES	Metropolitan Council Environmental Services
20	MCL	maximum contaminant level
21	MDH	Minnesota Department of Health
22	MERLA	Minnesota Environmental Response and Liability Act
23	mgd	million gallons per day
24	MGS	Minnesota Geological Survey
25	MPCA	Minnesota Pollution Control Agency
26	N/A	not applicable
27	NPS	National Park Service
28	O&M	operations and maintenance
29	PFAS	per- and polyfluoroalkyl substances
30	PFBA	perfluorobutanoic acid
31	PFBS	perfluorobutane sulfonate
32	PFHxS	perfluorohexane sulfonate
33	PFOA	perfluorooctanoic acid
34	PFOS	perfluorooctane sulfonate
35	POETS	point-of-entry treatment system
36	POUT	point-of-use treatment
37	QA/QC	quality assurance/quality control
38	Settlement	2018 Agreement and Order
39	SPRWS	St. Paul Regional Water Services
40	State	State of Minnesota
41	Subgroup 1	Drinking Water Supply Technical Subgroup
42	SWBCA	Special Well and Boring Construction Area

SWTP	surface water treatment plant
3M	3M Company
2007 Consent Order	2007 Settlement Agreement and Consent Order
2018 Settlement	2018 Agreement and Order
TCE	trichloroethylene
VOC	volatile organic compound
Wood	Wood Environment & Infrastructure Solutions, Inc.

1. Introduction

In February 2018, the State of Minnesota and the 3M Company (3M) announced an agreement to settle the State's Natural Resources Damage lawsuit for per- and polyfluoroalkyl substances (PFAS) contamination in the East Metropolitan Area of the Twin Cities. As part of the Settlement, the State of Minnesota and 3M entered into a 2018 Agreement and Order (2018 Settlement or Settlement) that established the 3M Grant for Water Quality and Sustainability Fund (Grant). Under the first and highest priority (Priority 1) of this Settlement, the Minnesota Pollution Control Agency (MPCA) and the Minnesota Department of Natural Resources (DNR) will use the Grant for long-term projects to enhance the quality, quantity, and sustainability of drinking water for residents and businesses affected by PFAS in the East Metropolitan Area. As a step toward addressing Priority 1, the MPCA and DNR have developed this Conceptual Drinking Water Supply Plan (Conceptual Plan) to evaluate and recommend a set of projects that provide safe, sustainable drinking water to the 14 communities currently known to be affected by PFAS contamination in the East Metropolitan Area, now and into the future. The options presented here are based on the totality of evaluating all appropriate and feasible alternatives, and incorporate feedback from the work groups and public outreach. Any of the recommended options would be reasonable and necessary in response to PFAS releases in the East Metropolitan Settlement area, and not inconsistent with provisions found in Minn. Stat. 115B, the Minnesota Environmental Response and Liability Act (MERLA).

This chapter provides background information on the Settlement, the overall goals of the planning and implementation effort, an overview of the Conceptual Plan, and information on communication and public involvement.

1.1 Overview of the 2018 Settlement

1.1.1 Background

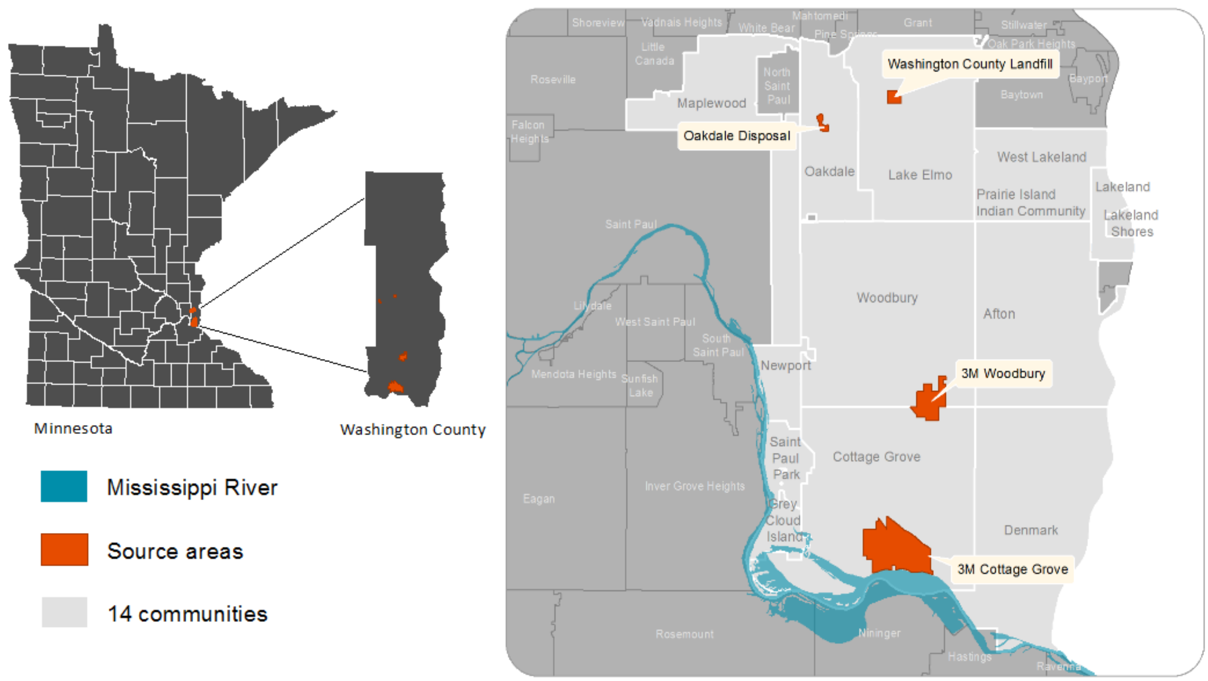
PFAS are a family of synthetic chemicals initially developed by 3M that have been used since the late 1940s to make products that resist heat, oil, stains, grease, and water. Types of PFAS chemicals include perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanoic acid (PFBA), among others. 3M has phased out the manufacture of some PFAS. There are currently other manufacturers of PFAS worldwide.

The chemical structures of PFOS and PFOA are quite stable and they can persist in the environment for long periods of times since they do not easily degrade under environmental conditions. As such, PFAS, including PFOS and PFOA, can bioaccumulate in humans and animals. The PFAS compounds are "emerging contaminants" that are the focus of active research and study. The Minnesota Department of Health (MDH) is monitoring the growing science about PFAS and issues health advisories accordingly.

PFAS contamination of drinking water wells was first identified in 2004 when concentrations were detected in drinking water supplies in parts of the East Metropolitan Area. The contamination was traced to the disposal of PFAS by 3M in three dump site locations and one landfill in the East Metropolitan Area. From the 1950s through the early 1970s, 3M disposed of wastes from PFAS manufacturing processes in disposal sites in Oakdale and Woodbury, at the 3M manufacturing facility in Cottage Grove, and at the Washington County landfill (Figure 1.1).

Following the first detections of PFAS in production wells at the 3M Cottage Grove facility, the MPCA requested that 3M conduct additional PFAS sampling of monitoring wells at the three 3M disposal sites (3M Cottage Grove, Woodbury, and Oakdale). The MPCA also conducted sampling of monitoring wells at the Washington County Landfill, which is managed by MPCA's Closed Landfill Program. The MPCA, in coordination with MDH, also began sampling nearby private and public supply wells in Washington County to identify drinking water supplies with PFAS impacts. Sampling soon expanded to a wider area of the East Metropolitan Area. In 2007, 3M entered into a Settlement Agreement and Consent Order (2007 Consent Order) with the MPCA, requiring 3M to investigate and take remedial actions to address releases of PFAS from the three 3M disposal sites. In 2010, Minnesota filed a lawsuit against 3M for damages to natural resources as a result of releases of PFAS chemicals in the East Metropolitan Area.

Figure 1-1. 3M disposal sites in the East Metropolitan Area.



1.1.2 Settlement

On February 20, 2018, the State of Minnesota (State) settled its Natural Resources Damage lawsuit against 3M in return for $850 million. These funds were provided to the State as a Grant described above. After legal and other expenses were paid, about $720 million remains available to fund drinking water and natural resource projects in the East Metropolitan Area. The Co-Trustees, the MPCA and DNR, are responsible for ensuring that funds from the Settlement are used for projects to enhance the quality, quantity, and sustainability of drinking water in the East Metropolitan Area; and for natural resource restoration and enhancement (see Section 1.1.3 for more detailed information on the priorities of the Settlement).

In addition to the 2018 Settlement, the 2007 Consent Order between the MPCA and 3M remains in place, requiring 3M to continue to perform remediation related to releases at and from the 3M Cottage

Grove Site, the 3M Oakdale Disposal Site, and the 3M Woodbury Disposal Site; and to reimburse the MPCA for its costs to oversee the remediation.

In addition, for the first five years after the 2018 Settlement, 3M is required to pay up to $40 million for short-term drinking water needs under the terms of the 2007 Consent Order. This includes, for example, expenses for:

- Providing bottled water and installing temporary in-home water filtering systems to residents with PFAS-contaminated wells that have been issued well advisories from MDH.
- The operations and maintenance (O&M) of temporary drinking water treatment systems for municipalities that have received well advisories from MDH and are not meeting the required community demand (i.e., existing groundwater wells being taken offline due to well advisories). Temporary drinking water treatment systems were installed to treat wells in Cottage Grove in late 2017 and again in spring/summer of 2020, as well as installed in St. Paul Park and Woodbury during the spring/summer of 2020.

These dollars, which are in addition to the Grant money, are intended to be used as a bridge to the long-term projects funded under Priority 1.

After five years or when the $40 million is spent, any remaining short-term drinking water expenses will be covered by Grant funds, if they remain available. After Grant funds are spent, 3M, under the 2007 Consent Order, will continue to be required to pay for the cost of providing alternative sources of drinking water when concentrations of PFAS exceed MDH drinking water values, as provided in the 2007 Consent Order.

1.1.3 Priorities

As outlined in the Settlement, the MPCA and DNR will use the Grant for projects that are reasonable and necessary to achieve the purposes of the Settlement, based on the following priorities.

Priority 1 – Ensure safe and sustainable drinking water

The first and highest priority for Grant funding is to enhance the quality, quantity, and sustainability of drinking water in the East Metropolitan Area. This area includes, but is not limited to, the cities of Afton, Cottage Grove, Lake Elmo, Lakeland, Lakeland Shores, Maplewood, Newport, Oakdale, St. Paul Park, and Woodbury; the townships of Denmark, Grey Cloud Island, and West Lakeland; and the Prairie Island Indian Community. The goal of Priority 1 is to ensure safe drinking water in sufficient supply to residents and businesses in the East Metropolitan Area to meet their current and future water needs.

Funded projects will address restoration of the provision of clean drinking water in a variety of ways, thereby helping provide the region's residents and businesses with safe drinking water. Such efforts could include, for example, drilling new wells, finding alternative sources of drinking water for communities or private well owners, treating existing drinking water supplies, connecting residences with private wells to public water systems, interconnecting public water systems, and centralizing municipal supply wells to make treatment more feasible. Grant funds could also support groundwater sustainability with projects such as promoting water conservation or preserving open spaces to help recharge drinking water sources and enhance water quality.

Priority 2 – Enhance natural resources

The second priority for Grant funding is to restore and enhance aquatic resources, wildlife, habitat, fishing, resource improvement, and outdoor recreational opportunities in the East Metropolitan Area and in downstream areas of the Mississippi and St. Croix rivers. Projects might include aquatic habitat and water resource protection and restoration; terrestrial and aquatic outdoor recreation facilities; restoration of wildlife habitat; and implementation of other terrestrial conservation and recreational improvements.

The MPCA and DNR have immediate access to $20 million in Grant funds for projects relating to Priority 2. After the safe drinking water goals of Priority 1 are reasonably achieved, all remaining Grant funds are then available for natural resource restoration and enhancement projects under Priority 2.

Priority 3 – Remaining grant funds

If funds remain after the first two priority goals have been met, the Grant can be used for statewide environmental improvement projects. Only projects in categories such as statewide water resources, habitat restoration, open space preservation, outdoor recreation improvements, or other sustainability projects would be eligible.

1.1.4 Roles and responsibilities

Agencies, work groups, and technical subgroup

The MPCA and DNR are responsible for implementing the 2018 Settlement. The terms of the Settlement require the MPCA and DNR to establish a working group to identify and recommend projects. The MPCA and DNR have ultimate responsibility, in their discretion, to determine what projects and other activities will be funded under the Grant.

The MPCA and DNR decided to create two work groups – the Government and 3M Working Group and the Citizen-Business Group – to engage communities, stakeholders, and technical experts to help identify and recommend priorities and projects to be funded under the Grant. To assist these two work groups, the MPCA and DNR formed a subgroup – the Drinking Water Supply Technical Subgroup (Subgroup 1) – composed of technical experts to analyze options, deliver assessments, and provide advice for long-term options for drinking water supply and treatment. The structures of the work groups and the subgroup are described below. See the Minnesota 3M PFC Settlement website (https://3msettlement.state.mn.us/) for additional information on the work groups and subgroup.

Government and 3M Working Group structure

The Government and 3M Working Group is composed of one representative each from the MPCA, the DNR, 3M, and Washington County; and one representative from each of the following affected communities: the cities of Afton, Cottage Grove, Lake Elmo, Lakeland, Lakeland Shores, Maplewood, Newport, Oakdale, St. Paul Park, and Woodbury; the townships of Denmark, Grey Cloud Island, and West Lakeland; and the Prairie Island Indian Community. One representative from the Citizen-Business Group also serves as a liaison to the Government and 3M Working Group to promote coordination and communication between the two groups.

Citizen-Business Group structure

The Citizen-Business Group is composed of the MPCA, the DNR, and about 15 citizen, business, and nongovernmental representatives who live or work in the East Metropolitan Area. One representative from the Government and 3M Working Group also serves as a liaison to this group to promote coordination and communication between the two groups. The following criteria were used by the MPCA and DNR to select representatives from the affected communities:

- Evaluation of a desire to become a member
- Evidence of East Metropolitan Area involvement either as a resident or working in the area

- Skills and abilities, such as personal and professional background and skills; technical abilities; or experience in public engagement, public involvement, or group participation
- Geographic diversity within the East Metropolitan Area
- Ethnic and age diversity
- Representation of individuals and businesses who are on private wells and public water systems
- Diversity of knowledge, skills, backgrounds, and experiences.

Drinking Water Supply Technical Subgroup (Subgroup 1) structure

Subgroup 1 is composed of technical experts from the MPCA, the DNR, MDH, 3M, Washington County, and the Metropolitan Council; one representative from each of the following affected communities: the cities of Afton, Cottage Grove, Lake Elmo, Lakeland, Lakeland Shores, Maplewood, Newport, Oakdale, St. Paul Park, and Woodbury; the townships of Denmark, Grey Cloud Island, and West Lakeland; and the Prairie Island Indian Community; and additional contributions from the Minnesota Geological Survey, the Minnesota Rural Water Association, the Minnesota Water Well Association, the Browns Creek Watershed District, the Middle St. Croix Watershed Management Organization, the Ramsey-Washington Metro Watershed District, the South Washington Watershed District, the Valley Branch Watershed District, and the Washington Conservation District (Lakeland Shores has not selected a representative to participate in this subgroup). The MPCA and DNR co-chair Subgroup 1. Technical experts not affiliated with the subgroup are invited to participate in some meetings on an ad hoc basis to consult on topics in their area of expertise, such as groundwater and sustainability.

Additional support

The MPCA and DNR retained Abt Associates (Abt) and Wood Environment & Infrastructure Solutions, Inc. (Wood) to support the development of this Conceptual Plan.

The MPCA and DNR selected Abt to coordinate and facilitate implementation activities for the 2018 Settlement, including the development of this Conceptual Plan. Abt has expertise with natural resource damage assessment and Settlement implementation.

The MPCA and DNR selected Wood to provide technical assistance in the development of this Conceptual Plan. Wood has engineering expertise in water system planning, cost estimating, modeling, and treatment; and also has experience in PFAS fate and transport, and treatment strategies.

1.1.5 Communication and public involvement

The MPCA and DNR are committed to keeping the public informed about the 3M Settlement implementation process and receiving input from the public. To that end, the MPCA and DNR have relied on multiple avenues of information sharing, including the following:

- The Minnesota 3M PFC Settlement website (https://3msettlement.state.mn.us/)
- GovDelivery messages, for which individuals can subscribe to receive updates
- Publicly available reports to the Minnesota Legislature (bi-annual)
- Information in community newsletters, council meetings, and local media
- Work group and subgroup meetings that are open to the public, and include time for questions and comments from the public
- A series of public meetings specifically about the development of the Conceptual Plan.

1.2 Goals

In collaboration with the work groups, the MPCA and DNR developed a set of goals to guide project planning and implementation under the Grant. These goals build upon the priorities in the Settlement and help provide a common understanding of success. The goals include long-term program goals, as well as operational goals that are focused on specific aspects of planning and implementation.

1.2.1 Long-term program goals

The program goals present the long-term vision of success under the Grant. They are aligned with, and organized by, the priorities in the Settlement. At this time, only goals for Priorities 1 and 2 are described. If funding remains after the MPCA and DNR have reasonably achieved the goals set forth under Priorities 1 and 2, goals under Priority 3 would be developed.

Priority 1 – Drinking water quality, quantity, and sustainability

- Provide clean drinking water to residents and businesses to meet current and future needs under changing conditions, population, and health-based values (HBVs)[1]
- Protect and improve groundwater quality
- Protect and maintain groundwater quantity
- Minimize long-term cost burdens for communities.

Priority 2 – Natural resource restoration, protection, and enhancement

- Restore, protect, and enhance aquatic resources, wildlife, and habitat
- Reduce fish tissue contamination and remove PFAS-based fish consumption advisories
- Improve and enhance outdoor recreational opportunities.

1.2.2 Operational goals

The operational goals are intended to support the efficient and effective achievement of long-term program goals. These operational goals are organized into categories of planning, implementation, governance, public outreach, and monitoring/evaluation/learning.

Planning goals

- Seek a combination of projects that benefit all affected communities
- Appropriately consider projects that transcend jurisdictional boundaries within the East Metropolitan Area
- Appropriately consider projects that incorporate the needs of private well owners as well as public or other drinking water systems
- Rely on science- and evidence-based decision-making and technological advances to achieve priorities and evaluate options
- Seek cost-effective projects that maximize benefits (such as cost-sharing opportunities and adding relevant project components to other planned projects)
- Achieve short- and long-term fiscal responsibility (such as employing smart investment strategies, leveraging funds, and allocating funds for future needs)

1. In addition to the use of HBVs as described in the Minnesota 3M PFC Settlement Program Goals, health risk limits (HRLs) and health indices (HIs) are also used to ensure that the goals of Priority 1 are met.

- Seek to reduce environmental justice health effects, avoid increasing such effects, and enhance access to and use of natural resources for disadvantaged populations
- Employ procedures that include consideration of stakeholders' input throughout the project selection process.

Implementation goals

- Act with an appropriate sense of urgency, utilizing existing information and analyses to the extent possible
- Utilize new leading technologies and leverage/incorporate existing infrastructure to the extent feasible
- Address multiple needs with a combination of strategies and approaches
- Achieve a process that can serve as a model for other communities facing similar issues.

Governance goals

- Develop a clear planning and decision-making process (such as a process for project evaluation, approval, and funding allocation)
- Respect roles and responsibilities of relevant decision-making authorities
- Respect and carefully consider recommendations provided by the groups to the MPCA and DNR
- Ensure that expenditure tracking is transparent and meets all state auditing requirements.

Public outreach goals

- Encourage public input and participation in the process
- Ensure the public is informed of the process and convey information accurately and in a timely manner
- Ensure public transparency about decision-making.

Monitoring/evaluation/learning goals

- Develop measurable objectives, and evaluate progress against them
- Employ adaptive management practices of monitoring, assessing progress toward goals, and adjusting processes to achieve goals
- Provide education to the public about drinking water sources, treatment, and conservation.

1.3 Overview of the Conceptual Plan

The goal of Priority 1 of the 2018 Settlement is to ensure safe drinking water in sufficient supply to residents and businesses in the East Metropolitan Area to meet current and future water needs. The MPCA and DNR developed this Conceptual Plan as a step toward meeting this goal. The purpose of this Conceptual Plan, and the need for a strategic planning effort and planning process are discussed below.

1.3.1 Purpose of this Conceptual Plan

The purpose of this document is to present a plan for providing safe, sustainable drinking water to the 14 communities currently known to be affected by PFAS contamination in the East Metropolitan Area, now and into the future. This Conceptual Plan takes into account both public water systems and private wells, considering options within and across communities. To support the evaluation of options, drinking water distribution modeling and groundwater modeling were performed, and included both current conditions as well as projected community build-out to the year 2040. This Conceptual Plan was completed with input from the Government and 3M Working Group, the Citizen-Business Group, Subgroup 1, and members of the general public.

1.3.2 Strategic planning effort and planning process

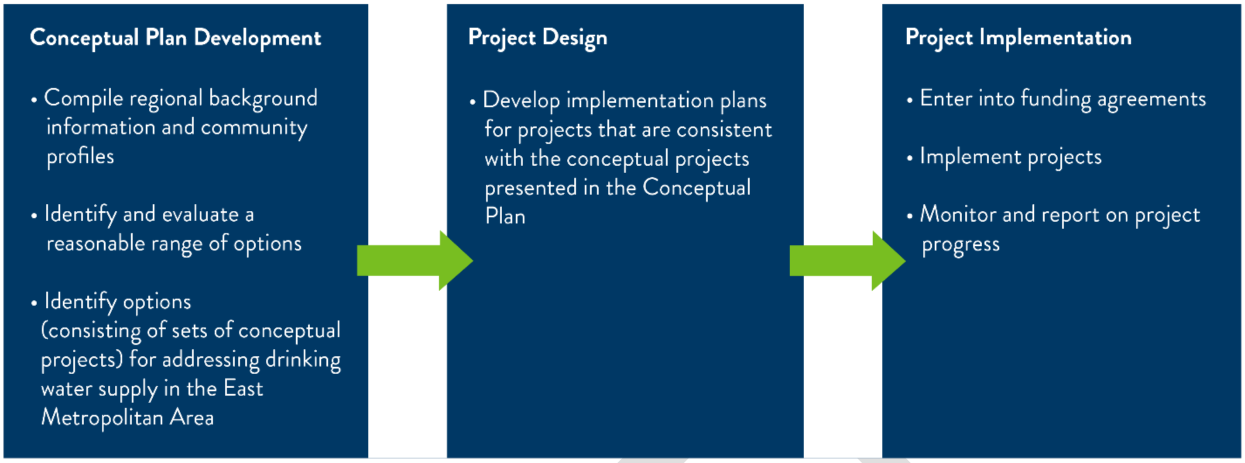
The MPCA and DNR determined that a strategic planning effort is required to effectively achieve the goals of Priority 1. This approach allows the affected communities to benefit from shared knowledge, data, and resources; a regional perspective; consistency across the planning effort; and economies of scale. The development of this Conceptual Plan aligns with this strategic planning effort, and considers the region as a whole when addressing drinking water quality, quantity, and sustainability in the East Metropolitan Area.

As described in more detail in Chapter 2, the Conceptual Plan was developed in a sequential process, refining a suite of reasonable alternatives to reach a recommended option that provides safe, sustainable drinking water to the East Metropolitan Area. The options relate sets of conceptual projects that, when combined, address PFAS-related drinking water quality and quantity issues for the 14 communities currently known to be affected by PFAS contamination. In the development of the options, and ultimately the recommended option, regional groundwater characteristics and community water profiles, including unique community characteristics and growth and development plans, administrative challenges, and water supply constraints, were considered and evaluated throughout the process. Any of the options discussed here would be reasonable and necessary in response to PFAS releases in the East Metropolitan Settlement area, and not inconsistent with provisions found in Minn. Stat. 115B, MERLA.

Following the completion of this Conceptual Plan, the MPCA and DNR will request project-specific implementation plans consistent with this Conceptual Plan. Following approval of the selected projects, the MPCA and DNR will enter into funding agreements with project sponsors for the implementation of the approved projects (described further below). An overview of the planning and implementation process is shown in Figure 1.2. See Section 1.4 for more information on project selection and implementation.

If a recommended conceptual project results in not being feasible upon further consideration, the MPCA and DNR will reevaluate the information obtained for this Conceptual Plan to identify an appropriate alternative.

Figure 1-2. Overview of the planning and implementation process.



1.4 Next steps: Project design and implementation

After this Conceptual Plan is developed, the MPCA and DNR intend to move forward with funding the implementation of projects to enhance the quality, quantity, and sustainability of drinking water in the East Metropolitan Area. Projects will likely proceed in a priority order based on level of contamination, public health considerations, engineering feasibility, and other factors.

The MPCA and DNR envision the following process to implement the projects that are proposed in this Conceptual Plan:

- Through a project implementation process, project sponsors, which may include individual communities, groups of communities, or other interested parties with community approval, will develop detailed project implementation plans that are consistent with the conceptual projects presented in this Conceptual Plan. As part of the development of the project implementation plans, the project sponsor will also conduct environmental reviews and permitting, as necessary. The development of project implementation plans will be fully or partially funded with Grant money.
- The MPCA and DNR will enter into funding agreements with project sponsors for the selected projects.
- The MPCA and DNR will work in consultation with project sponsors and local communities to implement the projects.
- Project sponsors will monitor the implementation and the results of the projects, and will report on progress to the MPCA and DNR, who will then communicate overall program progress to the Minnesota Legislature and the public.

1.5 Document contents

This document includes information on MPCA and DNR's plan for enhancing drinking water quality, quantity, and sustainability in the East Metropolitan Area; and is organized as follows:

- Chapter 1, this chapter, provides an introduction to the document and describes its purpose

- Chapter 2 presents an overview of the approach used to develop this Conceptual Plan
- Chapter 3 presents an overview of the region and community profiles
- Chapter 4 presents water supply improvement options that were identified and evaluated
- Chapter 5 presents conceptual projects that were identified
- Chapter 6 presents an overview of the scenarios that were developed and evaluated
- Chapter 7 provides the Co-Trustees' recommendation.
- Appendix A provides an overview of each of the 14 communities currently known to be affected by PFAS contamination in the East Metropolitan Area of the Twin Cities.
- Appendix B provides an overview of the conceptual site model (CSM) that was developed for the East Metropolitan Area.
- Appendix C provides a summary of the groundwater model setup, calibration, and simulations developed for the East Metropolitan Area.
- Appendix D provides the list of potential conceptual projects identified for each of the 14 communities currently known to be affected by PFAS contamination in the East Metropolitan Area of the Twin Cities.
- Appendix E presents the detailed modeling and costing results for the previously evaluated scenarios, including the community-specific, regional, treatment, and integrated scenarios.
- Appendix F provides supplemental information to Chapter 7 and Appendix E, including unit cost estimations, a small community water system analysis, and a treatment technology comparison.
- Appendix G presents the detailed results of the scenario evaluations.

1.6 Preparers

This Conceptual Plan was prepared by the MPCA and DNR, with support from Abt and Wood.

2. Approach

This chapter provides a description of the approach used to develop this Conceptual Plan for providing safe, sustainable drinking water to the East Metropolitan Area (Section 2.1). It also provides an overview of the modeling effort used to support the evaluation of drinking water options considered as part of this Conceptual Plan (Section 2.2).

2.1 Description of approach

As described in Chapter 1, the purpose of this document is to present a plan for providing safe, sustainable drinking water to the 14 communities currently known to be affected by PFAS contamination in the East Metropolitan Area, now and into the future. This Conceptual Plan takes into account both public water systems and private wells, considering options within and across communities. To support the evaluation of options, drinking water distribution modeling and groundwater modeling were performed, and included both current conditions as well as projected community growth up to the year 2040. This year was selected because the comprehensive plans and/or water supply plans for each community, approved by the Metropolitan Council, include population projections to the year 2040.

The Conceptual Plan was developed in a sequential process, refining a suite of reasonable options to reach a recommendation for providing safe, sustainable drinking water to the East Metropolitan Area. An overview of the step-wise approach is described below.

Step 1: Compile regional background information and community profiles

As a first step, regional background information and community profiles were compiled to identify the characteristics of the East Metropolitan Area, including major aquifers, the current drinking water infrastructure, and potential constraints on water use. This information helped provide bounds on regional models and identify feasible options moving forward. To support this effort, members of Subgroup 1 identified and shared relevant data and information, including current municipal water system infrastructure, location of private wells, and other information. The compilation of regional background information and community profiles are summarized in Chapter 3 of this Conceptual Plan, with more detailed information presented in Appendix A.

Step 2: Identify and evaluate water supply improvement options

As a second step, an initial list of water supply improvement options was identified and evaluated. These options represent general project types that could improve drinking water supply quality and quantity in the East Metropolitan Area, without specifying details such as PFAS treatment technology (if applicable), location, source water, scale, or capacity (incorporated in Step 3 below). These options may include both centralized and decentralized systems. A specific option may be applicable to one or more communities in the East Metropolitan Area. The initial list of water supply improvement options was developed with input from the Government and 3M Working Group, the Citizen-Business Group, and Subgroup 1, as well as through a general public suggestion process. Chapter 4 of this Conceptual Plan presents the list of options identified and evaluated.

Step 3: Identify conceptual projects

As a third step, more specific conceptual projects were identified for each of the affected communities in the East Metropolitan Area. These conceptual projects are consistent with the water supply improvement options from Step 2, but provide more detail, such as information on project location(s), project components(s), and PFAS treatment technologies. As shown in Figure 2.1, there may be a number of feasible conceptual projects that could benefit one or more communities in the East Metropolitan Area. Conceptual projects were identified by the Government and 3M Working Group, the Citizen-Business Group, Subgroup 1, members of the public, and the Co-Trustees. Chapter 5 of this Conceptual Plan presents the list of potential conceptual projects that were identified. Appendix D provides additional details on the list of potential conceptual projects identified for each community.

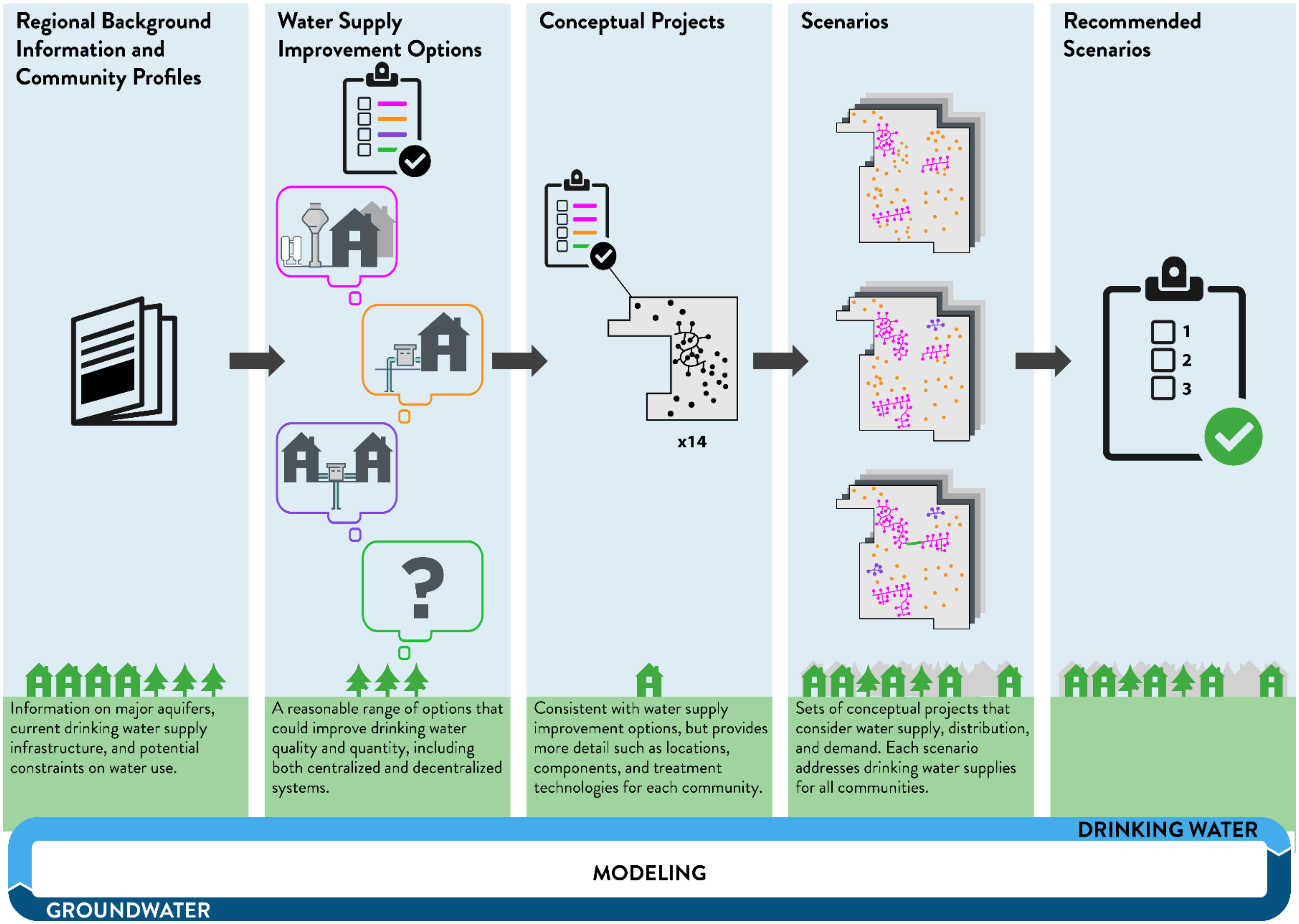
Step 4: Develop and evaluate scenarios

As a fourth step, scenarios for the entire East Metropolitan area were developed and analyzed for cost and technical feasibility. These scenarios consist of sets of conceptual projects; and consider water supply, distribution, and demand. As shown in Figure 2.1, each scenario addresses PFAS-related drinking water quality and quantity issues for the 14 communities currently known to be affected by PFAS contamination in the East Metropolitan Area. Once developed, these scenarios were evaluated using the drinking water distribution and groundwater models. Timing and implementation of the scenarios were considered as part of the evaluation. Local government units (LGUs) provided input on the refinement of scenarios. Chapter 6 of this Conceptual Plan presents the list of scenarios that were developed and evaluated. Appendices B, C, E, and F provide additional supplemental information used for the development and evaluation of the scenarios, including an overview of the CSM, a summary of the groundwater model, detailed modeling and cost results, unit cost estimations used, a small community water system analysis, and a treatment technology comparison. Appendix G presents the detailed results of the scenario evaluations.

Step 5: Identify recommended options

As a final step, the scenarios were further evaluated using a set of evaluation criteria (see Chapter 6). These evaluation criteria were developed by the Co-Trustees in collaboration with the Government and 3M Working Group, the Citizen-Business Group, and Subgroup 1. Based on this evaluation, the Co-Trustees provided recommended options on the sets of projects that provide safe, sustainable drinking water to the East Metropolitan Area. Chapter 7 of this Conceptual Plan describes these three recommendations.

Figure 2-1. Approach for the development of the Conceptual Plan.



2.2 Modeling overview

Drinking water distribution modeling and groundwater modeling were conducted to support the evaluation of scenarios as part of Step 4 (above). An overview of these two models and how they were used is provided below. Appendices B and C provide a more detailed description of the groundwater model.

2.2.1 Drinking water distribution modeling

Purpose

The purpose of the drinking water distribution modeling is to provide a comprehensive representation and understanding of the drinking water supply infrastructure in the East Metropolitan Area. This information was used to support the evaluation of each proposed scenario (Chapter 6), both within and across communities for both existing and proposed modifications to the distribution system. The modeling allows for the evaluation of the existing drinking water distribution infrastructure to:

1. Determine if the existing infrastructure is sufficient for any given scenario
2. Determine where infrastructure may need to be changed to accommodate current safe drinking water supply and future demands
3. Evaluate scenarios where multiple communities' systems are connected.

The drinking water distribution modeling is also a significant factor in determining the costs for each scenario. The assumptions, objectives, and development of models for a given scenario will be described in greater detail in Appendix E.

Data gathering and assessment

Individual hydraulic models were constructed for each community using data collected from the communities. Geographic information system (GIS) software was used to map each system for spatial analysis, which assisted in determining the proximity of private wells to municipal water systems and other such relative locations between infrastructure elements. GIS also allowed for the mapping of proposed infrastructure elements or modifications that could then be imported into the hydraulic modeling software. The drinking water distribution model incorporated current drinking water supply infrastructure as well as projected future infrastructure, based on each community's projected growth up to year 2040, as defined in their respective water supply plan.

Available information on drinking water supply infrastructure in the 14 affected communities was received from the communities' engineers and/or consultants. The information included raw data (i.e., pumping data and demand calculations), record drawings, previous reports (e.g., studies, water supply plans, comprehensive plans, system statements), electronic files [i.e., GIS files, existing hydraulic model files, or computer-aided design (CAD) files]. The information included the following:

- Number of connections, current demands, and water usage
- Available water supply
- System pressures
- Existing infrastructure layouts and specific location information for municipal water systems.

Private and non-community public supply well data were also assembled from the Minnesota Well Index and MPCA's PFAS sampling database.

Model development

Using the infrastructure information and data collected above, drinking water distribution models were developed for the affected communities via an iterative process, including:

1. Converting all existing model data (where available) to GIS format across all communities
2. Assigning uniform data fields for each system component type (i.e., pipes, tanks, pumps, valves, and wells) across all communities
3. Analyzing each community's data for consistency
4. Identifying missing information needed for data import
5. Collecting/verifying any missing data and assumptions
6. Importing GIS data into WaterCAD (a modeling software)
7. Establishing all base models with current infrastructure and maximum day demands
8. Calibrating the models and performing intermediate quality assurance and quality control (QA/QC).

Once the base models were established, the various scenarios were laid out within the WaterCAD software to evaluate costs and feasibility. The development of the drinking water distribution models was coordinated with the development of the groundwater model (Section 2.2.2) to identify the impacts of potential new or modified well sites. These models were reviewed by local government personnel to ensure they accurately represent current systems.

2.2.2 Groundwater modeling

Purpose

A numerical, three-dimensional groundwater flow model was developed to support the evaluation of the scenarios. The purpose of the groundwater model is to provide insight into the current groundwater flow system, predict impacts to flow paths and existing and future wells related to PFAS contamination and transport, and assess groundwater resources availability associated with the proposed scenarios through the year 2040. The predicted impacts to existing and future wells by PFAS flow paths and to groundwater quantity estimates are based on projected groundwater recharge/precipitation rates, surface water elevations, and pumping volumes of the proposed scenarios. The year 2040 was selected because it was the time period for which there are population projections in the comprehensive plans and/or water supply plans for each community, which determine drinking water demand.

The objectives of the groundwater model are to:

1. Assess aquifer sustainability and viability of production rates for the proposed scenarios that may involve changes in pumping rates or new water supply wells
2. Analyze contaminant flow paths under different proposed scenarios and climate conditions to the determine potential risk of PFAS contamination at existing and future wells, both municipal and private
3. Evaluate potential impacts to groundwater resources in response to projected future groundwater use under the different proposed scenarios and climate conditions
4. Communicate model results and technical issues (e.g., flow direction, impacts to current remediation) internally and to stakeholders through visual representations of simulated flow systems.

This groundwater model may also be used in the future to further evaluate projects as they are refined following development of this Conceptual Plan.

Notably, a flow path analysis will be performed whereby groundwater flow will be used to determine how current contamination may move over time. However, this does not take into consideration exact concentrations or other factors in groundwater contamination movement, such as adsorption, dispersion, and degradation of chemicals.

Data gathering and assessment

The data and content used within the groundwater model were selected in collaboration with several agencies, LGUs, and consultants. Major data contributors to the development of the groundwater model included the MPCA, the DNR, MDH, and the Minnesota Geological Survey (MGS). Additional contributors included local watershed districts and Washington County. The data compiled and evaluated for the groundwater model are summarized in Appendix B.

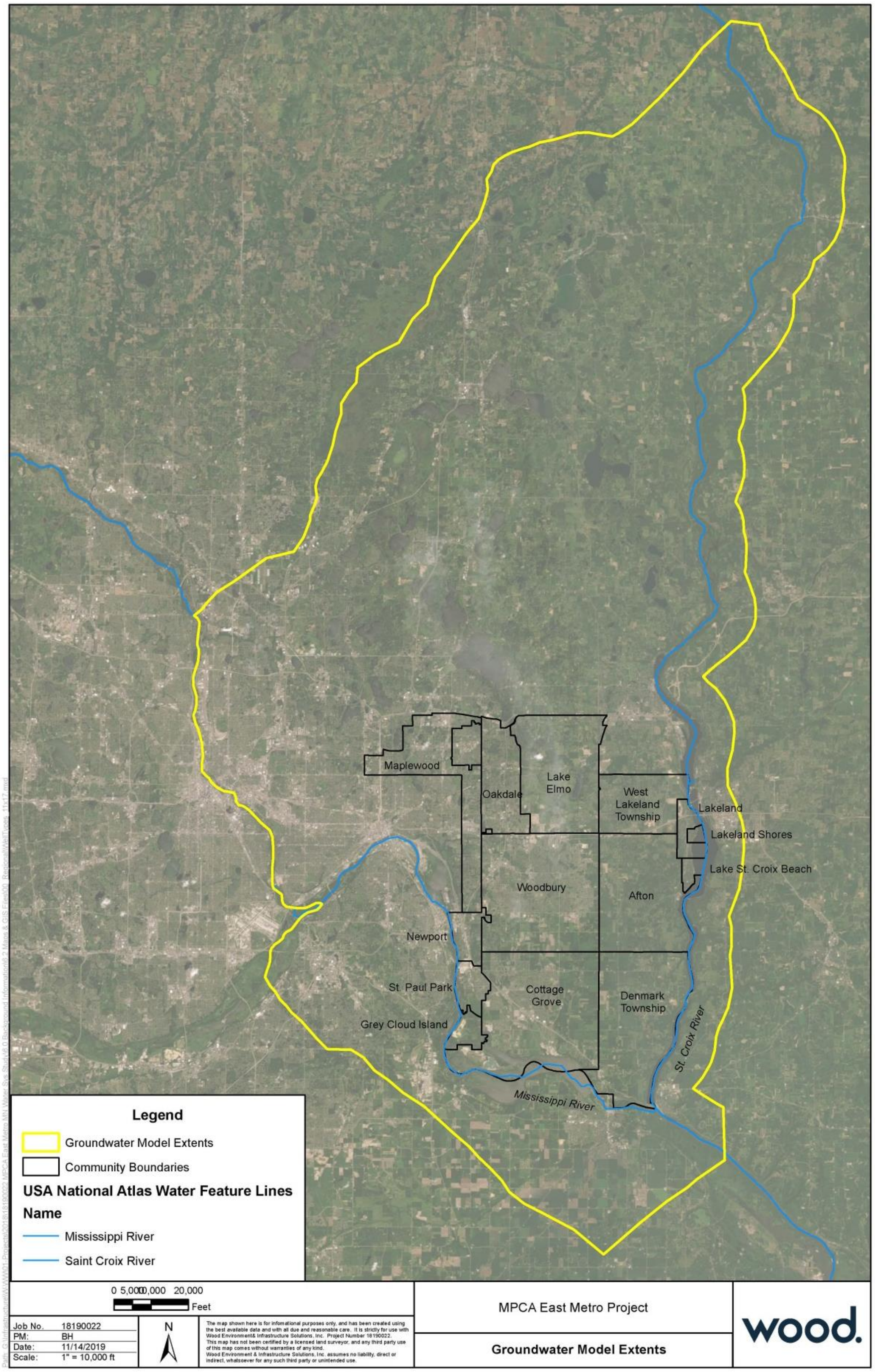
CSM development

A CSM was first developed before the numerical groundwater model for an area that includes the greater East Metropolitan Area (including the 14 affected communities as well as additional communities nearby). A CSM provides a way to better understand a very complex natural system by reducing it to a simplified set of relevant assumptions, data, and information to develop a picture of how the system functions. AECOM provided a third-party, independent review of the CSM. The CSM served as the basis for input parameters used in the numerical groundwater model and more information on the model is included in Appendix B.

Numerical model development and review

The numerical model was built using data compiled during the CSM development. As with the CSM, the numerical model was peer-reviewed by AECOM. The final domain of the completed model is presented in Figure 2.2. Additional details on the numerical model development are provided in Appendix C.

Figure 2-2. Numerical groundwater model domain boundary.



3. Background

This chapter provides background information on the East Metropolitan Area that helps lay the groundwork for this Conceptual Plan. Section 3.1 discusses the groundwater and surface water in the region, the PFAS contamination in the East Metropolitan Area, and constraints on water use. Section 3.2 discusses water supply profiles for each affected community in the East Metropolitan Area.

3.1 Regional overview

3.1.1 Groundwater

The geology of Washington County was formed over the course of several hundred millions of years. The basement bedrock units of Mt. Simon and Hinckley are discussed in detail in the Metropolitan Council's 2014 report, "Twin Cities Metropolitan Area Groundwater Flow Model Version 3.0" (Metropolitan Council, 2014b). During the Cambrian and Ordovician Periods of the Paleozoic Era (about 500 to 450 million years ago), rising and falling marine seas left behind layers of sedimentary rock, including carbonate, sandstone, and shale (Bauer, 2016). These bedrock layers were typically deposited horizontally; however, over time, some of these layers shifted from the Earth's movement via folding, fracturing, and/or faulting. More recently, during the Quaternary Period (beginning 2.6 million years ago), a series of advancing and retreating glaciers carved the land and deposited unconsolidated clay, silt, sand, and gravel on top of these bedrock formations (Bauer, 2016).

Bedrock formations are a main factor governing groundwater in the region. Groundwater can move rapidly and in large quantities through some bedrock types, such as sandstone and fractured carbonates (i.e., limestone and dolostone), which act as aquifers (Bauer, 2016). Other rocks, such as siltstone and shale, have low permeability, serving as aquitards that impede vertical flow between aquifers (Bauer, 2016). A brief description of major hydrostratigraphic components found in the complete stratigraphic sequence is presented in Table 3.1 and Figure 3.1.

In Washington County, there are six bedrock aquifers, including the (1) St. Peter Sandstone, (2) Prairie du Chien Group including the Shakopee Formation (aquifer) and Oneota Dolomite (aquitard), (3) Jordan Sandstone, (4) Tunnel City Group including the Upper Tunnel City aquifer, (5) Wonewoc Sandstone, and (6) Mt. Simon Sandstone (Table 3.1 and Figure 3.1). These aquifers occur at different depths, and vary in thickness, porosity, permeability, and water quality. The Prairie du Chien (Shakopee Formation) and Jordan aquifers are the shallowest major bedrock aquifers, and the principal groundwater sources used by municipalities and private well owners in Washington County (Washington County, 2014). The Wonewoc aquifer is used as a drinking water source in areas of Washington County where the Prairie du Chien (Shakopee Formation) and Jordan aquifers are absent or unusable (Washington County, 2014). The Mt. Simon aquifer is another productive aquifer, but Minnesota Statute restricts the use of this aquifer in some areas (see Section 3.1.4.2).

The major aquifers are separated by three bedrock features that function as major aquitards, including the (1) Decorah Platteville Glenwood (uppermost bedrock), (2) St. Lawrence Formation (below the Jordan aquifer), and (3) Eau Claire Formation (below the Wonewoc aquifer) (Table 3.1 and Figure 3.1; Washington County, 2014). However, in some parts of the East Metropolitan Area, variations in porosity and permeability; and disruption by structures such as faults, fractures, and incised valleys may significantly reduce the ability of these formations to impede the downward movement of groundwater and contaminants.

Washington County sits on a groundwater divide that runs roughly longitudinally north-south through the county and is particularly pronounced in the upper bedrock aquifers down through at least the Jordan aquifer (Figure 3.2). Although groundwater flow direction and the location of the groundwater divide vary from aquifer to aquifer, on the east side of the divide, groundwater generally flows east-southeast toward the St. Croix River; on the west side of the divide, groundwater generally flows southwest toward the Mississippi River (Figure 3.2). Locally, however, the direction of groundwater flow may be influenced by other features, such as faults, buried valleys, lakes, and streams, and by well pumping. Groundwater flow directions in the Mt. Simon aquifer in the region are controlled primarily by well pumping (Sanocki et al., 2008). The major groundwater discharge zones in the county are the St. Croix and Mississippi rivers (Washington County, 2014).

Table 3.1. Washington County bedrock aquifers and aquitards. Information adapted from Figure 1, Plate 2 of the Geologic Atlas of Washington County (Bauer, 2016).

Name	Hydrologic function	Sediment type	Thickness (feet)
Decorah, Platteville, and Glenwood	Aquitards	Shale, limestone, and dolostone	0–70
St. Peter Sandstone	Aquifer Minor Aquitard Minor	Sandstone	0–160
Prairie du Chien Group: Shakopee Formation Oneota Dolomite	 Aquifer Major Aquitard Minor	Dolostone and sandstone	0–200
Jordan Sandstone	Aquifer Major	Sandstone	0–100
St. Lawrence Formation	Aquitard	Siltstone, sandstone, and shale	0–45
Tunnel City Group: Mazomanie Formation Lone Rock Formation	 Aquifer Upper Aquitard Lower	Sandstone, siltstone, and shale	0–180
Wonewoc Sandstone	Aquifer Major	Sandstone	0–60
Eau Claire Formation	Aquitard	Sandstone, siltstone, and shale	0–100
Mt. Simon Sandstone	Aquifer Major	Sandstone	200–280

Figure 3-1. Cross-section showing Washington County bedrock aquifers and aquitards. Cross-section goes west to east from Maplewood to West Lakeland Township/Lakeland. Figure adapted from Berg (2019).

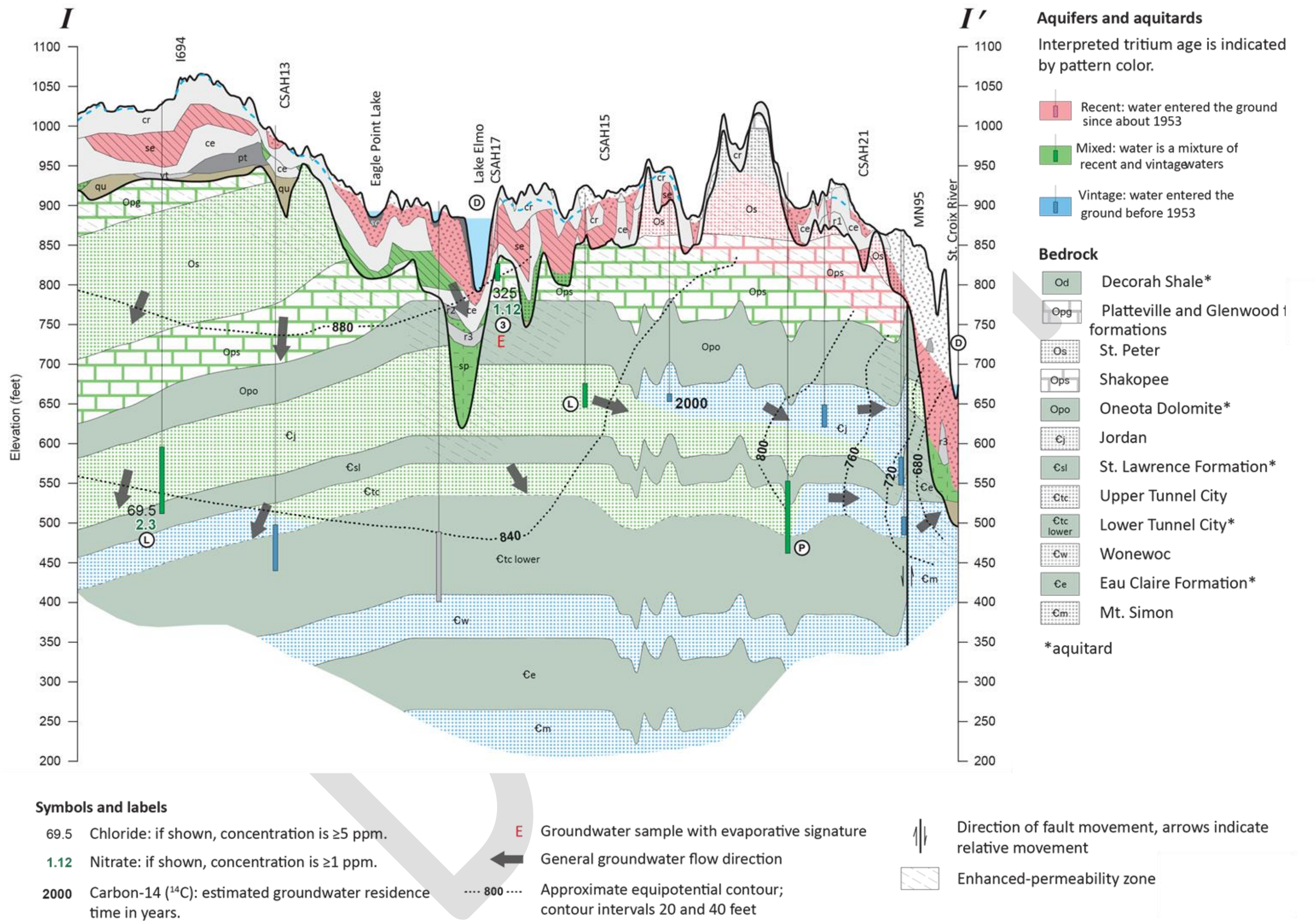
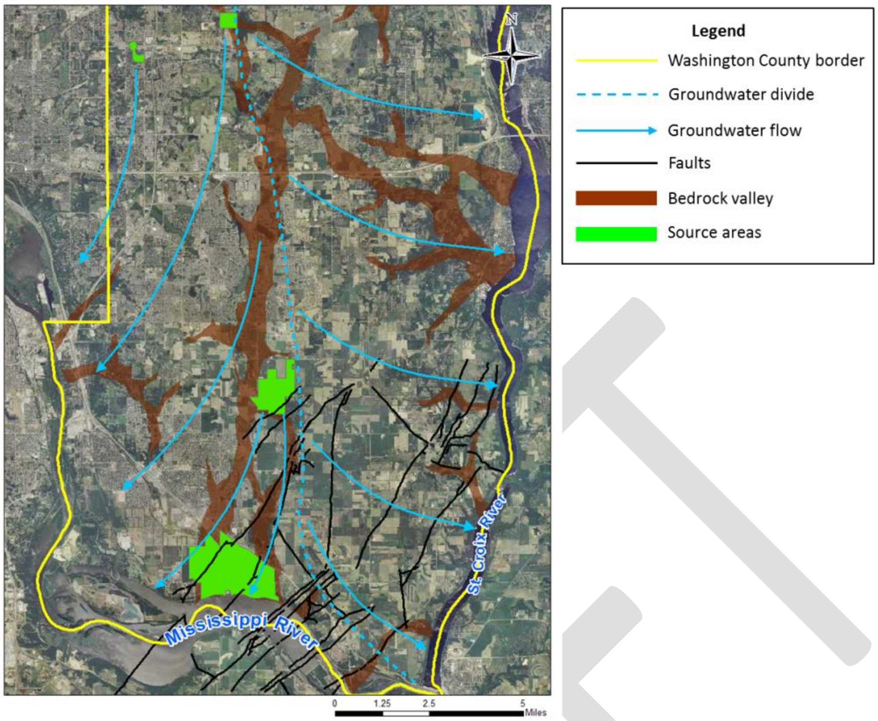


Figure 3-2. General groundwater flow in Washington County.



3.1.2 Surface water

Southern Washington County is bounded by the Mississippi River to its south and the St. Croix River to its east (Figure 3.2). Other surface water features in Washington County include lakes, rivers, streams, creeks, and wetlands. Many of these surface water features are in hydraulic connection with groundwater. For example, lakes may be a source of recharge to groundwater, an area of groundwater discharge, or both (Washington County, 2014). Likewise, streams and creeks can lose or gain water to and from the groundwater below. Many Washington County creeks that are primarily supplied by groundwater discharge are suitable for brook trout and brown trout (Washington County, 2014). Notably, not all surface water features in Washington County serve as recharge or discharge to groundwater, and are instead separated from the groundwater by a confining layer (Washington County, 2014). These water bodies are referred to as being "perched."

3.1.3 PFAS contamination

PFAS are a family of manmade chemicals that have been used for decades to make products that resist heat, oil, stains, grease, and water. Some PFAS are extremely stable, do not break down in the environment, and are generally water-soluble. As such, after being released from a source, these PFAS are able to enter groundwater relatively quickly and will remain in the environment without human intervention to remove them.

The State's understanding of and ability to detect PFAS in the environment has evolved since the MPCA and MDH first began investigating the compounds in 2002. Laboratories at that time only identified a few PFAS and could not detect very low concentrations. However, method detection limits have become progressively lower over time, and the State is now able to measure extremely small amounts (parts per trillion in water) of a few PFAS. Recent toxicological studies also indicate greater potential for human health impacts from PFAS compounds than earlier thought. As the science has improved, health-based guidance values established by MDH have become progressively lower over time.

An overview of the current extent of PFAS contamination in the East Metropolitan Area and health-based guidance values are presented in the sections below.

Current extent of contamination

Since 2002, the MPCA and MDH have partnered to investigate PFAS in Minnesota. This work began with drinking water investigations near the 3M Cottage Grove plant and the 3M disposal sites in Washington County. The investigations in the East Metropolitan Area have identified an area of groundwater contamination covering over 150 square miles, affecting the drinking water supplies of over 140,000 Minnesotans. At the time of publication, over 3,300 public and private wells have been sampled in the East Metropolitan Area and 1,300 well advisories have been issued. The MPCA and MDH continue to sample nearly 1,000 private wells annually in the area to identify PFAS-impacted wells and monitor PFAS movement. [Note: We will provide the most recent numbers in the final draft.]

PFAS sources and movement in the East Metropolitan Area

The 3M Cottage Grove Site, the 3M Woodbury Disposal Site, the 3M Oakdale Disposal Site, and the Washington County Landfill, where 3M disposed of PFAS waste from approximately 1951 to 1975, released PFAS to the groundwater in the East Metropolitan Area.[2] The disposal site locations are shown in Figure 3.3. An overview of each site and PFAS movement are provided below.

3M Cottage Grove Site – 3M produced PFAS at its Cottage Grove Plant from the late 1940s until 2002. 3M disposed of PFAS waste from its manufacturing process at several disposal sites on the Cottage Grove Plant property from approximately 1951 to 1980, and discharged wastewater containing PFAS to the Mississippi River since 1955. Environmental testing shows that the groundwater beneath the 3M Cottage Grove Site is contaminated with PFAS. Groundwater beneath the site flows south and discharges to the Mississippi River. PFAS contamination has also been identified in river sediments near the 3M Cottage Grove Site. Fish consumption advisories exist for certain fish in Pool 2 of the Mississippi River adjacent to and downstream of the 3M Cottage Grove Site. Under terms of the 2007 Consent Order, 3M completed excavation and offsite disposal of PFAS impacted soils/sediments; implemented an enhanced groundwater recovery and treatment process; and is required to conduct long-term ground and surface water monitoring as appropriate, and implement institutional controls at the Site.

Woodbury Disposal Site – The Woodbury Disposal Site consists of two locations used for the disposal of solid waste, industrial solvents, and acids from 3M's Cottage Grove and Saint Paul manufacturing facilities during the 1960s. 3M disposed of PFAS waste at the Woodbury Disposal Site from approximately 1960 to 1966. Between 1967 and 1973, 3M installed and operated four "barrier" groundwater pumping wells at the site to address non-PFAS contamination. 3M pumped the groundwater to the 3M Cottage Grove plant to be used as non-contact process water in its operations, and then discharged the water without treatment to the Mississippi River. In 1992, 3M entered the Woodbury Disposal Site and installed a cap as part of MPCA's Voluntary Investigation and Cleanup Program. In spring 2005, 3M reported to the MPCA that PFAS, including PFOA and PFOS, were detected

---

2. While these disposal sites are the primary sources of PFAS impacts in the East Metropolitan Area, which resulted in larger groundwater plumes, there may be other secondary sources of PFAS due to the many uses of products containing PFAS (i.e., firefighting foam). These secondary sources may have contributed to some localized environmental impacts from PFAS.

in the groundwater pump-out system at the Woodbury Disposal Site. Groundwater beneath the site flows south and southwest, resulting in PFAS migration toward the Mississippi River. Under terms of the 2007 Consent Order, 3M completed excavation and offsite disposal of PFAS impacted soils/sediments; implemented an enhanced groundwater recovery and treatment process; and is required to conduct long-term ground and surface water monitoring as appropriate, and implement institutional controls at the Site.

Oakdale Disposal Site – The Oakdale Disposal Site consists of three former chemical waste dump sites that were used for waste burial, drum reclamation, and open burning of combustible materials. In 1983, 3M entered into a Consent Order with the MPCA to investigate and implement response actions to address releases of volatile organic compounds (VOCs) from the site. Groundwater sampling at the site in 2004 indicated PFAS were present in the groundwater monitoring wells. 3M disposed of PFAS waste at this site, and the PFAS have traveled from the Oakdale Disposal Site both south and southeast in the groundwater. Because of the connections between surface water and groundwater, PFAS have also entered the surface water in Raleigh Creek, which flows eastward into the City of Lake Elmo, where it discharges to Eagle Point Lake in the Lake Elmo Park Reserve. All fish from Lake Elmo (i.e., the lake within the City of Lake Elmo) have a “Do Not Eat” advisory due to PFOS contamination. Under terms of the 2007 Consent Order, 3M completed excavation and offsite disposal of PFAS impacted soils/sediments; implemented an enhanced groundwater recovery and treatment process; and is required to conduct long-term ground and surface water monitoring as appropriate, and implement institutional controls at the site.

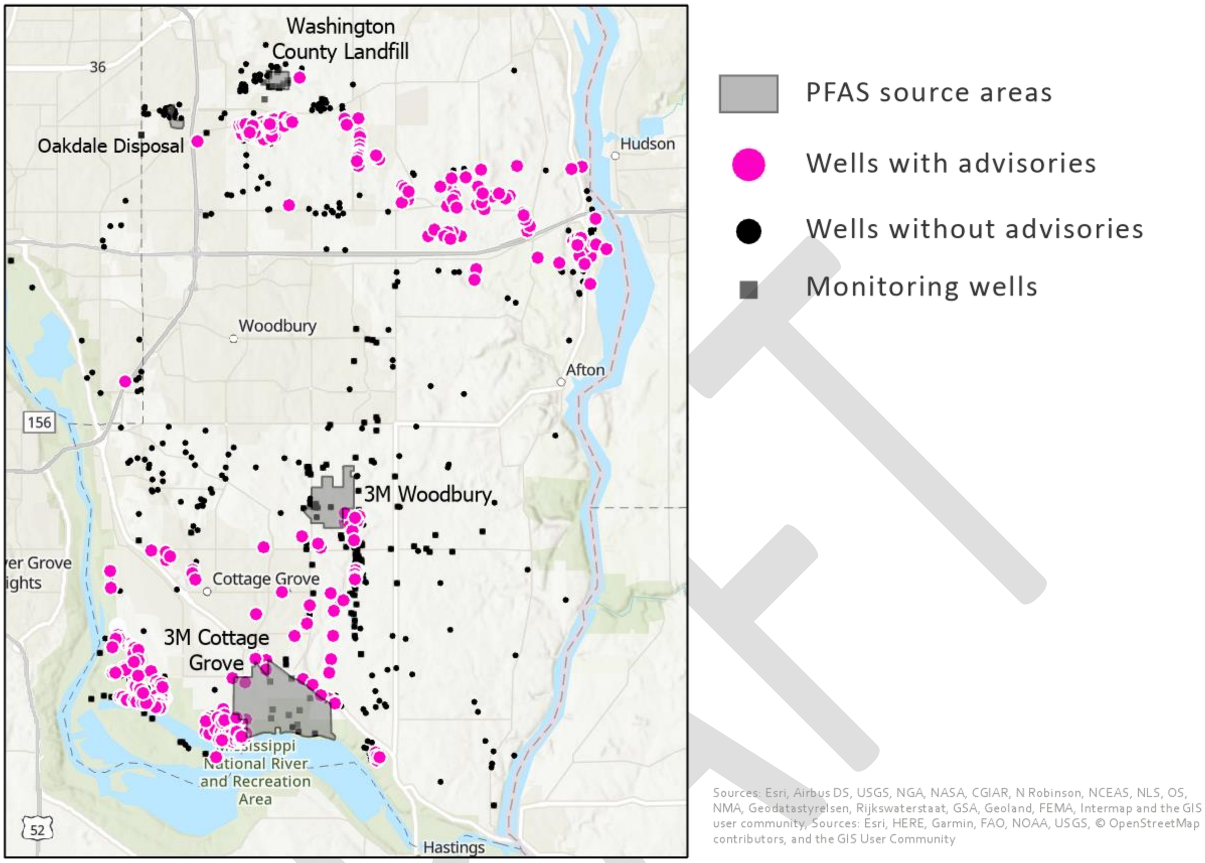
Washington County Landfill – In 2004, the MPCA and MDH learned that 3M disposed of PFAS waste in the former Washington County Landfill from approximately 1971 to 1974. Environmental sampling determined that PFAS in the groundwater in the City of Lake Elmo came from both the former Washington County Landfill (where PFAS waste contained primarily PFOA waste) and the Oakdale Disposal Site (where PFAS waste contained both PFOA and PFOS waste). Because of the connections between surface water and groundwater, PFAS have been found in several area surface water bodies (i.e., Eagle Point Lake, Lake Elmo, Sunfish Lake, and Horseshoe Lake). As the MPCA Closed Landfill Program is obligated to conduct appropriate response actions in response to PFAS releases from the Washington County Landfill, waste was consolidated into a triple-liner system as the remedy at the direction of the State Legislature. In addition, under the terms of the 2007 Consent Order, 3M agreed to provide up to $8 million toward the triple-liner system.

For all four of these 3M PFAS waste disposal sites, the MPCA conducts long-term monitoring of residential wells and installs/maintains granular activated carbon (GAC) systems in private residential homes as appropriate.

Future mobility

The MPCA and MDH continue to monitor and track movement of PFAS in the East Metropolitan Area. Over time, PFAS will continue to move down-gradient as they are transported with groundwater and/or surface water. However, the future extent and movement of PFAS are uncertain. A number of factors affect movement of PFAS, including the relative solubility of PFAS, local bedrock features, well pumping, and future water use, among others.

Figure 3-3. Current well advisories and 3M PFAS disposal sites in the East Metropolitan Area. Wells tested and identified with a black circle showed no or low levels of PFAS. Wells tested and marked with a pink circle showed elevated levels of PFAS for which the MDH issued the well owner a well water advisory. In addition, public supply wells are not public information and therefore are not shown on this map.



State and federal guidance for PFAS

Although knowledge of PFAS science has been in existence for more than half a century, health-related impacts from PFAS exposure have only evolved significantly over the past 20 years. The State and the U.S. federal government continue to research these substances and provide guidance to the public. Below, information is presented on MDH's drinking water guidance and the United States Environmental Protection Agency's (EPA's) current role in PFAS regulation.

MDH's HBVs and Health Risk Limits

HBVs and health risk limits (HRLs) are developed by toxicologists at MDH using the best peer-reviewed science and public health policies available at the time of their development. An HBV or HRL is the level of a contaminant that can be present in water and pose little or no health risk to a person drinking that water. The guidance values apply to short periods of time as well as over a lifetime of exposure. HBVs and HRLs are developed to protect sensitive populations, such as infants and children, and highly exposed populations.

HBVs and HRLs are both considered guidance values, but have undergone different levels of review. HRLs have been through the Minnesota rulemaking process, which includes at least one public comment period for stakeholders to provide feedback on proposed guidance values. HBVs, on the other hand, have not been promulgated using the public process described by the Administrative Procedures Act (Minnesota Statutes Chapter 14). Instead, an HBV is technical guidance made available by MDH. These values may be used by the public, risk managers, and other stakeholders to assist in evaluating potential health risks to humans from exposures to a chemical.

In 2002, MDH developed drinking water guidance values for PFOS and PFOA. Since then, MDH continues to review available toxicological information for all PFAS and develop new or revised values. Currently, MDH has guidance values for perfluorobutane sulfonate (PFBS), PFBA, perfluorohexane sulfonate (PFHxS), PFOS, and PFOA (Table 3.2). MDH continues to monitor the growing body of science about PFAS and will adjust their guidance as needed.

Table 3.2. Minnesota's drinking water guidance values for PFAS (as of 11/1/2019).

PFAS	Drinking water guidance value (parts per trillion)	Type of guidance value
PFBS	2,000	HBV
PFBA	7,000	HRL
PFHxS (perfluorohexane sulfonate)	47	HBV
PFOS	15	HBV
PFOA	35	HRL

Since water samples often contain multiple chemicals, there is the possibility that chemicals in combination may cause effects that would not be predicted based on separate exposures to individual chemicals. Therefore, when drinking water contamination involves multiple PFAS chemicals for which guidance values are available and which share a common health endpoint, MDH evaluates their "additive" risk and calculates a health risk index (HRI or health index, HI, used interchangeably throughout) to determine if the combined health risk exceeds a certain level. The HI is determined by calculating the concentration of each chemical divided by its HRL or HBV, and adding the resulting ratios. A HI greater than one indicates a possible health risk from a group of PFAS chemicals that share a common health endpoint. For more information, visit the MDH webpage on evaluating concurrent exposures to multiple chemicals (https://www.health.state.mn.us/communities/environment/risk/guidance/gw/additivity.html).

EPA's role in PFAS

At the federal level, the EPA establishes drinking water standards and provides guidance to ensure safe drinking water for public water supplies. Among other roles, EPA is responsible for establishing:

- Maximum contaminant levels (MCLs): MCLs are drinking water standards for public water supplies. States are allowed to enforce lower (i.e., more strict) standards than MCLs, but are not allowed to enforce higher (i.e., less strict) standards. MCLs are established through a scientific process that evaluates health impacts of the contaminant; and the technology and cost required for the prevention, monitoring, and/or treatment. New MCLs or changes to existing MCLs are infrequently made.
- Health advisories: Health advisories provide technical guidance to EPA and other public health officials, but are not enforceable water quality standards. Health advisories are based on non-cancer health effects for different lengths of exposure (i.e., 1 day, 10 days, or lifetime).

In 2016, EPA released health advisory values for PFOA and PFOS to reflect the latest scientific evidence about the risk posed by PFAS. MDH's current guidance values for PFOA and PFOS (35 parts per trillion for PFOA and 15 parts per trillion for PFOS) are more protective than the EPA value of 70 parts per trillion for either chemical or when added together. While the EPA value is protective for most people, it does not address the potential for mothers to pass along the chemicals to fetuses and nursing infants.

The updated MDH values reflect new state-level analyses of existing and new scientific literature that resulted in the calculation of more protective guidance values.

In February 2019, EPA released a PFAS Action Plan (EPA, 2019). This Conceptual Plan describes EPA's approach to identifying and understanding PFAS, addressing current PFAS contamination, preventing future contamination, and effectively communicating with the public about PFAS (EPA, 2019). Key actions EPA identified include:

- Initiating steps to evaluate the need for an MCL for PFOA and PFOS
- Beginning the necessary steps to propose designating PFOA and PFOS as "hazardous substances" through one of the available federal statutory mechanisms (e.g., Comprehensive Environmental Response, Compensation, and Liability Act; Clean Water Act; Resource Conservation and Recovery Act)
- Developing groundwater cleanup recommendations for PFOA and PFOS at contaminated sites
- Developing toxicity values or oral reference doses for GenX chemicals (a replacement for PFOA) and PFBS
- Developing new analytical methods and tools for understanding and managing PFAS risk
- Promulgating Significant New Use Rules that require EPA notification before chemicals are used in new ways that may create human health and ecological concerns
- Using enforcement actions to help manage the risks of PFAS, where appropriate (EPA, 2019).

3.1.4 Groundwater use

Groundwater is the main source of drinking water for the communities in the East Metropolitan Area. Below, information is presented on the management of groundwater resources (Section 3.1.4.1), and potential constraints and issues with groundwater use (Section 3.1.4.2).

Management of groundwater resources

The DNR is responsible for managing the use of groundwater in Minnesota (Minnesota Rules Chapter 6115 and Minnesota Statutes Chapter 103G). A DNR permit is required for appropriations of more than 10,000 gallons per day or 1 million gallons per year. The DNR is also mandated by statute to ensure the sustainability of water resources. The sustainability standard described in Minnesota Statutes § 103G.287, subd. 5, is as follows:

> The commissioner may issue water-use permits for appropriation from groundwater only if the commissioner determines that the groundwater use is sustainable to supply the needs of future generations and the proposed use will not harm ecosystems, degrade water, or reduce water levels beyond the reach of public water supply and private domestic wells constructed according to Minnesota Rules, chapter 4725.

The DNR has statutory authority to designate groundwater management areas (Minnesota Statutes § 103G.287, subd. 4). Washington County, along with Ramsey County and portions of Anoka and Hennepin counties, fall within the North and East Metropolitan Groundwater Management Area. Within these areas, the DNR may limit total annual water appropriations and uses to ensure sustainable use of groundwater that protects ecosystems, water quality, and the ability of future generations to meet their own needs (Minnesota Statutes § 103G.287, subd. 4). The DNR also monitors groundwater levels and has an extensive observation well network in the county (Washington County, 2014).

Watershed districts also have the authority to protect groundwater and regulate its use to preserve it for beneficial purposes (Minnesota Statutes § 103D.201, subd. 2(14)). However, none of the watershed districts in Washington County currently use their authority to regulate groundwater (Washington County, 2014).

Groundwater use constraints and issues

Groundwater availability and use in the region are affected by groundwater withdrawals, recharge rates, areas of contamination, and other constraints. Below are some specific factors that affect the availability of groundwater use for drinking water supply.

Population growth and land use changes

The population of Washington County is expected to grow by 32% between 2015 and 2040 (Washington County, 2018). Even with improved water conservation and efficiency, this growth is expected to increase groundwater withdrawals to serve the changing residential, commercial, agricultural, and industrial needs of the county (Washington County, 2014). While the region’s aquifers have been able to serve current populations, increased pumping may reduce the overall quantity. In addition, new development typically increases the amount of impervious surfaces (e.g., roads, buildings) and compacts the soil, which may further reduce the infiltration of water into the aquifer (Washington County, 2014). A study conducted by the Metropolitan Council in 2016 found that approximately 13,000 acres of good recharge potential and 49,000 acres of limited recharge potential are mostly located in the eastern and southern portions of their study area, including the communities of Afton, Cottage Grove, Denmark Township, and West Lakeland Township (Metropolitan Council, 2016a).

Aquifer contamination

Groundwater contamination in the East Metropolitan Area further reduces the amount of groundwater that is available for drinking water supply, unless properly treated. As discussed in Section 3.1.3, a portion of groundwater in the East Metropolitan Area is contaminated with PFAS. In addition, groundwater in portions of the area is also contaminated with VOCs, such as trichloroethylene (TCE), from industrial sites and nitrates from the use of fertilizers for agriculture and landscaping, among other contaminants (Washington County, 2014).

Pollution containment

The 3M Woodbury Site has four groundwater barrier wells to contain PFAS-impacted groundwater onsite. These barrier wells pump approximately 4 million gallons of groundwater per day for pollution containment. The groundwater pumped from the 3M Woodbury barrier wells is piped to the 3M Cottage Grove facility, which, along with production wells for the plant and groundwater pump-out wells that contain PFAS-impacted groundwater at the 3M Cottage Grove Site, is treated with carbon prior to use at the plant. Once used for plant production or non-contact cooling water, the water is once again treated with carbon as part of the plant’s wastewater treatment system before discharge to the Mississippi River. PFAS-impacted groundwater that is pumped out at the 3M Oakdale Site for pollution containment is also treated with carbon before discharge to the sanitary sewer system.

Before the installation of the triple-liner system at the Washington County Landfill, a groundwater containment system was in place to control offsite migration of VOC-contaminated groundwater. This groundwater containment system consisted of a spray irrigation system to reduce VOC concentrations, before infiltration. After completion of the triple-liner system, the groundwater containment system was removed and VOC-/PFAS-impacted leachate was collected and transported to the Metropolitan Council Environmental Services (MCES) Metropolitan Wastewater Treatment Plant for disposal.

Aquifer restrictions

Minnesota Statutes § 103G.271, subd. 4a, restricts the DNR from issuing new water-use permits that will appropriate water from the Mt. Simon-Hinckley aquifer in a metropolitan county unless the appropriation is for drinking water, there are no feasible or practical alternatives, and a water conservation plan is developed and incorporated with the permit.

To date, 10 Mt. Simon wells have been sampled for PFAS. PFBA was detected in four of the wells, ranging in concentration from 8–12 parts per trillion. The MDH HRL for PFBA is currently 7,000 parts per trillion.

Special Well and Boring Construction Area

A Special Well and Boring Construction Area (SWBCA) is a mechanism that provides for controls on the drilling or alteration of public and private water supply wells and environmental wells in an area where groundwater contamination has resulted in, or may result in, risks to public health. Minnesota Rules 4725.3650, Subpart 1, provides that "[w]hen the commissioner designates an area where contamination is detected as a special well and boring construction area, a well or boring must not be constructed, repaired, or sealed until the commissioner has reviewed and approved a proposed plan submitted by the installer. Sealing, repair, construction, and location must comply with the approved plans." Thus, consistent with this rule, contractors and property owners must submit a written request and a well construction plan to MDH's Well Management Section; and must receive written approval before construction, repair, or sealing of a well in a SWBCA. In addition, before signing an agreement to sell or transfer property in Washington County that is not served by a municipal water system, the seller must state in writing to the buyer whether the property is located within a SWBCA (Minnesota Statutes § 103I.236).

In Washington County, all or portions of the following communities have SWBCAs in effect: Bayport, Baytown Township, Lake Elmo, Lakeland, Lakeland Shores, Newport, Oakdale, St. Paul Park, and West Lakeland Townships.

Sustainability standard

As discussed in Section 3.1.4.1, the DNR may only issue water-use permits for groundwater appropriations if groundwater use is sustainable to supply the needs of future generations and will not harm ecosystems, degrade water, or reduce water levels (Minnesota Statutes § 103G.287, subd. 5). This mandate may limit the water-use permits that can be issued in an area. Minnesota Administrative Rules 6115.0630 (Definitions) defines "safe yield" as "the amount of groundwater that can be withdrawn from an aquifer system without degrading the quality of water in the aquifer." For water-table (unconfined) aquifers, this rule further indicates that safe yield does not allow "the long term average withdrawal to exceed the available long term average recharge to the aquifer system based on representative climatic conditions." For confined aquifers, the rule indicates that there cannot be a "progressive decline in water pressures and levels to a degree which will result in a change from artesian condition to water table condition."

3.1.5 Surface water use

Surface water is another source of drinking water for some communities in the Twin Cities. St. Paul Regional Water Services (SPRWS) uses water from the Mississippi River to provide drinking water to St. Paul and the surrounding communities, including Maplewood. SPRWS also maintains a series of groundwater wells from the Prairie du Chien-Jordan aquifer as a backup supply system. The City of Minneapolis also relies on the Mississippi River as a source of water.

Below, information is presented on the management of surface water resources (Section 3.1.5.1) and potential constraints and issues with surface water use (Section 3.1.5.2).

Management of surface water resources

The DNR regulates the appropriation of water from surface water bodies, including streams, rivers, and lakes. Regarding streams and rivers (termed "watercourses"), Minnesota Statutes § 103G.285, subd. 2, states: "[i]f data are available, permits to appropriate water from natural and altered natural watercourses must be limited so that consumptive appropriations are not made from the watercourses during periods of specified low flows." Regarding lakes (termed "water basins"), Minnesota Statutes § 103G.285, subd. 3(a), states that: "[p]ermits to appropriate water from water basins must be limited so that the collective annual withdrawals do not exceed a total volume of water amounting to one-half acre-foot per acre of water basin." There would also be federal requirements associated with appropriating water from the St. Croix River and the Mississippi River. See a further discussion on restrictions for the St. Croix River National Scenic Riverway below.

Surface water use constraints and issues

Below are some specific factors that affect the availability of surface water for drinking water supply.

St. Croix River

The St. Croix River, with its headwaters in Wisconsin, flows along the east side of Washington County until it joins with the Mississippi River just southeast of Denmark Township. The St. Croix River watershed encompasses over 7,000 square miles, with approximately 46% of the watershed in Minnesota (MPCA, 2019).

The St. Croix River is federally protected as a National Scenic Riverway. The upper 200 miles of the river is managed by the National Park Service (NPS); and the lower 52 miles of the river are under cooperative management by NPS, the Minnesota DNR, and the Wisconsin DNR. This lower designation spans from Taylors Falls, Minnesota/St. Croix Falls, Wisconsin, to the confluence with the Mississippi River at Point Douglas, Minnesota/Prescott, Wisconsin. In 2001, NPS prepared a Final Cooperative Management Plan and Environmental Impact Statement for the Lower St. Croix National Scenic Riverway to guide the management of the riverway (NPS, 2001).

As presented in the Washington County Municipal Water Coalition Water Supply Feasibility Study, current regulations do not preclude the use of water from the Lower St. Croix River. Permitting such use, however, would be very dependent on the specifics of the project, including the exact location, the amount of water to be diverted from the river, and the characteristics of structures that would be built. It would require multiple permits and review and approval from a number of agencies, potentially including state and federal environmental reviews (Metropolitan Council, 2016b).

Water flow

The Mississippi and St. Croix River water flow is influenced by multiple factors in the region, including precipitation, snowmelt, upstream water use, altered hydrology, and land use change. The water flow of the Mississippi River in St. Paul has increased by 24% over the last 70 years (NPS and Friends of the Mississippi River, 2016).

Contaminants

Surface water sources may contain elevated concentrations of contaminants due to point and non-point sources of pollution. Some contaminants of concern in the Mississippi River within the Twin Cities

Metropolitan Area include nitrate, chloride, mercury, PFOS, pesticides (e.g., atrazine, acetochlor, chlorpyrifos), and pharmaceuticals (NPS and Friends of the Mississippi River, 2016).

3.2 Community water supply profiles

3.2.1 Overview

Within the East Metropolitan Area, 14 communities are currently known to be affected by PFAS contamination in their drinking water supplies. These communities include the cities of Afton, Cottage Grove, Lake Elmo, Lakeland, Lakeland Shores, Maplewood, Newport, Oakdale, St. Paul Park, and Woodbury; the townships of Denmark, Grey Cloud Island, and West Lakeland; and the Prairie Island Indian Community. All the communities are within DNR's North and East Metro Ground Water Management Area, and use the Prairie du Chien-Jordan aquifer as their primary source of drinking water (Metropolitan Council, 2016b). While many residents and businesses in the East Metropolitan Area are connected to municipal water systems, many others utilize private wells and some (specifically Maplewood) receive water from SPRWS.

The communities where residents and businesses rely solely on private wells are generally found on the eastern side of the East Metropolitan Area, and are typically rural residential townships with relatively smaller populations that are planned for either complete buildout (i.e., the majority of the land area is already developed) or minimal growth until 2040 (Figure 3.4). Many of these communities have groundwater contamination issues related to PFAS and/or other contaminants, which have been resolved by GAC treatment at individual residences. The MPCA and MDH continue to monitor throughout the PFAS-impacted areas of the East Metropolitan Area to evaluate potential risks to residences with private wells, and will take appropriate action to mitigate identified risks.

Communities with a combination of residents and businesses receiving drinking water from municipal water systems and private wells are generally larger and found on the western side of the East Metropolitan Area (Figure 3.5). These larger communities are commonly areas where high growth is anticipated for the 2040 planning period, as indicated in the Metropolitan Council's System Statements (https://metrocouncil.org/Communities/Planning/Local-Planning-Assistance/System-Statements.aspx). Many of these communities have groundwater contamination issues related to PFAS. Some have already conducted evaluations and all are implementing alternative measures for providing safe drinking water to their residents to some degree; in addition to treatment at individual residences, as administered by the MPCA and MDH when there are private wells and the State carries out the work, where necessary.

Figure 3-4. All non-municipal wells within the East Metropolitan Area. Includes private wells as well as those used for irrigation, monitoring, testing, and other applications (based on current Minnesota Well Index data).

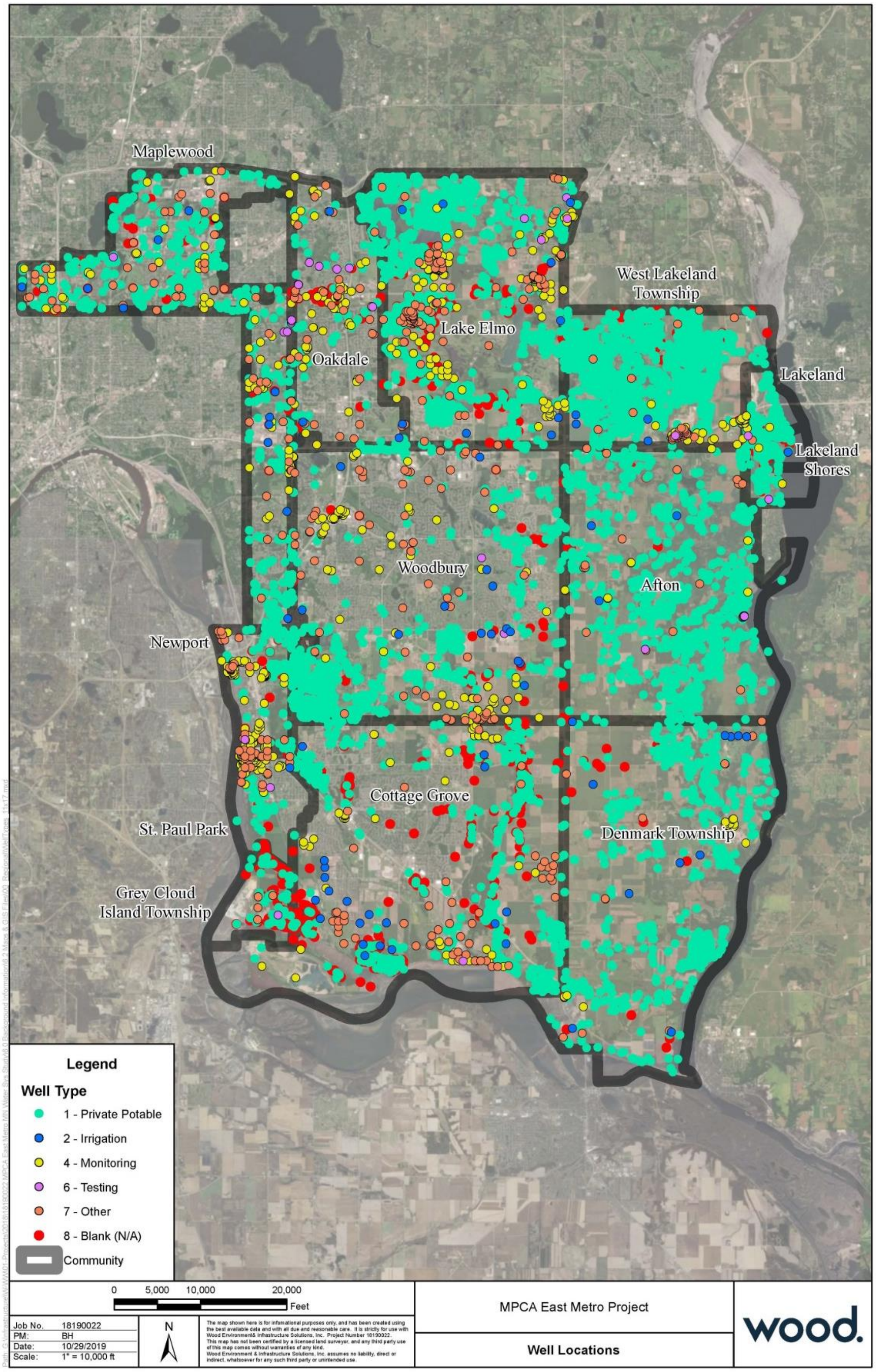
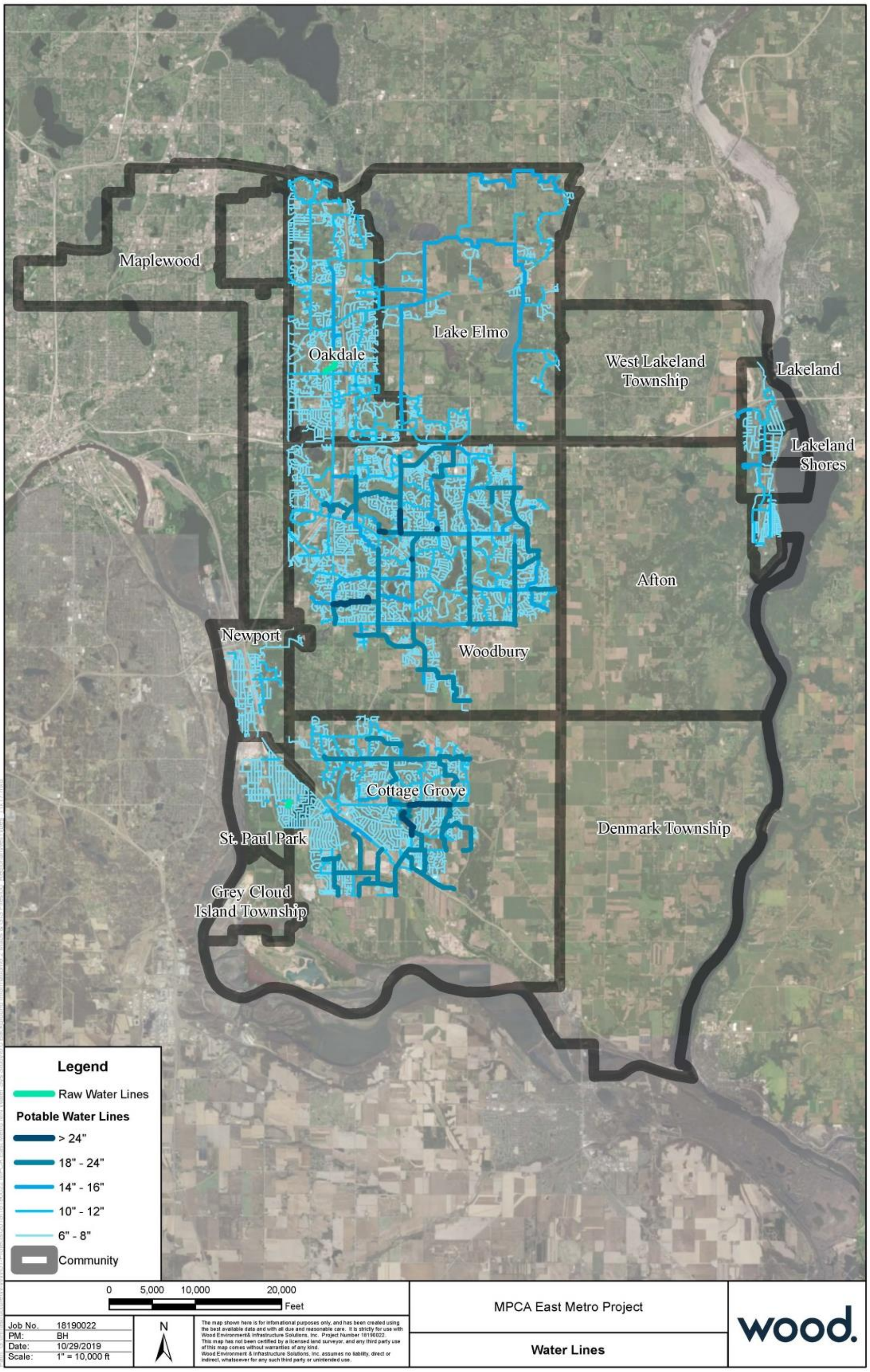


Figure 3-5. Municipal water system infrastructure (current conditions) in the East Metropolitan Area. Includes municipal water system infrastructure of Cottage Grove, Lake Elmo, Lakeland/Lakeland Shores, Newport, Oakdale, Saint Paul Park, and Woodbury. Note that Maplewood is also served by a municipal system, but is not shown. [Note: Need to gain concurrence on use of water supply system locations for report as a whole.]



3.2.2 Community water supply summaries

An overview of the existing water supplies and treatment systems for each of the 14 affected communities is provided below and summarized in Table 3.3. See Appendix A for more information on each community.

Table 3.3. Community water supply summaries.

Community	Drinking water source	PFAS impacts of HI > 1?	PFAS treatment	Other considerations
Afton	Private wells	Yes – northern portion	GAC treatment on private wells	None
Cottage Grove	Mixed – 12 municipal supply wells from the Prairie du Chien-Jordan aquifer and private wells	Yes – throughout	Mixed temporary GAC treatment and blending on some municipal supply wells, other wells offline; GAC treatment on private wells or connecting to the municipal supply	None
Denmark	Private wells	No	None	None
Grey Cloud Island	Private wells	Yes – throughout	GAC treatment on private wells and/or bottled water	None
Lake Elmo	Mixed – 3 municipal supply wells from the Prairie du Chien-Jordan, Jordan-St. Lawrence, and soon to be Jordan-only aquifers as well as private wells	Yes – southern three-quarters of the city	GAC treatment on private wells or connecting to the municipal supply	White Bear Lake restrictions and Bayport TCE plume
Lakeland	Mixed – 2 municipal supply wells from the Mt. Simon aquifer as well as private wells	Yes – northern three-quarters of the city	GAC treatment on private wells or connecting to the municipal supply	Bayport TCE plume to the north
Lakeland Shores	Mixed – supplied by Lakeland municipal water system as well as private wells	Yes – throughout	GAC treatment on private wells or connecting to the municipal supply	None
Maplewood	Mixed – SPRWS and private wells	Yes – southern end of the city	GAC treatment on private wells	None
Newport	Mixed – 2 municipal supply wells from the Jordan-St. Lawrence aquifer as well as private wells	No	Connecting to the municipal supply	None
Oakdale	Mixed – 9 municipal supply wells from the Jordan-St. Lawrence aquifer as well as private wells	Yes – southern two-thirds of the city	GAC treatment for 2 affected municipal supply wells, other wells offline; GAC treatment on private wells or connecting to the municipal supply	White Bear Lake restrictions

Community	Drinking water source	PFAS impacts of HI > 1?	PFAS treatment	Other considerations
Prairie Island Indian Community	Not applicable; currently vacant land	Yes – irrigation well	None	Tribe plans to develop this land in the near future
St. Paul Park	Mixed – 3 municipal supply wells from Jordan-St. Lawrence aquifer as well as private wells	Yes – throughout	Temporary GAC treatment for 2 affected municipal supply wells in progress; GAC treatment on private wells or connecting to the municipal supply	None
West Lakeland	Private wells	Yes – primarily southern three-quarters of the township	GAC treatment on private wells and/or bottled water	Bayport TCE plume in the northern third of the township
Woodbury	Mixed – 19 municipal supply wells from the Jordan, Jordan-St. Lawrence, Prairie du Chien-Jordan aquifers, as well as private wells	Yes – primarily near central and eastern municipal supply well fields	Blending for municipal supply wells, with the addition of a temporary treatment system in 2020; GAC treatment on private wells or connecting to the municipal supply	Valley Creek Watershed in the northeastern corner of the city

Afton

Afton, located on the eastern side of the East Metropolitan Area, is a rural city designated as a Diversified Rural community by the Metropolitan Council (2014a). Afton has no municipal water system, with residents and businesses in the community on private wells. According to available data from PFAS sampling to date, the northern border of Afton is the only area of the community with PFAS levels that exceed the HI of 1. The remaining areas of the community that have been sampled to date have detectable levels of PFAS but do not exceed the HI of 1. Treatment has been provided for individual residences that have received well advisories.

Cottage Grove

Cottage Grove, located on the southwestern side of the East Metropolitan Area, is designated as a Suburban Edge community by the Metropolitan Council (2014a). Cottage Grove has a municipal water system as well as residences on private wells. To date, 8 out of Cottage Grove's 12 municipal supply wells exceed the HI of 1. Of those, two have been taken offline, two receive temporary GAC treatment, and one is used for blending if needed. Cottage Grove's population is expected to increase – the city would likely need an additional municipal supply well to meet anticipated needs by 2040. According to available data from PFAS sampling to date, many of the non-municipal wells in Cottage Grove exceed the HI of 1. Treatment has been provided for individual residences that have received well advisories.

Denmark

Denmark, located on the southeastern side of the East Metropolitan Area, is a rural township designated as a Diversified Rural community by the Metropolitan Council (2014a). Denmark has no municipal water system, with residents and businesses in the community on private wells. According to available data from PFAS sampling to date, one non-municipal well in the community had PFAS levels that exceeded the HI of 1. However, according to MDH, this well was located on an old farm that was sampled just before being sealed; therefore, no well advisory was issued for the well. The remaining areas of the community that have been sampled to date have detectable levels of PFAS but do not exceed the HI of 1.

Grey Cloud Island

Grey Cloud Island, located on the southwestern side of the East Metropolitan Area, is a small rural township designated as a Diversified Rural community by the Metropolitan Council (2014a). Grey Cloud Island has no municipal water system, with residents and businesses in the community on private wells. According to available data from PFAS sampling to date, Grey Cloud Island has detectable levels of PFAS in the majority of its non-municipal wells and PFAS exceeding the HI of 1 in many of them. Treatment and/or bottled water has been provided for individual residences that have received well advisories.

Lake Elmo

Lake Elmo, located on the northern side of the East Metropolitan Area, is designated as an Emerging Suburban Edge and Rural Residential community by the Metropolitan Council (2014a). Lake Elmo has a municipal water system as well as residences on private wells. Currently, Lake Elmo has two municipal supply wells in use and a third being installed to meet the city's current water needs; however, these wells are unlikely to meet 2040 needs. In addition, one municipal supply well exceeded the HI of 1 and has been sealed; and another well was installed but never used due to contamination issues. One of the municipal supply wells also falls within a five-mile radius of White Bear Lake, which has legal implications for the city's appropriation permits and future growth. According to available data from PFAS sampling to date, a substantial number of non-municipal wells exceed the HI of 1. Treatment has been provided for individual residences that have received well advisories.

Lakeland and Lakeland Shores

Lakeland and Lakeland Shores, located on the eastern side of the East Metropolitan Area, are designated as Rural Residential communities by the Metropolitan Council (2014a). Lakeland has a municipal water system that serves a large fraction of the community, and also serves Lakeland Shores and Lake St. Croix Beach. Lakeland has two municipal supply wells to meet the city's current and 2040 water demands. At this time, neither municipal supply well has exceeded the HI of 1. A number of residences are on private wells and, according to available data from PFAS sampling to date, many exceed the HI of 1. Treatment has been provided for individual residences that have received well advisories and the city continues to connect residents to their municipal supply as a long-term measure.

Maplewood

Maplewood, located on the northwestern side of the East Metropolitan Area, is designated as an Urban community by the Metropolitan Council (2014a). The community is primarily supplied drinking water by the private utility provider SPRWS, which utilizes a series of surface water bodies (primarily the Mississippi River and a series of lakes) as its source water. Some residences are on private wells throughout the community, particularly in the southern portion. According to available data from PFAS sampling to date, some of these private wells exceed the HI of 1. Treatment has been provided for individual residences that have received well advisories.

Newport

Newport, located on the southwestern side of the East Metropolitan Area, is designated as an Urban community by the Metropolitan Council (2014a). The majority of the community is currently served by the city's municipal water system, with the exception of a few residences and neighborhoods on private wells. Newport has two municipal supply wells with sufficient capacity to meet the city's current and 2040 water demands. At this time, neither the municipal supply wells nor non-municipal wells have exceeded the HI of 1. The city does not currently have any established interconnects with neighboring communities to provide backup water supply if needed.

Oakdale

Oakdale, located on the northern side of the East Metropolitan Area, is designated as a Suburban community by the Metropolitan Council (2014a). The majority of the community is currently served by the city's municipal water system, with the exception of some residences and neighborhoods on private wells. Oakdale's municipal water system has nine municipal supply wells to meet the city's water demands; however, many have been taken offline due to PFAS contamination. Currently, the city relies primarily on two municipal supply wells and a centralized GAC treatment facility, with water also being supplied from two additional wells in the north with very low HI values. These four wells have sufficient capacity to meet current water demands, but may not be sufficient to meet 2040 demands. According to available data from PFAS sampling to date, a number of non-municipal wells exceed the HI of 1. Treatment has been provided for individual residences that have received well advisories. Some of Oakdale's wells are within a five-mile radius of White Bear Lake, which has legal implications for the city's appropriation permits and future growth.

Prairie Island Indian Community

The Prairie Island Indian Community is located in Goodhue County, Minnesota; however, the community owns 111 acres of undeveloped land in West Lakeland Township. The property in West Lakeland is currently undeveloped, but the Prairie Island Indian Community has submitted an initial site plan indicating a proposed 71 residential lots and approximately 12 acres for commercial development. One irrigation well within the property exceeds the HI of 1 that has been evaluated for conversion to a potable water supply well to supply the future development.

St. Paul Park

St. Paul Park, located on the southwestern side of the East Metropolitan Area, is designated as an Emerging Suburban Edge community by the Metropolitan Council (2014a). The majority of the community is currently served by the city's municipal water system, with the exception of some residences in the central and western portion of St. Paul Park on private wells. St. Paul Park's municipal water system consists of three municipal supply wells with sufficient capacity to meet the city's current and 2040 water demands. To date, two of the municipal supply wells had PFAS concentrations that exceeded the HI of 1. As a result, the city relies primarily on one well with minimal water being supplied from the other two. A temporary treatment system is being installed in 2020 as an interim measure pending the final Conceptual Plan. According to available data from PFAS sampling to date, a substantial number of the non-municipal wells also exceed the HI of 1. Treatment has been provided for individual residences that have received well advisories or residents have been connected to city water.

West Lakeland

West Lakeland, located on the northeastern side of the East Metropolitan Area, is a rural township designated as a Rural Residential community by the Metropolitan Council (2014a). West Lakeland has no municipal water system, with residents and businesses in the community on private wells. West Lakeland has been faced with contamination issues from PFAS and TCE. The northern portion of the community has TCE groundwater contamination from the Baytown Township National Priorities List

Site. In addition, recent sampling efforts have indicated that groundwater in the southern portion of the community is contaminated with PFAS. Many homes already have GAC treatment systems in place because of actions taken following the earlier TCE contamination issue, and many additional GAC systems have been installed in response to PFAS well advisories. Residences in the southern portion without GAC treatment systems already installed are being provided bottled water until these individual systems can be installed.

Woodbury

Woodbury, located on the western side of the East Metropolitan Area, is designated as a Suburban Edge community by the Metropolitan Council (2014a). The majority of the community is currently served by the city's municipal water system, with the exception of some residences on private wells, primarily located in the southern-third of the city. Woodbury has 19 municipal supply wells to meet its current water demands and it is anticipated that 5 additional wells will be required to meet the City's projected 2040 water demands. To date, eight municipal supply wells have been identified as consistently exceeding the HI of 1. Some of the impacted wells are currently used for blending. A temporary treatment system is being installed in 2020 as an interim measure pending the final Conceptual Plan. According to available data from PFAS sampling to date, a few non-municipal wells in Woodbury also exceed the HI of 1. Treatment has been provided for individual residences that have received well advisories.

4. Water supply improvement option identification and evaluation

The second step of the Conceptual Plan development process involved the identification and evaluation of water supply improvement options. These water supply improvement options are general project types that could improve drinking water supply quality and quantity in the East Metropolitan Area, without specifying details such as PFAS treatment technology (if applicable), location, source water, scale, or capacity. These options represent the initial list of project types that would be considered further in the development of this Conceptual Plan. As a next step, conceptual projects that were consistent with these water supply improvement options were identified and evaluated (Chapter 5).

This chapter provides an overview of the approach to identify and evaluate water supply improvement options (Section 4.1) and a summary of the evaluation of each option (Section 4.2).

4.1 Approach to identify and evaluate water supply improvement options

The approach to identify and evaluate water supply improvement options is presented below.

4.1.1 Identification of water supply improvement options

Water supply improvement options were identified that could improve drinking water supply quality and quantity in the East Metropolitan Area, including both centralized and decentralized water supply systems. The list of options included all alternatives considered in the Washington County Municipal Water Coalition Water Supply Feasibility Assessment (Metropolitan Council, 2016b), as well as additional options added by the Co-Trustees. The Government and 3M Working Group, the Citizen-Business Group, and Subgroup 1 reviewed the initial list and provided refinements and suggested additional options to be added (as reflected in the list below). Public input was also requested on the initial list.

The final list of water supply improvement options considered in this Conceptual Plan is as follows (generally going from decentralized to centralized systems):

1. Provide point-of-use treatment (POUT) or point-of-entry treatment (POET) of drinking water
2. Create new small community water system(s) (with treatment)
3. Move private well hookups to existing municipal water system(s) (where available)
4. Provide drinking water treatment of existing municipal water system(s)
5. Drill new wells in optimized locations
6. Create new regional water supply system(s) (with treatment)
7. Connect subsets of communities to SPRWS

8. Create one or more new surface water treatment plants (SWTPs) for use of Mississippi and/or St. Croix River waters
9. Non-potable and potable reuse of treated 3M containment water
10. Minimize water well usage by reducing current potable demand, through:
    - Beneficial use of other non-treated or less-treated water (e.g., grey water, storm water)
    - Water conservation.

See Section 4.2 (below) for a description of each option.

These options represent the initial list of project types that would be considered in the development of this Conceptual Plan. These options were then evaluated against a set of screening criteria to determine their relevance to the affected communities (described below), and then used to inform the identification of conceptual projects for each community (Chapter 5).

4.1.2 Water supply improvement options screening criteria

Water supply improvement options were evaluated against a set of screening criteria to determine their relevance to the individual communities in the East Metropolitan Area. This step was conducted to determine if there are any options that are not viable for one or more communities. If a given option was determined to not be viable, it would not be considered further for that specific community in the Conceptual Plan.

For this step in the process, a standard set of screening criteria was used to evaluate the options. These criteria were considered minimum requirements for any option to be considered further. This step of the process was focused on the technical aspects of the option, and did not consider specific preferences of the LGUs, work groups, or the Co-Trustees. However, further analyses of these options would be conducted later during the development and evaluation of scenarios.

Specific screening criteria used in the evaluation of water supply improvement options are as follows:

1. Be technically and administratively feasible
2. Address drinking water supply and/or groundwater protection/restoration issues due to PFAS contamination in the East Metropolitan Area consistent with Priority 1 of the Settlement
3. Comply with applicable/relevant federal, state, tribal, and local laws, regulations, and rules (in some limited instances, projects that conflict with local regulations and rules can be considered if a reasonably achievable plan is provided to address these conflicts)
4. Not jeopardize public health or safety
5. Not negatively impact results of remediation under the 2007 Consent Order or other remedies addressing other sources of contamination.

These criteria were developed previously by the Co-Trustees with input from the Government and 3M Working Group, and Citizen-Business Group to support the screening of projects considered under Priority 1 of the Settlement.

Water supply improvement options had to meet all the screening criteria to be considered further. None of the options were eliminated at this stage, but some options were determined to have limited technical and/or administrative feasibility (the first criterion above) for some communities. An overview of the evaluation is provided in Section 4.2, below.

4.2 Evaluation of water supply improvement options

This section provides an overview of each water supply improvement option and a summary of the evaluation of each option against the screening criteria, with a particular focus on differences in technical and administrative feasibility (Criterion 1). At this stage, each option is evaluated in isolation, without any assumptions about whether or how different options would be combined. Table 4.1 summarizes the evaluation of the water supply improvement options.

4.2.1 Provide POUT or POETS of drinking water

Description of the option

This option would involve installing and maintaining treatment systems, such as GAC filters, on private wells. While POUT (i.e., faucet-only) systems were identified as a treatment option, they do not provide treatment for an entire household. Untreated water used for irrigation or other purposes would reintroduce PFAS to the environment. Therefore, only POETS, or whole-home systems, were considered for this evaluation. This option would apply to residences on private wells.

Screening criteria evaluation

Criterion 1 – Technical and administrative feasibility

This option would be feasible for residences on private wells, which are present in all communities of the East Metropolitan Area, except the Prairie Island Indian Community, where the property with the irrigation well is currently vacant. This option would require a system for maintaining treatment systems, including a process for monitoring the condition of treatment systems to determine when maintenance should be performed, and, when needed, changing out filter media. These maintenance activities will carry a long-term cost, but do not limit the feasibility of this option.

Criterion 2 – Address drinking water supply issues

This option would contribute to enhancing drinking water supply in the East Metropolitan Area, consistent with Priority 1 of the Settlement. However, it would not address all drinking water supply needs, such as for those residents and businesses served by municipal water systems. Therefore, this option would have to be implemented in conjunction with one or more other options.

Criterion 3 – Comply with applicable laws, regulations, and rules

No compliance issues have been identified with this option.

Criterion 4 – Not jeopardize public health or safety

There are no known impacts on public health or safety with this option.

Criterion 5 – Not negatively impact results of remediation

There are no known impacts on the results of remediation with this option.

4.2.2 Create new small community water system(s) (with treatment)

Description of the option

This option would involve creating one or more new small community water systems to serve neighborhood-sized clusters of residences that are currently on individual private wells. Such neighborhoods exist throughout the East Metropolitan Area.

Screening criteria evaluation

Criterion 1 – Technical and administrative feasibility

This option is most applicable in communities with clusters of residences that use private wells. This option would not apply to Lakeland and St. Paul Park since they do not have clusters of residences on private wells. In addition, this option has low feasibility in Afton due to an ordinance against using private wells for more than one residence. Neighborhoods in Cottage Grove, Lake Elmo, Newport, Oakdale, and Woodbury are not likely to create small community water systems, given the feasibility of connecting to an existing municipal water system in those communities. The same is true for Maplewood, where it would be most feasible to connect residences on private wells to SPRWS.

National drinking water standards dictate that water supplies serving 15 or more homes (or other connections), or 25 people or more for at least 60 days a year be designated as a public water system. This means they must comply with federal standards, such as providing additional water treatment, redundancy in infrastructure, and employing a trained treatment plant operator. Operation of these systems would require new organizational and governance infrastructure (e.g., staff, oversight boards, financing mechanisms). Regulatory compliance and the necessary organizational and governance infrastructure could limit the feasibility of this option, as small communities may not have the resources to run a public water system.

Criterion 2 – Address drinking water supply

This option would contribute to enhancing drinking water supply in the East Metropolitan Area, consistent with Priority 1 of the Settlement. However, it would not address all drinking water supply needs, such as for residents and businesses served by municipal water systems. Therefore, this option would have to be implemented in conjunction with one or more other options.

Criterion 3 – Comply with applicable laws, regulations, and rules

As noted above, a small community water system serving 15 or more connections or 25 or more people is classified as a public water system and must comply with requirements under the Safe Drinking Water Act and other requirements.

Criterion 4 – Not jeopardize public health or safety

There are no known impacts on public health or safety with this option.

Criterion 5 – Not negatively impact results of remediation

There are no known impacts on results of remediation with this option.

4.2.3 Move private wells to existing municipal water system(s) (where available)

Description of the option

This option would involve connecting residences on private wells, including non-community public supply wells (e.g., at parks, schools, recreation centers), to existing municipal water systems. It is assumed that private well users would be connected to a nearby municipal water system where feasible, including Cottage Grove, Lake Elmo, Lakeland, Lakeland Shores, Maplewood, Newport, Oakdale, St. Paul Park, and Woodbury.

Screening criteria evaluation

Criterion 1 – Technical and administrative feasibility

It is more feasible to connect residences on private wells in more densely populated areas where a municipal water system already exists. This includes most areas of the East Metropolitan Area, with the exception of Denmark and most of Afton. Areas of Cottage Grove, Lake Elmo, and Oakdale, for instance, are not as densely populated, but are in closer proximity to existing water mains. For those residences located far from existing water mains and more spread out, substantial new pipe would be required to enable the connection, which would increase the costs and administrative burden of this option.

This option would not apply to the Prairie Island Indian Community as the property with the non-municipal well is currently vacant.

Criterion 2 – Address drinking water supply issues

This option would contribute to enhancing drinking water supply in the East Metropolitan Area, consistent with Priority 1 of the Settlement. However, it would not address all drinking water supply needs, such as for residents and businesses served by municipal water systems. Therefore, this option would have to be implemented in conjunction with one or more other options.

Criterion 3 – Comply with applicable laws, regulations, and rules

No compliance issues have been identified with this option.

Criterion 4 – Not jeopardize public health or safety

There are no known impacts on public health or safety with this option.

Criterion 5 – Not negatively impact results of remediation

There are no known impacts on the results of remediation with this option.

4.2.4 Provide drinking water treatment of existing municipal water system(s)

Description of the option

This option would provide drinking water treatment of existing municipal water systems that are impacted by PFAS contamination. Treatment would be accomplished using established technologies, such as GAC systems. Treatment would be provided to manage existing or potential future PFAS contamination.

Screening criteria evaluation

Criterion 1 – Technical and administrative feasibility

This option would be feasible for communities with existing municipal water systems, including Cottage Grove, Lake Elmo, Lakeland/Lakeland Shores, Newport, Oakdale, St. Paul Park, and Woodbury.

This option would not apply to communities that do not have existing municipal water systems, including Afton, Denmark Township, Grey Cloud Island Township, Prairie Island Indian Community, and West Lakeland Township. In addition, this option would not apply to Maplewood since it is primarily supplied by SPRWS.

Criterion 2 – Address drinking water supply issues

This option would contribute to enhancing drinking water supply in the East Metropolitan Area, consistent with Priority 1 of the Settlement. However, it would not address all drinking water supply needs, such as for residents and businesses on private wells. Therefore, this option would have to be implemented in conjunction with one or more other options.

Criterion 3 – Comply with applicable laws, regulations, and rules
No compliance issues have been identified with this option.

Criterion 4 – Not jeopardize public health or safety
There are no known impacts on public health or safety with this option.

Criterion 5 – Not negatively impact results of remediation
There are no known impacts on results of remediation with this option.

4.2.5 Drill new wells in optimized locations

Description of the option
This option would involve drilling new wells to replace or supplement existing wells. Wells would have to be drilled in optimized locations to avoid aquifers with current PFAS contamination and, to the extent possible given the best available science, avoid using aquifers that might become contaminated in the future. This option could include drilling new wells in areas outside the community that will be served by the well(s), and developing the pipelines and associated infrastructure to move the water to the target community.

Screening criteria evaluation

Criterion 1 – Technical and administrative feasibility
This option is most feasible for communities with existing municipal water systems, specifically Cottage Grove, Lake Elmo, Lakeland/Lakeland Shores, Newport, Oakdale, St. Paul Park, and Woodbury. For these communities, a new municipal supply well could provide safe and reliable water but would require identifying optimized locations to avoid current contamination and minimize the chance that the well would be affected by contamination in the future. Since all available aquifers in the East Metropolitan Area are known to be affected by varying PFAS compounds to some degree (depending on geographic location), identifying optimized locations for new municipal supply wells may require siting wells outside the communities to be served by the wells. This would require additional infrastructure to move the water to the target communities, adding to the cost.

The feasibility of this option for Lake Elmo, Lakeland, and Oakdale may be lower than for other communities with municipal water systems. Based on PFAS sampling to date, the aquifer that Lakeland's municipal supply wells currently draw from (Mt. Simon) has relatively low levels of PFAS (11 to 12 parts per trillion), compared to occurrences of up to 300 parts per trillion in the Metropolitan Area, regardless of known PFAS source areas nearby. However, there are restrictions on drilling new wells in this aquifer (see Section 3.1.4.2). The upper aquifers at Lakeland are contaminated by TCE and/or PFAS. Lake Elmo and Oakdale currently face restrictions on drilling and groundwater use in northern areas due to their proximity to White Bear Lake and outstanding drawdown issues. Aquifers in the southern areas of both cities are impacted by PFAS.

The feasibility of this option is low for residences that use private wells, which is the sole drinking water source for residents and businesses of Afton, Denmark, Grey Cloud Island, and West Lakeland. It may be possible to drill a new well for a residence with an existing private well, either at a location or depth to avoid aquifers with PFAS contamination. However, the deepest and least-impacted aquifer (Mt. Simon) has new well drilling restrictions (see Section 3.1.4.2). Available shallower aquifers in the East

Metropolitan Area are known to have PFAS impacts in at least some portion of the aquifer, which make it challenging to identify an optimized location within a private well user's current property boundaries.

Drilling a well outside a private well user's property boundary would require additional infrastructure to bring the water to their property (pipelines and possibly additional pumping capacity). In many cases, an optimized location may be a substantial distance from the target property, which would require a substantial amount of new infrastructure that would cross other properties and agreements between property owners. If this is the case for many residences that currently use private wells, the total cost could be very high and the evaluation of such circumstances would be very time-consuming.

Overall, an evaluation of optimized well locations for residences on private wells would need to be done on a case-by-case basis, and is therefore not feasible within the scope of the Conceptual Plan.

This option would not apply to Maplewood since it is primarily supplied by SPRWS.

Criterion 2 – Address drinking water supply issues

This option would contribute to enhancing drinking water supply in the East Metropolitan Area, consistent with Priority 1 of the Settlement. However, it would not address all drinking water supply needs, such as for those residents and businesses on private wells. Therefore, this option would have to be implemented in conjunction with one or more other options.

Criterion 3 – Comply with applicable laws, regulations, and rules

State regulations and rules about the region's aquifers must be considered for this option. The Mt. Simon aquifer is the deepest aquifer in the area (see the discussion under Criterion 1 above and Section 3.1.4.2). However, Minnesota Statutes § 103G.271, subd. 4a, restricts the DNR from issuing new water-use permits that will appropriate water from this aquifer in a metropolitan county (see Section 3.1.4.2). These restrictions are in place to prevent contaminants from being introduced into the Mt. Simon aquifer. The cross-contamination can occur when shallow PFAS-impacted groundwater enters the deeper aquifer during well drilling, pumping at high rates, or during regular well use. The natural buffer created by bedrock layers above the Mt. Simon aquifer is called aquitards (see Section 3.1.1). Once the aquitards are pierced, contaminated water can travel to the deeper, less-impacted groundwater.

Other sensitive, groundwater use areas should be considered, including drinking water supply management areas and SWBCAs. Impacts from groundwater pumping to White Bear Lake north of Oakdale and Lake Elmo, Valley Creek in Afton and eastern Woodbury, and near the St. Croix River also need to be considered when evaluating this option.

Criterion 4 – Not jeopardize public health or safety

To avoid potential public health or safety impacts, new wells would have to be drilled in optimized locations (see above) and may need ongoing monitoring to ensure early detection if PFAS contamination were to affect these new wells in the future.

Criterion 5 – Not negatively impact results of remediation

As with Criterion 4, the key factor in preventing impacts on remediation is to site new wells in optimized locations, which would prevent new groundwater pumping from causing unanticipated movement of PFAS contaminants to new aquifers or new areas of aquifers. This will be evaluated in detail using the groundwater model.

4.2.6 Create new regional water supply system(s) (with treatment)

Description of the option

This option would involve creating a new regional water supply system to be shared by at least two communities. This option could use a surface water and/or groundwater source, and would likely be applied for multiple communities across the East Metropolitan Area. Possible communities that could become regional suppliers, given their current infrastructure and/or administrative capacity, include Cottage Grove, Lakeland, Maplewood, Newport, Oakdale, Prairie Island Indian Community, St. Paul Park, and Woodbury.

Screening criteria evaluation

Criterion 1 – Technical and administrative feasibility

Developing a new regional public water system would require new infrastructure to interconnect the communities involved with the source(s) of water and there are no technical issues that would prevent this. However, local conditions such as topography, existing roads, and other factors would have to be considered in planning new infrastructure.

Administratively, a new regional public water system would require a new governance structure (e.g., a board or a commission with representation for each community); and integrated management systems for engineering, operations, financing, and other functions. In general, these are feasible for many communities but would require substantial work to develop and implement. Being part of a new regional water system may not be feasible for smaller, less-dense communities, given the cost of necessary infrastructure and the administrative burden of running such a system.

Criterion 2 – Address drinking water supply issues

This option would contribute to enhancing drinking water supply in the East Metropolitan Area, consistent with Priority 1 of the Settlement. However, it would not address all drinking water supply needs if not all residents and businesses in the East Metropolitan Area are able to connect. Therefore, this option might need to be implemented in conjunction with one or more other options.

Criterion 3 – Comply with applicable laws, regulations, and rules

This option is expected to comply with all applicable laws, regulations, and rules, though various permits and compliance processes would likely be required.

Criterion 4 – Not jeopardize public health or safety

In terms of a regional groundwater supply system, there are no known impacts on public health or safety. However, for those communities already on groundwater supply systems, switching to a surface water source generally has an impact on taste for users, as well as impacts on pipes and other infrastructure due to a change in water chemistry. Communities at a greater distance from the treatment plant(s) could experience water quality issues under this option due to the time it takes for the treated water to reach customers. These potential water quality issues can be addressed by changing treatment technologies or processes, but that would impact the cost of this option.

Criterion 5 – Not negatively impact results of remediation

There are no known impacts on the results of remediation with this option.

4.2.7 Connect subsets of communities to SPRWS

Description of the option

This option would involve connecting communities to SPRWS, either directly or via secondary connection through an adjoining community. A direct connection to SPRWS could be done for Newport and Oakdale due to their proximity to existing SPRWS infrastructure. A secondary connection through an adjoining community would be more likely for Cottage Grove, Grey Cloud Island Township, Lake Elmo, St. Paul Park, and Woodbury. This option could be applied to serve all residents and businesses within the East Metropolitan Area, but doing so would require additional distribution infrastructure.

Screening criteria evaluation

Criterion 1 – Technical and administrative feasibility

Currently SPRWS, which draws water from the Mississippi River in Fridley, has 25 million gallons per day (mgd) in additional capacity. The water demand for the whole East Metropolitan Area is approximately 50 mgd. However, SPRWS is willing to complete significant capacity and infrastructure improvements, which would allow this option to be applied across the whole East Metropolitan Area. SPRWS uses groundwater for backup supply and it is possible they would need to expand their backup groundwater system if they took on additional demand from the East Metropolitan Area.

This option would involve more work and costs to connect the communities of Afton, Denmark, Grey Cloud Island, Prairie Island Indian Community, and West Lakeland since they do not currently have municipal water systems or associated distribution infrastructure. Communities connecting to SPRWS with existing distribution infrastructure have their own set of technical challenges due to the need for infrastructure upgrades, including additional length and capacity (diameter) of water main and anti-corrosion measures, which affect the cost of this option.

Criterion 2 – Address drinking water supply issues

This option would contribute to enhancing drinking water supply in the East Metropolitan Area, consistent with Priority 1 of the Settlement. However, as noted above, SPRWS has about 25 mgd of spare capacity, while the entire East Metropolitan Area requires about 50 mgd for projected 2040 growth. If SPRWS is able to complete capacity and infrastructure improvements, this option could be applied across the whole East Metropolitan Area.

Criterion 3 – Comply with applicable laws, regulations, and rules

No compliance issues have been identified with this option.

Criterion 4 – Not jeopardize public health or safety

Switching to surface water for communities with existing groundwater-sourced systems would likely alter groundwater movement after pumping is stopped, and this could affect movement of PFAS contaminants. It is unlikely that this would pose new risks and ongoing monitoring would track whether new areas of aquifers have become impacted by PFAS.

Switching to a surface water source generally has an impact on taste for users, but this is unlikely to have health or safety impacts. The switch could also impact pipes and other infrastructure due to a change in water chemistry. Communities at a greater distance from SPRWS (the treatment plant is located in Maplewood), such as Denmark or Grey Cloud Island, could experience water quality issues under this option due to the time it takes for the treated water to reach customers. These potential water quality issues can be addressed by changing treatment technologies or processes, but that would impact the cost of this option.

Criterion 5 – Not negatively impact results of remediation

As stated above, switching to surface water from groundwater could alter groundwater movement after pumping is stopped at existing municipal supply wells, and this could affect movement of PFAS contaminants. There is the possibility this could also affect results of remediation, but ongoing monitoring would track whether new areas of aquifers have become impacted by PFAS.

4.2.8 Create a new SWTP for use of Mississippi or St. Croix waters

Description of the option

This option would involve the construction of one or more SWTPs drawing water from the Mississippi River and/or the St. Croix River. It would also require the construction of new intakes on the Mississippi River and/or St. Croix River, pipelines to deliver the water to the SWTPs, and additional infrastructure to deliver the water to existing or newly constructed distribution systems.

Screening criteria evaluation

Criterion 1 – Technical and administrative feasibility

Supplying water from a centralized SWTP would require a public water system (or multiple connected systems) to operate, maintain, and administer the associated infrastructure (i.e., a distribution system). As a result, this option would be most feasible for communities that already have a public water system. Other communities could form or join a public water system, but administrative and infrastructure costs (e.g., connecting residences that are currently on private wells) would likely be cost-prohibitive for communities with lower population density. This would also be true for residents or businesses in Maplewood that are not part of the public water system and are using private wells.

SWTPs require large investments to build and they carry substantial O&M costs. To achieve cost savings, it would be most efficient to develop no more than two SWTPs for the East Metropolitan Area. This could include building one large SWTP to serve most or all of the 14 affected communities, or two smaller SWTPs, one on the Mississippi River and one on the St. Croix River. Siting one large SWTP for the whole East Metropolitan Area may be challenging given the large footprint necessary. There are infrastructure and capacity limitations, as discussed above in terms of lack of existing infrastructure.

Criterion 2 – Address drinking water supply issues

This option would contribute to enhancing drinking water supply in the East Metropolitan Area, consistent with Priority 1 of the Settlement. However, cost and other issues would make this option less feasible for communities that currently do not have a public water system. Therefore, this option may need to be combined with one or more other options.

Criterion 3 – Comply with applicable laws, regulations, and rules

This option would require permits under Minnesota Statutes, the Federal Clean Water Act and Safe Drinking Water Act, and possibly other statutes. These are standard regulatory processes for using surface water, and constructing and operating SWTPs, and this option would need to comply with all these requirements.

Criterion 4 – Not jeopardize public health or safety

Switching to surface water for communities with existing groundwater-sourced systems would likely alter groundwater movement after pumping is stopped, and this could affect movement of PFAS contaminants. It is unlikely that this would pose new risks and ongoing monitoring would track whether new areas of aquifers have become impacted by PFAS.

Switching to a surface water source generally has an impact on taste for users, but this is unlikely to have health or safety impacts. A larger concern is the potential impact on existing infrastructure, mainly water lines, due to a change in water chemistry. This would need to be addressed through chemical addition and further evaluation would be necessary during the design phase before implementation, particularly in areas where the distribution water lines are older and there is the potential for lead service lines or piping to be present. Communities at a greater distance from the SWTP could experience water quality issues under this option due to the time it takes for the treated water to reach customers. These potential water quality issues can be addressed by changing treatment technologies or processes, but that would impact the cost of this option.

Criterion 5 – Not negatively impact results of remediation

As stated above, switching to surface water from groundwater could alter groundwater movement after pumping is stopped at existing wells, and this could affect movement of PFAS contaminants. There is the possibility this could affect results of remediation, but additional monitoring wells would be necessary to track whether new areas of aquifers have become impacted by PFAS.

4.2.9 Non-potable and potable reuse of treated 3M containment water

Description of the option

This option involves the reuse of treated containment water at the former 3M disposal site. Currently, groundwater treatment at the former 3M disposal site results in millions of gallons of water being pumped from the affected aquifers daily. The treated water could be reused for non-potable or potable purposes, though there are some significant challenges (see below).

Screening criteria evaluation

Criterion 1 – Technical and administrative feasibility

Reuse of treated 3M containment water could be feasible for communities near the treatment sites (Cottage Grove, Lake Elmo, Oakdale, and Woodbury) if they have a demand for reuse water (i.e., industrial applications for water treated to non-potable standards). Much of this water is currently being reused by 3M in its industrial processes. Non-potable reuse of treated 3M containment water would be less feasible for communities that do not contain or lie adjacent to an active 3M groundwater containment system.

Several drawbacks significantly limit the feasibility of non-potable reuse of 3M containment water:

- There are no non-potable or surface water/wastewater discharge standards for PFAS, and protective precedents have been set to treat non-potable water to non-detect levels – in essence, this requires treating to potable water standards even for uses such as irrigation (considered a discharge), again contributing to treatment costs.
- Non-potable reuse would require a brand-new infrastructure system for distributing the water (often referred to as a "grey water" system). This system would have to be completely separate from drinking water and wastewater infrastructure and may require a variance from Minnesota

plumbing code, increasing costs, especially for reuse sites at a greater distance from pumping sites.

Potable reuse of *normal* wastewater is challenging due to the level of treatment required, as discussed above; the associated cost relative to other sources of water; the potential for health impacts; and, in many cases, a lack of public trust in the quality of treated wastewater for use as drinking water. For these reasons, this option is considered to have low feasibility and was not considered further in the Conceptual Plan.

Criterion 2 – Address drinking water supply issues

Non-potable reuse of 3M containment water for industrial uses, if any can be identified, would meet only a very small portion of the water needs of the region. Therefore, this option would need to be implemented in conjunction with one or more other options.

Criterion 3 – Comply with applicable laws, regulations, and rules

The State regulates wastewater treatment and reuse; therefore, the implementation of this option would have to comply with those requirements.

Criterion 4 – Not jeopardize public health or safety

There are no known impacts on public health or safety associated with non-potable reuse of treated containment water if used for industrial purposes. Non-potable reuse for irrigation and potable reuse was considered to have low feasibility and not considered further in the Conceptual Plan.

Criterion 5 – Not negatively impact results of remediation

There are no known impacts on results of remediation with non-potable reuse of treated containment water if used for industrial purposes. Non-potable reuse for irrigation and potable reuse was considered to have low feasibility and not considered further in the Conceptual Plan.

4.2.10 Minimize water well usage by reducing current potable demand

Description of the option

A wide range of conservation practices can reduce indoor, outdoor, and industrial water use, including upgrading plumbing fixtures and appliances, detecting and fixing distribution system leaks, installing closed-loop reuse systems for some industrial applications, and using “grey water” for landscape irrigation. Such practices are widely implemented throughout Minnesota and the United States. These practices could help reduce overall water use today, the future need for more water supply, and, as a result, groundwater pumping. All East Metropolitan Area municipal water systems are currently working to reduce water consumption to 75 gallons per capita per day, the conservation goal set by the DNR (2018). However, many communities are not yet close to that goal and may not be able to achieve that goal even in the long-term without incentives such as buy-back programs or city-/region-wide mandates.

While this option meets all the screening criteria below, it addresses water demand rather than water supply. Thus, conceptual projects were not developed for this option as part of this Conceptual Plan (see Chapter 5).

Screening criteria evaluation

Criterion 1 – Technical and administrative feasibility

There are no known technical or administrative issues that limit the feasibility of water conservation measures in the East Metropolitan Area.

Criterion 2 – Address drinking water supply issues

Even with reduced demand for water due to new conservation measures, residents and businesses in the East Metropolitan Area will need a reliable water supply of roughly 50 mgd by 2040. Therefore, while this option could reduce the total amount of water needed, it would need to be applied in conjunction with one or more options to address all drinking water supply needs in the East Metropolitan Area, consistent with Priority 1 of the Settlement.

Criterion 3 – Comply with applicable laws, regulations, and rules

No compliance issues have been identified with this option.

Criterion 4 – Not jeopardize public health or safety

There are no known impacts on public health or safety with this option.

Criterion 5 – Not negatively impact results of remediation

There are no known impacts on results of remediation with this option.

4.2.11 Use of treated water from multi-benefit wells

Potable or non-potable use of treated 3M containment water was considered as one of the general water supply improvement options as discussed above. Ongoing legal cases and recent court decisions about groundwater use and nearby White Bear Lake have again raised the possible benefits of using treated groundwater from multi-benefit wells for water supply. It is possible that future court and/or regulatory decisions could restrict new groundwater wells that affect water levels in White Bear Lake. Simultaneously, future remedial actions may include the installation of pump-and-treat wells in contaminated areas. As a result, the Co-Trustees may again consider options for using treated remediation water as a source of water supply for one or more communities. Table 4.1 summarizes the technical and administrative feasibility of each option for each community; based on information from the communities and other sources to determine which options could feasibly work, but it does not reflect community preferences.

Table 4.1. Technical and administrative feasibility of each option.

	SPRWS[a]	Private well communities				Public water system and private well communities								
Water supply improvement option	Maplewood	Afton	Denmark	Grey Cloud Island	Prairie Island Indian Community	West Lakeland	Cottage Grove	Lake Elmo	Lakeland	Lakeland Shores[b]	Newport	Oakdale	St. Paul Park	Woodbury
1. Provide POUT or POETS of drinking water.	●	●	●	●	○	●	●	●	●	●	●	●	●	●

2. Create new small community water system(s) (with treatment).	○	○	◖	◖	◖	◖	○	○	○	○	○	○	○	○
3. Move private well hookups to existing municipal water system(s) (where available).	●	◖	◖	●	✕	●	●	●	●	●	●	●	●	●
4. Provide drinking water treatment of existing municipal water system(s).	✕	✕	✕	✕	✕	✕	●	●	●	●	●	●	●	●
5. Drill new wells in optimized locations.	✕	◖	◖	◖	◖	◖	◖	◖	○	●	●	◖	●	●
6. Create new regional water supply system(s) (with treatment).	✕	◖	◖	◖	●	◖	●	●	●	●	●	●	●	●
7. Connect subsets of communities to SPRWS.	●	◖	◖	◖	◖	◖	●	●	●	●	●	●	●	●
8. Create a new SWTP for use of Mississippi River or St. Croix River waters.	✕	◖	◖	◖	○	◖	●	○	●	●	●	○	●	○
9. Non-potable and potable reuse of treated 3M containment water.	○	○	○	○	○	○	○	○	○	○	○	○	○	○
10. Minimize water well usage by reducing current potable demand.	●	●	●	●	●	●	●	●	●	●	●	●	●	●

LEGEND	● Generally feasible	◖ Possibly feasible, but there are challenges to address	○ Low feasibility	✕ Not applicable

a. Maplewood is connected to SPRWS, with some residences on private wells.
b. Lakeland Shores is connected to Lakeland's municipal water system.

5. Conceptual project identification

The third step of the Conceptual Plan development process involved the identification of potential conceptual projects for each community. These conceptual projects are consistent with the water supply improvement options described in Chapter 4, but provide more detail, such as information on project location(s), project components(s), and PFAS treatment technologies (if applicable). The list of conceptual projects represents the range of potential solutions for improving drinking water supply for the affected communities in the East Metropolitan Area; however, additional projects may be identified and evaluated at a later date as new information comes to light. As a next step, these potential projects were bundled into scenarios and evaluated using the drinking water distribution and groundwater models (as will be discussed in Chapter 6).

This chapter provides an overview of the approach to identify conceptual projects (Section 5.1) and a summary of the conceptual projects identified for further evaluation (Section 5.2).

5.1 Approach for identifying conceptual projects

The approach to identify conceptual projects is presented below.

5.1.1 Preliminary identification of projects

Building from the water supply improvement option evaluation (Chapter 4), an initial list of potential conceptual projects was identified for each of the 14 communities currently known to be affected by PFAS contamination in the East Metropolitan Area. This initial list was developed by the Co-Trustees based on discussions with the LGUs and supplemented with additional project ideas, such as inter-community options.

5.1.2 Work group and Subgroup 1 input

Members of the Government and 3M Working Group, the Citizen-Business Group, and Subgroup 1 provided input on the list of potential conceptual projects. First, this initial list was shared with Subgroup 1 technical members for review and feedback. Then, a revised list of conceptual projects was shared with the two work groups and Subgroup 1 for additional review and feedback. All work group and subgroup members could also submit ideas via the online project portal (discussed below in Section 5.1.3).

5.1.3 Public input

A request for project ideas from the public was conducted through an online project portal posted on the Minnesota 3M PFC Settlement website (https://3msettlement.state.mn.us/). The submission window was open from August 6 to September 4, 2019. The project idea request was circulated through GovDelivery, the 3M Settlement listserve, press releases to local newspapers, work group members, and the LGUs.

A total of 24 project ideas were received during the submission window. This included 14 project ideas from the LGUs (via the work group or subgroup members) and 10 project ideas from individuals.

5.1.4 Final list refinement

Based on feedback from the work groups and Subgroup 1, the conceptual project list was refined to exclude redundant or duplicate projects, and incorporate new project submittals that were received. The final list consisted of 103 unique conceptual projects.

5.2 Conceptual project list

Appendix D presents the final list of potential conceptual projects identified for each of the 14 communities. This list includes projects that were identified by the Government and 3M Working Group, the Citizen-Business Group, Subgroup 1, members of the public, and the Co-Trustees. Table 5.1 provides a summary of the types of conceptual projects identified for each community, organized by water supply improvement option. The range of potential conceptual projects varies by community due to differences in community characteristics (e.g., those with municipal water systems vs. those without), location of water supply sources, and other factors (e.g., proximity of residences to each other).

These projects were then bundled into scenarios and evaluated using the drinking water distribution and groundwater models. The scenarios were then further evaluated using a set of evaluation criteria. Based on this evaluation, the Co-Trustees provided recommended options on the sets of conceptual projects that provide safe, sustainable drinking water to the East Metropolitan Area. Chapter 6 provides the results of the modeling and evaluation of the scenarios.

Table 5.1. Summary of conceptual project types identified for each community, organized by water supply improvement option. A checkmark indicates the potential conceptual project was identified for that specific community. These conceptual projects were then bundled into scenarios and evaluated using the drinking water distribution and groundwater models.

	SPRWS[a]	Private well communities					Public water system and private well communities							
Water supply improvement option	**Maplewood**	**Afton**	**Denmark**	**Grey Cloud Island**	**Prairie Island Indian Community**	**West Lakeland**	**Cottage Grove**	**Lake Elmo**	**Lakeland**	**Lakeland Shores[b]**	**Newport**	**Oakdale**	**St. Paul Park**	**Woodbury**
1. Provide POUT or POETS of drinking water.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2. Create new small community water system(s) (with treatment).		✓	✓	✓		✓	✓	✓			✓	✓		✓
3. Move private well hookups to existing municipal water system(s) (where available).	✓						✓	✓	✓	✓	✓	✓	✓	✓
4. Provide drinking water treatment of existing municipal water system(s).							✓	✓	✓	✓	✓	✓	✓	✓
5. Drill new wells in optimized locations.					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6. Create new regional water supply system(s) (with treatment).	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7. Connect subsets of communities to SPRWS.				✓			✓	✓			✓	✓	✓	✓
8. Create a new SWTP for use of Mississippi River or St. Croix River waters.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
9. Non-potable and potable reuse of treated 3M containment water.														
10. Minimize water well usage by reducing current potable demand.								✓[c]						

a. Maplewood is connected to SPRWS, with some residences on private wells.
b. Lakeland Shores is connected to Lakeland's municipal water system.
c. As noted in Section 4.2.10, this water supply improvement option does not directly address water supply and, thus, no conceptual projects were developed for this option by the Co-Trustees. However, one project was submitted online for Lake Elmo, which is indicated in the table.

6. Scenario development and evaluation

6.1 Scenario development and evaluation

The fourth step of developing the Conceptual Plan involved formulating and evaluating scenarios. These scenarios consist of sets of conceptual projects that, when combined, address PFAS-related drinking water quality and quantity issues for the 14 communities currently known to be affected by PFAS contamination in the East Metropolitan Area. Once developed, these scenarios were assessed using the drinking water distribution and groundwater models. The scenarios were then further evaluated using a set of pre-determined evaluation criteria. As the next step, the Co-Trustees provided a recommendation on the scenarios that provide safe, sustainable drinking water to the East Metropolitan Area (presented in Chapter 7).

This chapter provides an overview of the approach to develop and evaluate the scenarios (Section 6.1), an overview of the scenarios (Section 6.2), the results of the modeling and costing (Section 6.3), and a summary of the scenario evaluations (Section 6.4).

6.1.1 Approach to develop and evaluate the scenarios

The approach to develop and evaluate the scenarios is presented below, including scenario development (Section 6.1.1), scenario modeling and costing (Section 6.1.2), and scenario evaluation (Section 6.1.3).

6.1.2 Scenario development

Using the conceptual projects identified in Chapter 5, four groups of scenarios were developed and evaluated in this Conceptual Plan, including:

1. Community-specific scenario – This scenario consists of conceptual projects submitted by the LGUs and tribal entities for the affected communities in the East Metropolitan Area.
2. Regional scenarios – These scenarios consist of a shared public water system for the whole East Metropolitan Area and include both groundwater and surface water options.
3. Treatment scenarios – These scenarios consist of implementing treatment at existing drinking water wells, both public and private; as well as irrigation and commercial wells in the East Metropolitan Area.
4. Integrated scenario – This scenario consists of a combination of conceptual projects from the community-specific, regional, and treatment scenarios.

Within each scenario group, one or more scenarios were considered with variations in conceptual projects and/or assumptions. In addition, after the initial evaluation of scenarios was performed, a review period allowed for the submission of public feedback for consideration or revision. Public and community meetings were held to supplement written feedback. Various communities also submitted revised water use projections and/or provided additional information.

The feedback and additional information from the communities was taken into consideration by the Co-Trustees, which resulted in revised community-specific and treatment scenarios, and a second round of scenario evaluations. During this step, many of the previous scenarios were not carried forward for further refinement and analysis.

Additional information and detailed discussion of the results can be found in Appendix E. In Appendix E, Section E.1 contains the information and results for the initial evaluations, Sections E.2 and E.3 contain the information and results for the revised community-specific and treatment scenarios, and Section E.4 contains the recommended scenarios. Note that Section E.1 was not updated to address comments received, and Sections E.2 and E.3 are a result of the feedback and comments that were received. Appendix F also contains information and assumptions made for the scenario evaluations. An overview of the scenarios is described in Section 6.2.

6.1.3 Scenario modeling and costing

Each of the scenarios was assessed using the drinking water distribution and groundwater models (for an overview of these models, see Chapter 2). The drinking water distribution model allows for an analysis of each scenario to determine the potential infrastructure installations and improvements necessary to meet future capacity requirements. The groundwater model assesses potential groundwater supply well locations using a drawdown analysis and future hydrogeologic impacts of increased or decreased groundwater use, including movement of known PFAS contamination based on particle tracking.

Cost estimates for each scenario were also developed to include capital and O&M costs. For the purposes of this Conceptual Plan, the cost estimates are considered screening level. The Association for the Advancement of Cost Engineering (AACE) International's cost estimate classification for a screening-level estimate is Class 5 (AACE, 2019). This Class 5 designation can be attributed to the complexity of the plan and its execution, as well as the time and level of effort available to prepare the estimates, among other risk factors. The cost assumptions are outlined in Appendices E and F. Note that the costs in Appendix E, Section E.1, are for information purposes only in order to show the initial set of results that were presented; new cost assumptions were developed for Sections E.2 through E.3, and therefore cannot be compared to the costs in Section E.1.

As the process moved forward with the second round of scenario evaluations, cost estimates were developed for the revised community and treatment scenarios, as described in Appendix E, Section E.2. A primary set of cost estimates was developed that included all costs relative to the improvement projects, which were considered "all-inclusive costs." These costs included all improvements necessary for each alternative, including new water lines, treatment facilities, POETS, water storage tanks, etc., as seen in the previous evaluation. However, not all of these costs will be covered by Settlement funds (e.g., those related to growth that would have occurred regardless of the PFAS contamination). The following guidelines were used to determine which project aspects would be eligible for Settlement funding. It is important to note that while the guidelines below were used for general Settlement funding determination, case-by-case considerations were also taken into account and will continue to be considered.

- Additional treatment beyond the treatment threshold selected
- Line upsizing due to growth
- Installation of wells needed for growth alone (as opposed to replacing a well that fell out of service due to PFAS contamination)

- Treatment required for chemicals other than PFAS (with the exception of pretreatment required for PFAS treatment technologies)
- Storage tanks needed for growth only
- Infrastructure recapitalization costs
- Certain neighborhood/home connections and water main extensions to those neighborhoods
- O&M for anything other than treatment plants and POETSs (e.g., O&M for water storage tanks, distribution or raw water lines, booster pump stations).

Costs that were considered not covered were removed from the all-inclusive costs and the remaining costs to be paid from the Settlement were referred to as "PFAS-eligible costs." These PFAS-eligible costs also exclude any neighborhoods or individual homes that had been originally proposed to be connected to the distribution system in the initial scenario evaluation, but were later determined to either not be connected or require additional sampling or evaluation before making a determination whether to connect them.

A third set of cost estimates termed "particle tracking costs" was developed that further reduced the PFAS-eligible costs by removing costs associated with the groundwater model particle tracking results. The particle tracking costs include those costs associated with treating wells or providing a municipal supply connection that is located within the projected areas of future particle movement, which originate in areas currently impacted by PFAS above an HI of 1.0.

As discussed in previous sections and chapters of the Conceptual Plan, particle tracking was used to anticipate potential areas of PFAS contamination over the next 20 years. Since a fate-and-transport analysis has not been performed at this time, it is unknown what the concentration of PFAS contamination could be in the projected areas. As a conservative assumption, costs were included to provide POETSs or connection to a municipal supply for all wells that fell within these projected areas. However, these areas may never encounter PFAS contamination to a level requiring treatment. These costs were therefore moved to a future contingency fund to address wells that may need future treatment due to PFAS contamination movement, changing health values, or cost overruns for eligible expenses. This fund was termed "future contingency fund for HBV/HRL and plume movement."

The modeling and costing results provide information to support the evaluation of the scenarios against the evaluation criteria (described below). The specific cost implications as they relate to each community are further discussed in Appendix E, Section E.2.

6.1.4 Scenario evaluation criteria and evaluation approach

The scenarios were evaluated using a set of criteria (Table 6.1) that support the evaluation of projects considered under Priority 1 of the Settlement. The criteria and the approach for applying them were developed by the Co-Trustees with input from the Government and 3M Working Group, and the Citizen-Business Group. The criteria shown in Table 6.1 were used to evaluate scenarios; however, several criteria were not applicable at the scenario level (see Table 6.1 for the rationale).

Each scenario had to meet the first criterion (see Focus Criterion #1) to be considered further in the evaluation. Scenarios that met the first criterion were then evaluated with the remaining criteria. For each applicable criterion, a qualitative rating of either "+," "O," or "-" was applied using the evaluation matrix as a guide (Table 6.1). These qualitative ratings describe how each scenario performs against the criteria relative to the other scenarios.

The evaluation of the scenarios was completed by the Co-Trustees and supported by technical experts from MPCA, DNR, and MDH; and outside consultants Abt and Wood. In addition, the Co-Trustees considered input from the Government and 3M Working Group, the Citizen-Business Group, and the general public.

The application of the qualitative ratings (+/O/-) for each criterion relied on quantitative outputs from the models, the estimated costs, expert judgement by technical experts, and input from the work groups and the public. In each case, to qualify for a higher rating (i.e., a "+" or "O"), the Co-Trustees required that there be clear information to demonstrate the scenario definitively meets the definition for the rating shown in Table 6.1. The example below illustrates the approach used to determine each rating, and Table 6.2 shows information sources that were used for each criterion.

Many of the scenarios consist of multiple projects across all of the communities. In some cases, a scenario might warrant different ratings across its separate projects or different ratings across the communities. To the extent feasible, the summary rating for each criterion (shown in Table 6.5 at the end of this chapter) was set by the lowest level of performance for a project or community within the scenario. In other words, if a scenario has one project that is rated as "-" against a criterion, its overall rating for that criterion is set to "-" for that given scenario. This allows the Co-Trustees, the work groups, and the public to easily see which scenarios have key weaknesses.

A summary of the scenario evaluation is provided in Section 6.4, and the rationale for each rating is provided in Appendix G.

Example 1: Rating Scenario 2A against Criterion 7a

Scenario 2A would involve one large regional water treatment plant on the Mississippi River to serve all 14 communities (details provided in Section 7.2.2 and in Appendix E). Groundwater wells would be maintained for emergency backup supply.

Criterion 7a requires that scenarios "Address future water needs" with the following definitions for the three ratings:

+ = High likelihood of being able to address future water needs
O = Some likelihood of being able to address future water needs
– = Low likelihood of being able to address future water needs.

The treatment plant and associated infrastructure under Scenario 2A would be sized to meet the projected 2040 maximum daily demand of 52 mgd. Water availability in the Mississippi River at the diversion point is sufficient and reliable to meet this demand. Further, groundwater wells would be maintained as a backup supply during emergencies (e.g., temporary disruption of treatment plant operation due to infrastructure outage).

As a result, the Co-Trustees concluded that Scenario 2A has a high likelihood of being able to address future water needs and gave it a rating of "+" for Criterion 7a.

Table 6.1. Evaluation criteria and evaluation framework; the table shows all of the criteria, including several that are not applicable to the drinking water scenarios

Criteria	Rating	Priority
Focus criteria		
1. For drinking water supply projects, projects that directly address water supplies where HBVs, HRLs, and/or HRIs for PFAS are exceeded will be evaluated more favorably	Scenario will address all water supplies where HBVs, HRLs, and/or HRIs for PFAS are exceeded	Required
2. For groundwater protection/restoration projects, projects that are expected to directly or indirectly address water supplies where HBVs, HRLs, and/or HRIs for PFAS are exceeded will be evaluated more favorably	Not applicable (N/A) – no groundwater protection/restoration projects are anticipated to be considered in the Conceptual Plan	N/A
Implementation criteria		
3. Has a high probability of success (i.e., project outcomes are likely to be achieved)	+ High probability of success (e.g., using reliable/proven technologies/approaches) O Medium probability of success (e.g., using relatively new technologies/approaches that have been successfully used in other places) – Low probability of success (e.g., using unproven technologies/approaches or case studies that show low effectiveness in long-term implementation)	High
4. Has the potential to adapt to new technologies (if applicable)	N/A at the scenario level – it is anticipated that all options will generally be able to adapt to changing technologies as needed	N/A
5. Provides long-term benefits (e.g., sustainability of water supply, longevity of infrastructure; assuming all necessary O&M activities are conducted)	+ High likelihood of being able to be sustained over the next 40 years or longer O Some likelihood of being able to be sustained over the next 40 years – Low likelihood of being able to be sustained over the next 40 years	High
6. Provides multiple benefits (e.g., benefits to the aquifer, benefits to multiple communities)	+ Provides substantial ancillary benefits O Provides some ancillary benefits – Provides negligible ancillary benefits	Low
7a. Addresses future water needs (e.g., population growth)	+ High likelihood of being able to address future water needs O Some likelihood of being able to address future water needs – Low likelihood of being able to address future water needs	Medium
7b. Addresses future unknown/uncertain conditions (e.g., new contaminants, movement of contaminants, changing HBVs, climate change impacts)	+ High likelihood of being able to address future unknown/uncertain conditions O Some likelihood of being able to address future unknown/uncertain conditions – Low likelihood of being able to address future unknown/uncertain conditions	High

Criteria	Rating	Priority
8. Has low risk of adverse impacts from remedial actions (e.g., those conducted under the Consent Order or other known remedies)	+ Low likelihood of being undone or harmed by actions under the Consent Order or other known remedies O Some likelihood of being undone or harmed by actions under the Consent Order or other known remedies – High likelihood of being undone or harmed by actions under the Consent Order or other known remedies	Medium
9. Has low risk of unintended adverse health impacts (e.g., change in water corrosiveness, generation of disinfection byproducts)	+ Low likelihood of unintended adverse health impacts O Some likelihood of unintended adverse health impacts – High likelihood of unintended adverse health impacts	Medium
10. Minimizes adverse environmental impacts (e.g., movement of contaminants, additional contamination, physical harm to the environment, generation of waste)	+ Negligible or minimal anticipated adverse environmental impacts O Moderate anticipated adverse environmental impacts – Substantial anticipated adverse environmental impacts	Medium
11. Minimizes adverse social impacts (e.g., construction impacts such as noise and poor air quality, disproportionate impact to disadvantaged communities)	+ Negligible or minimal anticipated adverse social impacts O Moderate anticipated adverse social impacts – Substantial anticipated adverse social impacts	Medium
12. Benefits can be measured for success	N/A at the scenario level – implemented projects will have monitoring plans as needed	N/A
Cost criteria		
13. Is cost-effective (metrics may include $ per household, $ per gallon treated; cost to include capital and O&M)	+ High ratio of expected benefits compared to expected costs O Medium ratio of expected benefits compared to expected costs – Low ratio of expected benefits compared to expected costs	Medium
14. Has low, long-term O&M costs	+ Low, long-term O&M costs O Moderate, long-term O&M costs – High, long-term O&M costs	Medium
15. Has appropriate cost-sharing (if applicable)	N/A at the scenario level – this information will not be incorporated into the Conceptual Plan	N/A
Other criteria		
16. Would not otherwise occur	N/A the scenario level – this information will not be incorporated into the Conceptual Plan	N/A
17. Leverages funds or builds upon existing efforts	N/A at the scenario level – this information will not be incorporated into the Conceptual Plan	N/A

Criteria	Rating	Priority
18. Is consistent with regional planning (e.g., Metropolitan Council planning, Washington County planning, regional aquifer planning)	+ Consistent with relevant regional planning O Neither conflicts nor is consistent with relevant regional planning – Known or anticipated to conflict with relevant regional planning	Medium
19. Is consistent with local planning (e.g., city comprehensive plans)	+ Consistent with relevant local planning O Neither conflicts nor is consistent with relevant local planning – Known or anticipated to conflict with relevant local planning	Medium
20. Is generally acceptable to the public (as reflected by public feedback on the preliminary results summary and input by the work groups)	+ Generally acceptable to the public O Generally neutral public approval – Generally not acceptable to the public	High

Table 6.2. Sources of information used to evaluate scenarios against the applicable criteria

Criteria	Sources of information used for evaluating scenarios
Focus criteria	
1. For drinking water supply projects, projects that directly address water supplies where HBVs, HRLs, and/or HRIs for PFAS are exceeded will be evaluated more favorably	Scenario will address all water supplies where HBVs, HRLs, and/or HRIs for PFAS are exceeded
Implementation criteria	
2. Has a high probability of success (i.e., project outcomes are achieved)	Expert input from engineers at Wood about the nature of technology and construction used for each project
3. Provides long-term benefits (e.g., sustainability of water supply, longevity of infrastructure; assuming all necessary O&M activities are conducted)	Results from groundwater modeling to determine the sustainability of aquifers Expert input from engineers at Wood about the expected lifespan of proposed projects Data on surface water availability for scenarios involving surface water
4. Provides multiple benefits (e.g., benefits to the aquifer, benefits to multiple communities)	Project descriptions, input from engineers at Wood, and groundwater modeling results
7a. Addresses future water needs (e.g., population growth)	The amount of water provided in each scenario compared to projected demands for 2040
7b. Addresses future unknown/uncertain conditions (e.g., new contaminants, movement of contaminants, changing HBVs, climate change impacts)	Input from engineers at Wood about treatment effectiveness Project descriptions and characteristics, including the number of homes that receive newly treated water
8. Has low risk of adverse impacts from remedial actions (e.g., those conducted under the Consent Order or other known remedies)	Input from engineers and scientists from MPCA and Wood about the proximity of proposed projects to existing remediation projects

Criteria	Sources of information used for evaluating scenarios
9. Has low risk of unintended adverse health impacts (e.g., change in water corrosiveness, generation of disinfection byproducts)	Expert input from engineers from MDH about potential water quality issues and the potential for health risks associated with water quality
10. Minimizes adverse environmental impacts (e.g., movement of contaminants, additional contamination, physical harm to the environment, generation of waste)	Data on the locations and layout of proposed projects (e.g., water mains, storage tanks) were compared to data on locations of landscapes that are highly valuable for the purposes of biodiversity and wildlife habitat
11. Minimizes adverse social impacts (e.g., construction impacts such as noise and poor air quality, disproportionate impact to disadvantaged communities)	Data on the locations and layout of proposed projects (e.g., water mains, storage tanks) were compared to (1) datasets on private property boundaries to estimate how many homes might be affected by construction, and (2) datasets on demographics to determine whether vulnerable populations would be disproportionately impacted by construction activities
Cost criteria	
12. Is cost-effective (metrics may include $ per household, $ per gallon treated; cost to include capital and O&M)	Twenty-year cost estimates, including both capital and O&M, as presented in Appendix E
13. Has low long-term O&M costs	O&M cost estimates, as presented in Appendix E
Other criteria	
14. Is consistent with regional planning (e.g., Metropolitan Council planning, Washington County planning, regional aquifer planning)	Regional plans available from the Metropolitan Council and Washington County
15. Is consistent with local planning (e.g., city comprehensive plans)	Community water supply plans
16. Is generally acceptable to the public (as reflected by public feedback on the preliminary results summary and input by the work groups)	Input from working groups and from the public during public comment processes

6.1.5 Overview of the previous scenarios

This section provides an overview of the scenarios, including the Community-Specific Scenario (Section 6.2.1), the Regional Scenarios (Section 6.2.2), the Treatment Scenarios (Section 6.2.3), and the Integrated Scenario (Section 6.2.4), which were initially evaluated. Results for these previous scenarios are discussed in detail in Appendix E, Section E.1. These results are provided for information purposes only and were not used after multiple feedback were received. Note that costs for each of the previous scenarios cannot be compared directly due to factors that were not included in the analysis, such as costs of water softeners, administrative startup costs for new utilities, and consistency in the neighborhoods proposed for connection. A new analysis was conducted on the revised scenarios, which are described in Section 6.3 and in Appendix E (Sections E.2 through E.4).

Community-specific scenario

Community-Specific Scenario 1 would provide safe drinking water on a community-by-community basis across the East Metropolitan Area. The scenario consists of conceptual projects submitted by communities through the conceptual project submittal process or communicated in discussions with Wood. These conceptual projects are consistent with each community's existing long-term water supply plan, current efforts, and/or preferred approach. Under this scenario, each community would remain autonomous. Residents and businesses would be served by their local public water system where feasible, and those that could not be connected would continue to be served by their groundwater wells with treatment as necessary. This scenario would minimize the establishment of new regional water systems and work within the existing political boundaries and structure of the East Metropolitan Area. Each community was independently analyzed using the groundwater model to assess the location and yield of any required additional groundwater supply well(s), as well as any potential hydrogeological impacts. All community-specific scenarios would be supplemented by individual GAC systems for private wells that either have an HI > 0.5 (including domestic, commercial, irrigation, and non-community public supply wells) or are identified within areas predicted to be impacted based on groundwater model particle tracking.

When selecting among multiple alternatives for a community, generally the most cost-effective alternative was selected as part of this scenario. However, in some cases the alternative selected for the overall scenario was not the most cost-effective alternative and was selected for other reasons, as outlined in Appendix E, Section E.1.

Regional scenarios

These scenarios would provide drinking water to the whole East Metropolitan Area via a shared public water system supplied by either surface water or groundwater. Potential surface water sources evaluated were the Mississippi River, the St. Croix River, and extending St. Paul Regional Water Services' distribution system. All of the regional surface water options require treatment to make the water potable, but the treatment required is not specific to PFAS. The option to serve all 14 communities via one large SWTP on the St. Croix River was not considered due to the extended implementation timeframe that would likely be needed as a result of the required environmental regulations and permitting, and stakeholders involved.

The following regional scenarios were evaluated:

- Regional Scenario 2A – This scenario consists of one large SWTP on the Mississippi River that would provide water to the affected communities in the East Metropolitan Area, including rural areas and townships. The SWTP would have the capacity to meet the total 2040 maximum daily demand of 52 mgd for the East Metropolitan Area. Sizing the SWTP for the 2040 maximum daily demand ensures that existing groundwater wells can be retained for emergency use only. Maplewood residents would not be served by the new SWTP, but instead be served by extending nearby St. Paul Regional Water Services' distribution lines.
- Regional Scenario 2B.1 – This scenario consists of one SWTP on the Mississippi River and one SWTP on the St. Croix River. The Mississippi SWTP would serve the western communities that have existing public water systems (i.e., Cottage Grove, Newport, Oakdale, St. Paul Park, and Woodbury), as well as Grey Cloud Island. The St. Croix SWTP would serve Afton, Lake Elmo, Lakeland, Lakeland Shores Prairie Island Indian Community, and West Lakeland. The two SWTPs would have a combined capacity capable of meeting the 2040 maximum daily demand for the East Metropolitan Area. Sizing the SWTPs for maximum daily demands ensures that existing groundwater wells can be retained for emergency use only. Maplewood residents would not be served by the new SWTPs, but instead be served by extending St. Paul Regional Water Services' distribution lines.

- Regional Scenario 2B.2 – This scenario consists of one SWTP on the Mississippi River and one SWTP on the St. Croix River, as in Scenario 2B.1. However, under this scenario the community of Woodbury would be served by the St. Croix River SWTP rather than the Mississippi SWTP.
- Regional Scenario 2C – This scenario consists of extending St. Paul Regional Water Services throughout the East Metropolitan Area.
- Regional Scenario 2D – This scenario consists of one groundwater well field in an optimized location, likely with treatment (as needed), with distribution throughout the East Metropolitan Area.
- Regional Scenario 2E – This scenario consists of multiple groundwater well fields in optimized locations, with or without treatment (as needed), with distribution throughout the East Metropolitan Area.

For Regional Scenarios 2D and 2E, the locations of groundwater well fields were optimized to avoid known PFAS impacts and the locations of individual wells were optimized based on well interference, as determined by a drawdown analysis.

Under each scenario, new transmission lines would convey flow from the proposed water treatment plant(s) to existing and proposed water storage facilities within each community, to then be distributed via the existing water distribution system. All regional scenarios would be supplemented by individual GAC systems for private wells that either have an HI > 1.0 (including domestic, commercial, irrigation, and non-community public supply wells) or are identified within areas predicted to be impacted based on groundwater model particle tracking.

The regional scenarios were not further refined in the revised scenarios based on the feedback received during the first public comment period, which indicated that these options were not supported.

Treatment scenarios

These scenarios would provide treatment for existing drinking water wells, both public and private, at individual well sites. Two treatment technologies were evaluated under these scenarios – GAC and ion-exchange (IX) for the public drinking water wells. GAC was only evaluated for private wells. An assessment of these and other PFAS treatment technologies is provided in Appendix F.

Relative costs associated with the levels of contamination described below (Scenarios 3A–3D) are provided as a desktop exercise, but do not reflect efficiencies that may be realized upon additional analysis (e.g., via centralized treatment facilities as opposed to treating each well individually). Those efficiencies are explored in the community-specific and integrated scenarios.

The determination of providing treatment to wells impacted above HRLs is based on the MDH HI calculation. The HI is calculated as the sum of five PFAS concentrations (in parts per billion) divided by their respective (most conservative) HBV or HRL, as shown in the equation below. Note that concentrations are expressed in parts per trillion elsewhere in the Conceptual Plan.

$$HI\ (PFAS) = \left(\left(\frac{[PFOA]}{0.035}\right) + \left(\frac{[PFOS]}{0.015}\right) + \left(\frac{[PFBA]}{7}\right) + \left(\frac{[PFBS]}{2}\right) + \left(\frac{[PFHxS]}{0.047}\right)\right)$$

The calculated HI does not include all PFAS, but rather only those that have HRLs or HBVs, as defined by the MDH (i.e., PFOS, PFOA, PFHxS, PFBA, and PFBS).

The following treatment scenarios were evaluated:

- Treatment Scenario 3A – This scenario would provide treatment at each well (both public and private drinking water wells) with PFAS detections of HI (PFAS) > 1.
- Treatment Scenario 3B – This scenario would provide treatment at each well (both public and private drinking water wells) with PFAS detections of HI (PFAS) > 0.5.
- Treatment Scenario 3C – This scenario would provide treatment at each well (both public and private drinking water wells) with any detection of PFOS, PFOA, and/or PFHxS. PFBA has been detected in groundwater and other media across not only the Twin Cities Metropolitan Area but worldwide. Requiring treatment of drinking water based on a PFBA and/or PFBS detection alone (i.e., no other PFAS are detected), which is potentially the case in Treatment Scenario 3D, has cost implications as well as implications for communities outside the East Metropolitan Area. Furthermore, PFBA and PFBS do not tend to build up in human bodies as easily as PFOS, PFOA, and PFHxS, which makes them a lower threat to human health.
- Treatment Scenario 3D – This scenario would provide treatment at each well (both public and private drinking water wells) with PFAS detections of HI (PFAS) > 0.

Integrated scenario

Integrated Scenario 4 consists of a combination of conceptual projects included in the community-specific, regional, and treatment scenarios that were bundled to address PFAS-related drinking water quality and quantity issues for the 14 affected communities in the East Metropolitan Area. Ideas for the integrated scenarios were based on projects submitted during the previous step of the process that did not fit under the other categories. These ideas included interconnections between communities and new groundwater well fields, with centralized treatment that serve multiple communities.

The integrated scenarios were not further refined in the revised scenarios based on the feedback received during the first public comment period. However, some of the projects from this scenario were carried forward to the revised community-specific scenarios based on factors such as cost-effectiveness and community support.

6.1.6 Overview of the revised scenarios

This section provides an overview of the revised scenarios, which were developed following the feedback received on the previous scenarios. These consist of revisions to the community-specific scenarios (Section 6.3.1) and the treatment scenarios (Section 6.3.2), which were evaluated to develop the final recommendation provided in Chapter 7. Results for these revised scenarios are discussed in detail in Appendix E, Sections E.2–E.4.

The primary changes that were incorporated based on the first public comment period as well as additional information provided by some communities include:

- Revised water supply projections from Lake Elmo, Oakdale, and Woodbury
- Refined the groundwater model
- Revised treatment technology O&M costs
- Adjusted land acquisition cost assumptions to include setbacks and green space requirements
- Revised municipal well HI values to better reflect MDH methodologies
- Incorporated Baytown TCE data – POETS installed and sampling data
- Revised private well counts in Afton and West Lakeland
- Evaluated neighborhood hookups for each community, as applicable (Appendix E).

Revised community-specific scenario

After the initial stages of evaluation, feedback and additional information submitted by the communities required modifications to some of the community alternatives while the selected alternatives for the remaining communities remained the same. Cost assumptions were also adjusted based on feedback received.

The community-specific scenario was modified to create the revised community-specific Scenarios A, B, C, and D, as described below.

- Scenario A – community alternatives selected from the previous scenarios
- Scenario B – same as Scenario A except Oakdale is supplied by SPRWS
- Scenario C – same as Scenario A except Oakdale and Lake Elmo are supplied by SPRWS
- Scenario D – same as Scenario A except West Lakeland Township is supplied by Prairie Island Indian Community.

For each community-specific scenario, results were provided for scenarios that factored in treatment thresholds of HIs > 0 and HIs > 1. This provided a range of costs associated with the number of wells that would require treatment when compared to HIs > 0 and HIs > 1.

From the above analysis, incremental costs were determined for scenarios for every HI threshold between 0 and 1 in increments of 0.1. These results, presented at the end of Appendix E, Section E.2, helped to inform the recommended scenarios.

Revised treatment scenario

Similar to the community scenario, feedback received after the initial round of evaluations led to a set of revised community and treatment scenarios. The revised treatment scenarios, evaluated under the same criteria described in Section 6.2.3, are described in Appendix E, Section E.3.

6.1.7 Scenario results summary

Appendix E contains the results for both previous and revised sets of scenarios, and contains detailed information regarding the modeling and costing results for each scenario. While the following tables summarize the cost estimates for each scenario, more detailed costs and supporting information and assumptions can be found in Appendices E and F. The first table (Table 6.3) below provides the resulting costs from the first round of scenario evaluations, while the second table (Table 6.4) provides the resulting costs from the second round of evaluations for the revised community and treatment scenarios.

Table 6.3. Modeling and cost results for each scenario

							Total 20-year costs					
							Undiscounted				Including 3% inflation	
Scenarios	Communities affected[a]	Components	Water provided	Capital cost (000s)[b]	% of $700 million Settlement funds	Annual O&M cost (000s)[b]	Total 20-year cost (000s)[b]	% of $700 million Settlement funds	O&M cost per thousand gallons	Capital and O&M cost per thousand gallons	Total 20-year costs (000s)[b]	% of Settlement funds
Community-Specific Scenario 1 (IX)	All except for Denmark and Newport	Municipal (44 wells) and non-municipal (969 wells) water addressed with GWTPs via community-proposed projects.	55 mgd	$405,820	58%	$11,874	$643,300	92%	$0.59	$1.60	$724,879	104%
Community-Specific Scenario 1 (GAC)	All except for Denmark and Newport	Municipal (44 wells) and non-municipal (969 wells) water addressed with GWTPs via community-proposed projects.	55 mgd	$430,329	61%	$18,823	$806,789	115%	$0.94	$2.01	$936,110	134%
Regional Scenario 2A – One SWTP	All except for Denmark	1 SWTP on Mississippi River, plus treatment at 2,070 non-municipal wells	52 mgd	$391,306	56%	$18,001	$751,326	107%	$0.95	$1.98	$875,000	125%
Regional Scenario 2B.1 – Two SWTPs	All except for Denmark	1 SWTP on Mississippi River and 1 SWTP on St. Croix River, plus treatment at 2,070 non-municipal wells	52 mgd total (43 mgd Mississippi SWTP, 8 mgd St. Croix SWTP)	$415,021	59%	$19,668	$808,381	115%	$1.04	$2.13	$943,508	135%
Regional Scenario 2B.2 – Two SWTPs	All except for Denmark	1 SWTP on Mississippi River and 1 SWTP on St. Croix River, plus treatment at 2,070 non-municipal wells	52 mgd total (24 mgd Mississippi SWTP, 28 mgd St. Croix SWTP)	$422,837	60%	$20,264	$828,117	118%	$1.07	$2.18	$967,338	138%
Regional Scenario 2C – SPRWS	All except for Denmark	Transmission of SPRWS to communities, plus treatment at 2,070 non-municipal wells	20–52 mgd (range between average and maximum daily demands)	$347,425	50%	$31,081 (based on average day demand of 20 mgd)	$969,045	138%	$1.64	$2.55	$1,182,583	169%
Regional Scenario 2D – One groundwater treatment plant (GWTP)	Not a feasible solution due to lack of water supply for a single 52-mgd well field in Denmark											
Regional Scenario 2E – Two GWTPs (GAC)	All except for Denmark	3 well fields, 2 GWTPs for region-wide groundwater supply, plus treatment at 738 non-municipal wells	52 mgd	$293,417	42%	$15,002	$593,457	85%	$0.79	$1.56	$696,526	100%
Regional Scenario 2E – Two GWTPs (IX)	All except for Denmark	3 well fields, 2 GWTPs for region-wide groundwater supply, plus treatment at 738 non-municipal wells	52 mgd	$280,832	40%	$9,986	$480,552	69%	$0.53	$1.27	$549,160	78%

							Total 20-year costs					
							Undiscounted				Including 3% inflation	
Scenarios	Communities affected[a]	Components	Water provided	Capital cost (000s)[b]	% of $700 million Settlement funds	Annual O&M cost (000s)[b]	Total 20-year cost (000s)[b]	% of $700 million Settlement funds	O&M cost per thousand gallons	Capital and O&M cost per thousand gallons	Total 20-year costs (000s)[b]	% of Settlement funds
Treatment 2040 Scenario 3A.2 – HI > 1.0 (IX)	All except Maplewood and Newport	GWTPs at 28 municipal and 1,623 non-municipal wells	36 mgd	$93,205	13%	$5,824	$209,685	30%	$0.44	$0.80	$249,698	36%
Treatment 2040 Scenario 3A.2 – HI > 1.0 (GAC)	All except Maplewood and Newport	GWTPs at 28 municipal and 1,623 non-municipal wells	36 mgd	$127,356	18%	$11,523	$357,816	51%	$0.88	$1.36	$436,983	62%
Treatment 2040 Scenario 3B.2 – HI > 0.5 (IX)	All except Newport	GWTPs at 39 municipal and 1,647 non-municipal wells	63 mgd	$150,241	21%	$8,252	$315,281	45%	$0.36	$0.69	$371,975	53%
Treatment 2040 Scenario 3B.2 – HI > 0.5 (GAC)	All except Newport	GWTPs at 39 municipal and 1,647 non-municipal wells	63 mgd	$206,861	30%	$18,151	$569,881	81%	$0.79	$1.24	$694,585	99%
Treatment 2040 Scenario 3C.2 – PFOS, PFOA, and PFHxS > 0 (IX)	All	GWTPs at 40 municipal and 1,712 non-municipal wells	64 mgd	$154,074	22%	$8,465	$323,374	46%	$0.36	$0.69	$381,532	55%
Treatment 2040 Scenario 3C.2 – PFOS, PFOA, and PFHxS > 0 (GAC)	All	GWTPs at 40 municipal and 1,712 non-municipal wells	64 mgd	$212,109	30%	$18,597	$584,049	83%	$0.80	$1.25	$711,817	102%
Treatment 2040 Scenario 3D.2 – HI > 0 (IX)	All	GWTPs at 54 municipal and 2,272 non-municipal wells	89 mgd	$214,646	31%	$11,477	$444,186	63%	$0.35	$0.68	$523,037	75%
Treatment 2040 Scenario 3D.2 – HI > 0 (GAC)	All	GWTPs at 54 municipal and 2,272 non-municipal wells	89 mgd	$295,717	42%	$25,790	$811,517	116%	$0.79	$1.25	$988,704	141%
Integrated Scenario 4A (IX)	All	Municipal (44 wells) and non-municipal (809 wells) water addressed with GWTPs while incorporating efficiencies	52 mgd	$403,810	58%	$11,093	$625,670	89%	$0.58	$1.65	$701,883	100%
Integrated Scenario 4B (GAC)	All	Municipal (44 wells) and non-municipal (809 wells) water addressed with GWTPs while incorporating efficiencies	52 mgd	$424,599	61%	$16,373	$752,059	107%	$0.86	$1.98	$864,548	124%

a. Communities affected are those communities that would incur changes to their current water supply under each scenario. Residences and other non-municipal well owners will still receive individual treatment systems under each scenario, as deemed necessary by the MDH based on well testing.

b. Values are given in thousands of dollars. To calculate the actual amount, multiply the number by 1,000.

Table 6.4. Modeling and cost results for the revised scenarios

Scenarios	Communities affected[a]	Components	Water provided	Capital cost (000s)[b]	% of $700 million Settlement funds	Annual O&M cost (000s)[b]	O&M cost per thousand gallons	Capital and O&M cost per thousand gallons	Total 20-year costs (000s)[b] with 3% inflation	% of Settlement funds
Revised Community-Specific Scenario A – HI > 1.0 (IX)	All	Municipal (34 wells) and non-municipal (3,792 wells) water addressed via community-proposed projects	41 mgd	$377,244	54%	$5,965	$0.40	$2.18	$652,602	93%
Revised Community-Specific Scenario A – HI > 1.0 (GAC)			41 mgd	$399,584	57%	$6,967	$0.47	$2.37	$709,942	101%
Revised Community-Specific Scenario A – HI > 0 (IX)		Municipal (54 wells) and non-municipal (6,293 wells) water addressed via community-proposed projects	70 mgd	$479,561	69%	$9,895	$0.39	$1.73	$886,341	127%
Revised Community-Specific Scenario A – HI > 0 (GAC)			70 mgd	$517,131	74%	$11,679	$0.46	$1.93	$984,281	141%
Revised Community-Specific Scenario A (PFAS eligible) – HI > 1.0 (IX)	All	Municipal (34 wells) and non-municipal (3,792 wells) water addressed via community-proposed projects	41 mgd	$296,534	42%	$4,131	$0.28	$1.36	$407,572	58%
Revised Community-Specific Scenario A (PFAS eligible) – HI > 1.0 (GAC)			41 mgd	$318,754	46%	$5,126	$0.34	$1.53	$456,532	65%
Revised Community-Specific Scenario A (PFAS eligible) – HI > 0 (IX)		Municipal (54 wells) and non-municipal (6,293 wells) water addressed via community-proposed projects	68 mgd	$379,448	54%	$8,229	$0.33	$1.21	$600,641	86%
Revised Community-Specific Scenario A (PFAS eligible) – HI > 0 (GAC)			68 mgd	$413,348	59%	$9,625	$0.39	$1.35	$672,071	96%
Revised Community-Specific Scenario A (PFAS and PT eligible) – HI > 1.0 (IX)	All	Municipal (32 wells) and non-municipal (3,792 wells) water addressed via community-proposed projects	41 mgd	$265,840	38%	$2,927	$0.20	$1.18	$344,525	49%
Revised Community-Specific Scenario A (PFAS and PT eligible) – HI > 1.0 (GAC)			41 mgd	$285,460	41%	$3,815	$0.26	$1.33	$388,015	55%
Revised Community-Specific Scenario A (PFAS and PT eligible) – HI > 0 (IX)		Municipal (54 wells) and non-municipal (6,293 wells) water addressed via community-proposed projects	68 mgd	$351,630	50%	$8,306	$0.33	$1.16	$574,955	82%
Revised Community-Specific Scenario A (PFAS and PT eligible) – HI > 0 (GAC)			68 mgd	$385,410	655%	$9,716	$0.39	$1.30	$646,555	92%
Revised Community-Specific Scenario B – HI > 1.0 (IX)	All	SPRWS supplying Oakdale, treatment at 31 municipal and 3,823 non-municipal wells addressed through projects	41 mgd	$396.663	57%	$8.671	$0.63	$2.70	$749,023	107%
Revised Community-Specific Scenario B – HI > 1.0 (GAC)			41 mgd	$416.963	60%	$9,460	$0.68	$2.88	$797,793	114%
Revised Community-Specific Scenario B– HI > 0 (IX)		SPRWS supplying Oakdale, treatment at 48 municipal and 6,253 non-municipal wells addressed through projects	69 mgd	$480,420	69%	$12,437	$0.50	$1.92	$953,755	136%
Revised Community-Specific Scenario B – HI > 0 (GAC)			69 mgd	$510,250	73%	$13,583	$0.55	$2.06	$1,024,235	146%

Scenarios	Communities affected[a]	Components	Water provided	Capital cost (000s)[b]	% of $700 million Settlement funds	Annual O&M cost (000s)[b]	O&M cost per thousand gallons	Capital and O&M cost per thousand gallons	Total 20-year costs (000s)[b] with 3% inflation	% of Settlement funds
Revised Community-Specific Scenario C– HI > 1.0 (IX)	All	SPRWS supplying Oakdale and Lake Elmo, treatment at 30 municipal and 3,768 non-municipal wells addressed through projects	41 mgd	$365,048	52%	$10,068	$0.67	$2.49	$743,924	106%
Revised Community-Specific Scenario C – HI > 1.0 (GAC)			41 mgd	$383,708	55%	$10,791	$0.72	$2.64	$788,734	113%
Revised Community-Specific Scenario C – HI > 0 (IX)		SPRWS supplying Oakdale and Lake Elmo, treatment at 53 municipal and 6,249 non-municipal wells addressed through projects	70 mgd	$433,787	62%	$13,659	$0.53	$1.81	$924,084	132%
Revised Community-Specific Scenario C– HI > 0 (GAC)			70 mgd	$460,097	66%	$14,660	$0.57	$1.93	$985,894	141%
Revised Community-Specific Scenario C (PFAS eligible) – HI > 1.0 (IX	All	SPRWS supplying Oakdale and Lake Elmo, treatment at 30 municipal and 3,768 non-municipal wells addressed through projects	41 mgd	$321,918	46%	$8,302	$0.47	$1.56	$545,044	78%
Revised Community-Specific Scenario C (PFAS eligible) – HI > 1.0 (GAC)			41 mgd	$340,618	49%	$9,033	$0.52	$1.66	$583,374	83%
Revised Community-Specific Scenario C (PFAS eligible) – HI > 0 (IX)		SPRWS supplying Oakdale and Lake Elmo, treatment at 53 municipal and 6,249 non-municipal wells addressed through projects	69 mgd	$361,677	52%	$12,231	$0.49	$1.37	$690,455	99%
Revised Community-Specific Scenario C (PFAS eligible) – HI > 0 (GAC)			69 mgd	$387,977	55%	$13,240	$0.53	$1.48	$743,895	106%
Revised Community-Specific Scenario C (PFAS and PT eligible) – HI > 1.0 (IX)	All	SPRWS supplying Oakdale and Lake Elmo, treatment at 28 municipal and 3,768 non-municipal wells addressed through projects	48 mgd	$281,019	40%	$7,447	$0.43	$1.37	$481,155	69%
Revised Community-Specific Scenario C (PFAS and PT eligible) – HI > 1.0 (GAC)			48 mgd	$298,659	43%	$8,146	$0.46	$1.48	$517,595	74%
Revised Community-Specific Scenario C (PFAS and PT eligible) – HI > 0 (IX)		SPRWS supplying Oakdale and Lake Elmo, treatment at 53 municipal and 6,249 non-municipal wells addressed through projects	69 mgd	$334,088	48%	$12,335	$0.49	$1.32	$665,577	95%
Revised Community-Specific Scenario C (PFAS and PT eligible) – HI > 0 (GAC)			69 mgd	$360,258	51%	$13,334	$0.53	$1.43	$718,627	103%

Scenarios	Communities affected[a]	Components	Water provided	Capital cost (000s)[b]	% of $700 million Settlement funds	Annual O&M cost (000s)[b]	O&M cost per thousand gallons	Capital and O&M cost per thousand gallons	Total 20-year costs (000s)[b] with 3% inflation	% of Settlement funds
Revised Community-Specific Scenario D– HI > 1.0 (IX)	All	Prairie Island Indian Community serving West Lakeland Township, treatment at 33 municipal and 3,792 non-municipal wells addressed through projects	41 mgd	$303,760	43%	$4,966	$0.33	$1.83	$547,090	78%
Revised Community-Specific Scenario D – HI > 1.0 (GAC)			41 mgd	$327,425	47%	$6,342	$0.42	$2.07	$619,050	88%
Revised Community-Specific Scenario D – HI > 0 (IX)		Prairie Island Indian Community serving West Lakeland Township, treatment at 3 municipal and 6,293 non-municipal wells addressed through projects	70 mgd	$402,420	57%	$7,621	$0.30	$1.47	$752,300	107%
Revised Community-Specific Scenario D – HI > 0 (GAC)			70 mgd	$445,682	64%	$11,030	$0.43	$1.77	$902,080	129%
Revised Treatment Scenario – HI > 1.0 (IX)	All except Maplewood, Newport, and Prairie Island Indian Community	Treatment at 24 municipal and 2,650 non-municipal wells	38	$87,557	13%	$7,018	$0.52	$0.84	$227,917	33%
Revised Treatment Scenario – HI > 1.0 (GAC)	All except Maplewood, Newport, and Prairie Island Indian Community	Treatment at 24 municipal and 2,650 non-municipal wells	38	$119,161	17%	$8,609	$1.07	$0.52	$291,341	42%
Revised Treatment Scenario – HI > 0.5 (IX)	All except Newport and Prairie Island Indian Community	Treatment at 27 municipal and 2,673 non-municipal wells	42	$98,507	14%	$7,434	$0.49	$0.81	$247,181	35%
Revised Treatment Scenario – HI > 0.5 (GAC)	All except Newport and Prairie Island Indian Community	Treatment at 27 municipal and 2,673 non-municipal wells	42	$134,369	19%	$9,186	$1.04	$0.49	$318,072	45%
Revised Treatment Scenario – PFOS, PFOA, and PFHxS > 0 (IX)	All except Prairie Island Indian Community	Treatment at 32 municipal and 4,827 non-municipal wells	53	$127,742	18%	$10,369	$0.54	$0.88	$335,106	48%
Revised Treatment Scenario – PFOS, PFOA, and PFHxS > 0 (GAC)	All except Prairie Island Indian Community	Treatment at 32 municipal and 4,827 non-municipal wells	53	$172,176	25%	$12,436	$1.10	$0.54	$420,877	60%

Scenarios	Communities affected[a]	Components	Water provided	Capital cost (000s)[b]	% of $700 million Settlement funds	Annual O&M cost (000s)[b]	O&M cost per thousand gallons	Capital and O&M cost per thousand gallons	Total 20-year costs (000s)[b] with 3% inflation	% of Settlement funds
Revised Treatment Scenario – HI > 0	All except Prairie Island Indian Community	Treatment at 49 municipal and 5,685 non-municipal wells	84	$198,934	28%	$13,643	$0.45	$0.77	$471,787	67%
Revised Treatment Scenario – HI > 0	All except Prairie Island Indian Community	Treatment at 49 municipal and 5,685 non-municipal wells	84	$270,148	39%	$16,681	$0.99	$0.45	$603,763	86%

a. Communities affected are those communities that would incur changes to their current water supply under each scenario. Residences and other non-municipal well owners will still receive individual treatment systems under each scenario, as deemed necessary by the MDH based on well testing.
b. Values are given in thousands of dollars. To calculate the actual amount, multiply the number by 1,000.

6.1.8 Scenario evaluation summary

Tables 6.5 and 6.6 summarize how each scenario is rated against the applicable evaluation criteria. Table 6.5 covers the original scenarios (i.e., the costs and features shown in Table 6.3), while Table 6.6 shows the revised and final scenarios (i.e., the costs and features shown in Table 6.4). They are evaluated separately because the revised scenarios are based on updated assumptions and inputs, including updated water demand forecasts for several communities. Note that Tables 6.5 and 6.6 show ratings for only the applicable criteria; as noted above, the Co-Trustees and work groups agreed that several criteria were not applicable to the drinking water scenarios.

Table 6.5. Ratings against the criteria for each of the original scenarios (the scenarios summarized in Table 6.3)

Criteria (high priority in bold)	Community-specific		Regional						Treatment								Integrated	
	1A (IX)	1A (GAC)	2A, 1 SWTP	2B.1, 2 SWTPs	2B.2, 2 SWTPs	2C, SPRWS	2E, GWTPs (GAC)	2E, GWTPs (IX)	3A, HI > = 1 (IX)	3A, HI > = 1 (GAC)	3B, HI > = 0.5 (IX)	3B, HI > = 0.5 (GAC)	3C, HI* > 0 (IX)	3C, HI* > 0 (GAC)	3D, HI > 0 (IX)	3D, HI > 0 (GAC)	4A (IX)	4B (GAC)
3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6	–	–	+	+	+	+	O	O	–	–	–	–	–	–	–	–	–	–
7a	+	+	+	+	+	+	+	+	O	O	+	+	+	+	+	+	+	+
7b	O	O	+	+	+	+	O	O	–	–	O	O	+	+	+	+	O	O
8	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
9	+	+	–	–	–	–	O	O	+	+	+	+	+	+	+	+	+	+
10	–	–	+	+	+	–	–	–	O	O	O	O	O	O	O	O	–	–
11	+	+	+	O	O	–	–	–	+	+	+	+	+	+	+	+	+	+
13	O	–	–	–	–	–	O	O	+	O	+	+	+	+	+	–	O	–
14	+	O	O	O	O	–	O	+	+	+	+	O	+	O	+	–	+	O
18	+	+	O	O	O	O	O	O	O	O	O	O	O	O	O	O	+	+
19	+	+	–	–	–	–	O	O	O	O	O	O	O	O	O	O	O	O
20																		

* Denotes HI calculate for only three PFAS compounds: PFOA, PFOS and PFHxS

Table 6.6. Ratings against the criteria for the final set of scenarios

Criteria (high priority in bold)	Community-Specific Scenario A, varying by HI threshold and treatment technology						Community-Specific Scenario B with SPRWS serving Oakdale				Community-Specific Scenario C with SPRWS serving Oakdale and Lake Elmo				
	HI > 1 (GAC)	HI > 1 (IX)	HI > 0.5 (GAC)	HI > 0.3 (GAC)	HI > 0 (GAC)	HI > 0 (IX)	HI > 1 (GAC)	HI > 1 (IX)	HI > 0 (GAC)	HI > 0 (IX)	HI > 1 (GAC)	HI > 1 (IX)	HI > 05 (GAC)	HI > 0 (GAC)	HI > 0 (IX)
Recommended[a]			a	a									a		
3	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
7a	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
7b	O	O	O	+	+	+	O	O	+	+	O	O	+	+	+
8	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
9	+	+	+	+	+	+	O	O	O	O	O	O	O	O	O
10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
11	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
13	+	+	+	O	–	–	O	O	–	–	O	+	O	–	–
14	+	+	+	+	–	O	O	O	–	–	O	+	O	–	–
18	+	+	+	+	+	+	O	O	O	O	O	O	O	O	O
19	+	+	+	+	+	+	O	O	O	O	O	O	O	O	O
20															

a. These three scenarios are carried forward as part of the recommended options in Chapter 7

7. Recommendation

7.1 Introduction to the Recommendation

From the beginning of this planning process, the Co-Trustees intended to present a plan for providing clean, sustainable drinking water to the 14 communities currently known to be affected by PFAS contamination in the East Metropolitan Area, now and into the future, taking into account both public water systems and private wells.

The Co-Trustees followed a strategic planning process that considered the region as a whole, starting from the source of the drinking water and ending when it comes out of the faucet. Because there is a clear community preference for groundwater sources over surface water, the recommended options are focused on **groundwater solutions to the extent possible**. The recommended options are designed to **invest in treatment systems, drinking water protection, and sustainability**. The Co-Trustees focused on balancing the building of **resilient systems** that can handle changing standards or contamination, with minimal impact on affected communities; with **reserving funding for O&M expenses and reducing these costs**, which would eventually need to be covered by residents after the Settlement funds are depleted.

The Co-Trustees have developed the following three recommended options for public review and comment, and, as described in Section 7.3.4 of this chapter, prefer recommended Option 1.

Option 1 (preferred)

- Treatment to a threshold of HI > 0.5 using GAC
- Funding of public water system O&M for approximately 40 years
- Funding of private well O&M for over 100 years
- Funding for protecting a sustainable water supply into the future
- Drinking water source remains groundwater

Option 2

- Treatment to a threshold of HI > 0.3 using GAC
- Funding of public water system O&M for approximately 35 years
- Funding of private well O&M for over 100 years
- Funding for protecting a sustainable water supply into the future
- Drinking water source remains groundwater

Option 3

- Treatment to a threshold of HI > 0.5 using GAC
- Funding of public water system O&M for approximately 21 years
- Funding of private well O&M for over 100 years
- Funding for protecting a sustainable water supply into the future
- Oakdale and Lake Elmo are supplied by SPRWS to ensure future water supply
- Drinking water source remains groundwater for other communities

This chapter describes the Co-Trustees' approach to developing the recommended options (Section 7.2), presents a summary of the three recommended options (Section 7.3), and describes the process for selecting a final preferred option (Section 7.4).

7.2 Approach to develop recommended options

The fifth step of developing the Conceptual Plan was to review the evaluation of the revised scenarios in Chapter 6, gather and consider feedback, modify the scenarios as necessary, and develop recommended options for public review and the eventual finalization of this Conceptual Plan.

In developing recommended options, the MPCA and DNR considered the long-term program goals for Priority 1 (see text box to the right) and evaluation criteria (see Chapter 6), the analysis of groundwater and drinking water models, feedback from the work groups and Subgroup 1, one-on-one meetings with elected officials and technical staff from the affected communities in the East Metropolitan Area, six public informational and listening sessions, and input received during a public comment period.

Long-term program goals for Priority 1 – Drinking water quality, quantity, and sustainability

- Provide clean drinking water to residents and businesses to meet current and future needs under changing conditions, population, and HBVs
- Protect and improve groundwater quality
- Protect and maintain groundwater quantity
- Minimize long-term cost burdens for communities.

As described in Chapter 6, all of the revised scenarios were developed to provide safe, sustainable drinking water to all of the affected communities in the East Metropolitan Area, but they differ in technology, the types of projects included, the HI threshold for treatment, and cost. To select which drinking water supply scenarios to include in the recommended options, the MPCA and DNR considered similar factors that were used to develop the options, specifically:

- How well the scenarios addressed the long-term program goals (see Section 1.2.1)
- How well the scenarios met the evaluation criteria (see Chapter 6 and Appendix G)
- How well the scenarios addressed feedback provided by the work groups, Subgroup 1, elected officials, and technical staff from the affected communities in the East Metropolitan Area; and members of the public.

The recommended options presented in this chapter are centered on three different drinking water supply scenarios, but also include broader recommendations to ensure that the plan addresses long-term program goals for Priority 1; by doing this, the MPCA and DNR are providing a roadmap for future decision-making.

7.3 Summary of recommended options

This section presents information about the three recommended options. Section 7.3.1 describes the elements that are common to each of the three options; Section 7.3.2 provides additional information on each option separately, including details on the elements of the option for each community in the East Metropolitan Area; and Section 7.3.3 presents side-by-side tables of the same information to facilitate a comparison of the options. In Section 7.3.4, the MPCA and DNR describe which option is currently preferred.

7.3.1 Common elements of all options

While developing the recommended options, the MPCA and DNR determined that all of the recommendations would have the following common components:

- **Each option uses a treatment threshold that is less than an HI of 1.** As discussed earlier in this Conceptual Plan, the HI threshold for treatment determines which wells receive treatment or become replaced by a hookup to a public water system (see the text box to the right).
- **Each option sets aside contingency funds to address additional wells should they become impacted in the future.** The HI threshold for treatment would be used to determine which wells receive treatment or become replaced by a hookup to a public water system.[3]
- **Each option uses GAC as a treatment technology.** Although IX is a well-established technology used throughout the country, it is not currently approved for use in Minnesota by MDH. GAC tends to be more expensive than IX, so recommending scenarios that use GAC is a conservative approach that ensures there will be sufficient funding for either technology in the future.

What do the HI thresholds mean? An HI of 1 or greater indicates that one or more PFAS chemicals are present in sufficient concentrations to potentially have a health effect. An HI of 1 or greater triggers a well advisory from MDH.

The MPCA and DNR recommendations use a HI threshold below 1. PFAS is one of the most studied class of chemicals; the understanding of PFAS and the ability to detect it is continually evolving. As a result, HBVs or HRLs may change or new compounds added, or the contamination location may change in the future. Instead of being in a reactive mode when changes occur, the recommended options are proactive and build a degree of resiliency into communities' drinking water systems to be able to better cover future potential changes. There is substantial interest among the work groups, local governments, and the general public for using an HI threshold less than 1.

It should be noted that the 2007 Consent Order requires 3M to cover the cost of treatment for wells with an HI of 1 or greater, but does not require 3M to cover the cost for wells with lower HI values. As a result, O&M costs for treatment on wells with an HI of less than 1 may eventually have to be covered by ratepayers or homeowners. For more explanation on the PFAS HI, refer to Section 6.2.3.

3. For any given well, the HI threshold would be used to determine whether that well will receive treatment or be replaced with a hookup to a municipal system. The Co-Trustees recommended a threshold lower than 1 to provide some resilience against future changes in contamination or future changes in HBVs or HRLs. As such, the initial capital investments have been determined using the HI threshold for each recommended option. In the future, if the HI for a given well exceeds the HI threshold because measured PFAS contamination increased, the well would receive treatment or a hookup to a municipal system. The Co-Trustees have not yet determined how to handle cases where the HI for a given well exceeds the treatment threshold due to changes in HBVs or HRLs, but the contamination does not cause an exceedance of the new HI of 1.

- Each option allocates approximately $548 million in funding for projects that will deliver finished drinking water at the faucet. This funding would cover capital costs (including initial capital and potential additional neighborhood hookups), O&M costs for treatment facilities, and costs for unforeseen circumstances. The amounts for each option differ across these categories. As described in Section 6.1.2, costs that do not directly address PFAS contamination would not be covered.
- **Each option invests $130 million in funding for projects that will ensure the communities' drinking water sources are protected and sustainable.** This includes $70 million for drinking water protection and $60 million for sustainability and conservation. The drinking water protection fund will be used for PFAS groundwater remediation, which can help reduce future treatment needs and costs, and will generally improve overall water quality. The sustainability and conservation fund would be used to support water conservation measures (among other activities) to help reduce water use and enhance long-term aquifer sustainability.
- **Each option would cover O&M costs for private well treatment for over 100 years.** To ensure effective treatment systems are maintained on private wells, it is necessary to plan for coverage of long-term O&M costs. While communities have the capability to plan for coverage of longer-term costs, the maintenance of private systems is more expensive and may be more difficult to achieve without dedicated funds.
- **Each option would cover O&M costs for new treatment infrastructure on public water systems for at least 21 years.** The projected coverage timeframe ranges from approximately 21 to 40 years depending on how much is spent on initial capital costs and the amount reserved for future contingency funds. Options with lower projected capital costs and/or lower annual O&M costs could provide funding for O&M for longer periods of time.
- **Each option includes connections of some neighborhoods to municipal systems.** The initial capital amount for each option includes funding for connecting neighborhoods where a significant number of private wells have high levels of PFAS, while considering the long-term cost of connections compared to POETS.[4] Details on these assumptions are provided in Appendix E, Section E.4.1.1. Each option also includes approximately $41 million in funding set aside for additional proposed neighborhood hookups that would require additional sampling or evaluation before making a decision about connecting them. For detailed information on wells that are recommended for connections, please visit https://arcg.is/0fmHXS where you can search by address.
- Each option includes feasible approaches for drinking water supply for future growth that could help address groundwater-use restrictions related to the current Court Order for White Bear Lake. Modeling based on projections of future water use indicates that Lake Elmo may need alternate sources of water to avoid adverse effects on White Bear Lake. If Oakdale were to seek additional capacity, there may be similar challenges. While the case remains in court and because future DNR regulatory requirements are not known, the Co-Trustees recommend two possible approaches for providing additional water supply to Oakdale and Lake Elmo. One approach provides funding for utilizing groundwater in ways that comply with the current Court Order for the cities' future growth. The funding level is based on a cost estimate of creating an interconnect from southern Woodbury to Lake Elmo to provide water for their future growth.

4. Some wells with HI values less than the given threshold may still be connected to public water systems because of their proximity to those wells with HI values exceeding the threshold.

However, it provides Lake Elmo and the State flexibility to explore approaches within that funding range. This approach is applied in recommended Options 1 and 2. The other option would be to have SPRWS provide all of the water supply for Lake Elmo and Oakdale,[5] as described in Chapter 6 as community-specific Scenario C. This approach is used in recommended Option 3.

7.3.2 Overview of recommended options

This section presents an overview of each of the three options. The key elements of each recommended option are provided in Figures 7.1–7.6, with two full-page figures per option. For each option, the first figure summarizes the key characteristics of the option, the estimated allocation of costs under the option, the primary infrastructure elements included in the initial capital, and the advantages of that option. The second figure summarizes the primary infrastructure elements for each community. Additional details about each option are provided in Appendix E.

For each of the recommended options, the Co-Trustees allocated $700 million, which is the amount of Settlement funding available after payment of legal fees and deducting the $20 million set aside for Priority 2. This allocation does not include funding for sampling of wells for PFAS, which will continue to be covered by 3M under the Consent Order. The funding categories presented in Figures 7.1 (Option 1), 7.3 (Option 2), and 7.5 (Option 3) are discussed below.

- **Initial capital costs** are costs to construct the drinking water supply infrastructure based on projected 2040 demand for the given option, including different combinations of treatment, distribution systems, home connections, and POETS. These costs include water mains and home connections that will be completed as part of the initial implementation. The MPCA and DNR recommend that neighborhoods be connected to public water systems if they currently have a significant number of wells with elevated HI values, and if the costs of water mains and connections are less than the cost of POETS after a reasonable amount of time. Many neighborhoods lacked sufficient sampling data to make the decision about connections at this time; these neighborhoods are discussed below.
- **O&M costs for public water systems and private wells** are estimated costs for the operation and maintenance of treatment facilities (e.g., media change-out, structure maintenance), or costs for purchasing water at bulk rates (applicable for Option 3). The recommended options include separate line items for funding for long-term O&M for treatment systems on public water systems and private wells. The Co-Trustees prioritized O&M costs for treatment since these costs are more directly tied to the PFAS contamination. Additionally, funding for POET O&M costs will be provided for as long as feasible so that these costs do not pose undue burdens on individual homeowners. Depending on actual future inflation and interest on funds, the number of years covered could be different from the estimates shown above. The allocation for O&M costs covers only treatment facilities (e.g., media change-out, structure maintenance) and does not cover distribution system O&M, which will be covered by the communities. For Option 3, the O&M allocation covers costs for purchasing water from SPRWS at their bulk water rate. It has been assumed that O&M costs would increase 3% annually due to inflation, and that funds would be set aside in an interest-bearing account that would generate an effective rate of return of 3.5%.

---

5. Oakdale would be provided water from SPRWS under recommended Option 3 to take advantage of infrastructure efficiencies and ensure future drinking water supply.

- **Capital costs for potential additional neighborhood hookups** include costs for additional water mains and home connections that could be completed in the future; these decisions will be based on future information, including additional well testing data. The MPCA and DNR allocated Settlement funds for the ability to connect those neighborhoods in the future if and when new sampling data show it is reasonable. Treating wells below an HI of 1 could result in future expenses, once the Settlement dollars are depleted, due to O&M expenses not covered for treatment of wells below an HI of 1.
- **Future contingency for HBV/HRL and plume movement, and cost over-runs** is funding set aside to address expenses that are difficult to predict today, future plume movement, future changes in HBV/HRLs, and cost over-runs. The amount is partially based on the cost for treatment and/or hookups for homes with wells that are within the flow path of the PFAS plumes developed using the groundwater model described in Appendix C. While the model is useful at predicting where known PFAS particles may migrate, the actual plume movement may differ from these predictions, and some areas may never encounter PFAS contamination to a level requiring treatment. One option to address this uncertainty would be to provide treatment at concentrations lower than an HI > 0.5 in the initial capital, which is why the contingency for projected future impacts is accordingly lower for Option 2. In addition, this category of funding is meant to cover additional treatment and/or municipal connection costs that may arise if HBV/HRLs are reduced in the future.
- **Drinking water protection** is funding set aside to be used for the remediation of groundwater not related to the actual 3M disposal sites, to help reduce future treatment needs and improve overall source water quality. Remediation at the disposal sites is the responsibility of 3M under the Settlement and Consent Order. Drinking water protection is a component of Priority 1 of the Settlement and is emphasized in the long-term goals for Priority 1 set out by the agencies and work groups at the beginning of this process.
- **Sustainability and conservation** is funding set aside to protect groundwater sustainability to preserve groundwater as a drinking water source into the future, and to support sustainable infrastructure enhancements for projects funded by the Settlement. Sustainability is a component of Priority 1 of the Settlement and was a high priority in the public feedback received.
- **State administration** is the anticipated cost to administer the Settlement in full. This estimate is based on current spending for the 3M Settlement program projected over 20 years, which is consistent with previous years of costs for the MPCA, DNR, and consultants.

Figure 7.1. Overview of recommended Option 1 – Community projects with a treatment threshold of HI > 0.5 and GAC

Key Characteristics

- Treatment to a threshold of HI > 0.5 using GAC
- Funding of public water system O&M for approximately 40 years
- Funding of private well O&M for over 100 years
- Funding for protecting a sustainable water supply into the future
- Drinking water source remains groundwater

Initial Capital Elements

2,062 homes with new connections to municipal public water systems
A total of 236 private wells with POETS (of these, 98 are new wells)
5 new public wells built (3 of these replace contaminated wells)
6 new treatment plants with a capacity of 23,580 gpm and 1 modified treatment plant with additional capacity of 1,750 gpm
33 existing and proposed public wells receiving treatment
72 miles of water mains

Why Select this Option?

- HI > 0.5 provides a resiliency to potentially lower HRL/HBV PFAS values or changing levels of contamination in the future
- Communities will bear a lesser cost to continue treatment below HI > 1 once Settlement funds are depleted than they would under recommended Option 2 (HI > 0.3)
- Provides for most years of O&M coverage out of Settlement funds

PFAS-Eligible Costs

Initial capital costs	$302.5 million
O&M costs for public water systems	$147 million
O&M costs for private wells	$19 million
Capital costs for potential additional neighborhood hookups	$41 million
Future contingency for HBV/HRL and plume movement, and cost over-runs	$38 million
Drinking water protection	$70 million
Sustainability and conservation	$60 million
State administration	$22 million

Percent of $700 million

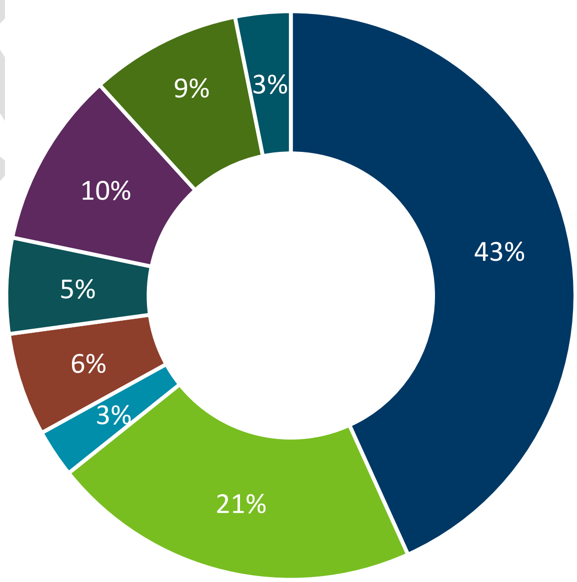


Figure 7.2. Community elements of recommended Option 1 – Community projects with a treatment threshold of HI > 0.5 and GAC

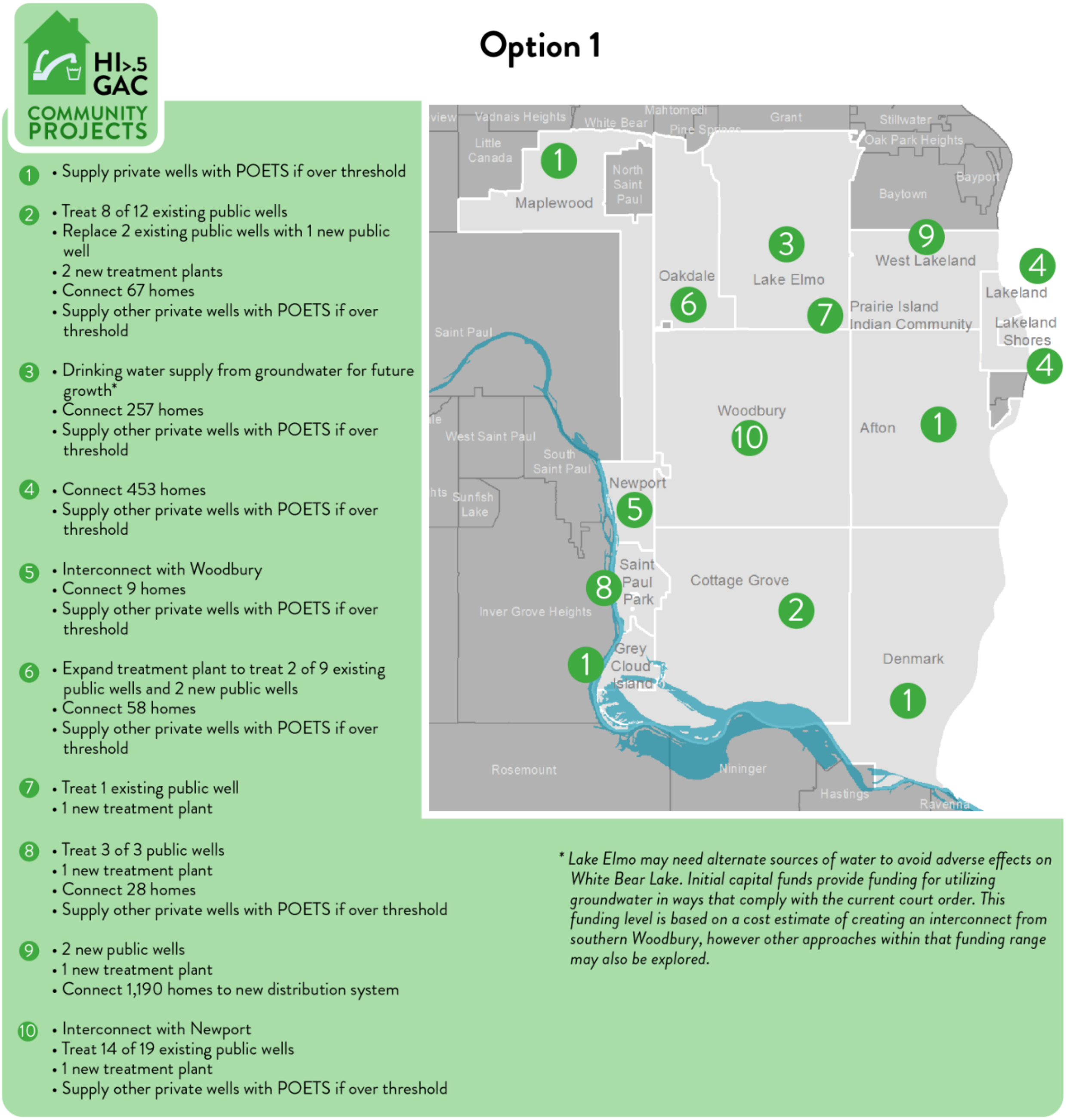


Figure 7.3. Overview of recommended Option 2 – Community projects with a treatment threshold of HI > 0.3 and GAC

Key Characteristics

- Treatment to a threshold of HI > 0.3 using GAC
- Funding of public water system O&M for approximately 35 years
- Funding of private well O&M for over 100 years
- Funding for protecting a sustainable water supply into the future
- Drinking water source remains groundwater

Initial Capital Elements

2,062 homes with new connections to municipal public water systems
A total of 297 private wells with POETS (of these, 159 are new wells)
5 new public wells built (3 of these replace contaminated wells)
6 new treatment plants with a capacity of 29,580 gpm, and 1 modified treatment plant with additional capacity of 1,750 gpm
39 existing and proposed public wells receiving treatment
75.3 miles of water mains

Why Select this Option?

- HI > 0.3 provides greater resiliency to potentially lower HRL/HBV PFAS values or changing levels of contamination in the future
- Provides treatment for 6 additional public wells and provides 61 additional private wells with POETS compared to recommended Option 1

PFAS-Eligible Costs

Initial capital costs	$319.1 million
O&M costs for public water systems	$131 million
O&M costs for private wells	$23.9 million
Capital costs for potential additional neighborhood hookups	$41 million
Future contingency for HBV/HRL and plume movement, and cost over-runs	$33 million
Drinking water protection	$70 million
Sustainability and conservation	$60 million
State administration	$22 million

Percent of $700 million

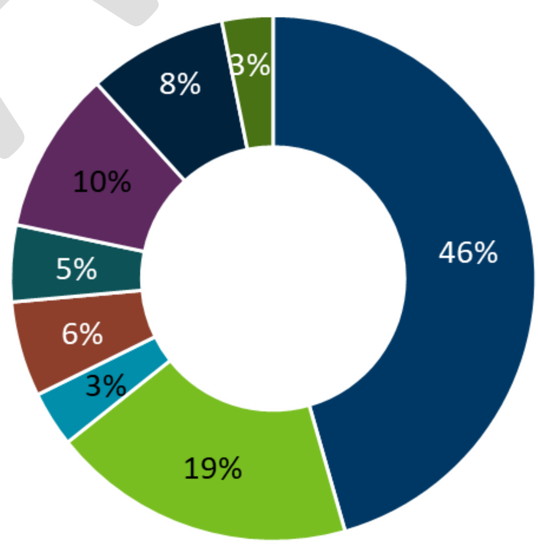


Figure 7.4. Community elements of recommended Option 2 – Community projects with a treatment threshold of HI > 0.3 and GAC

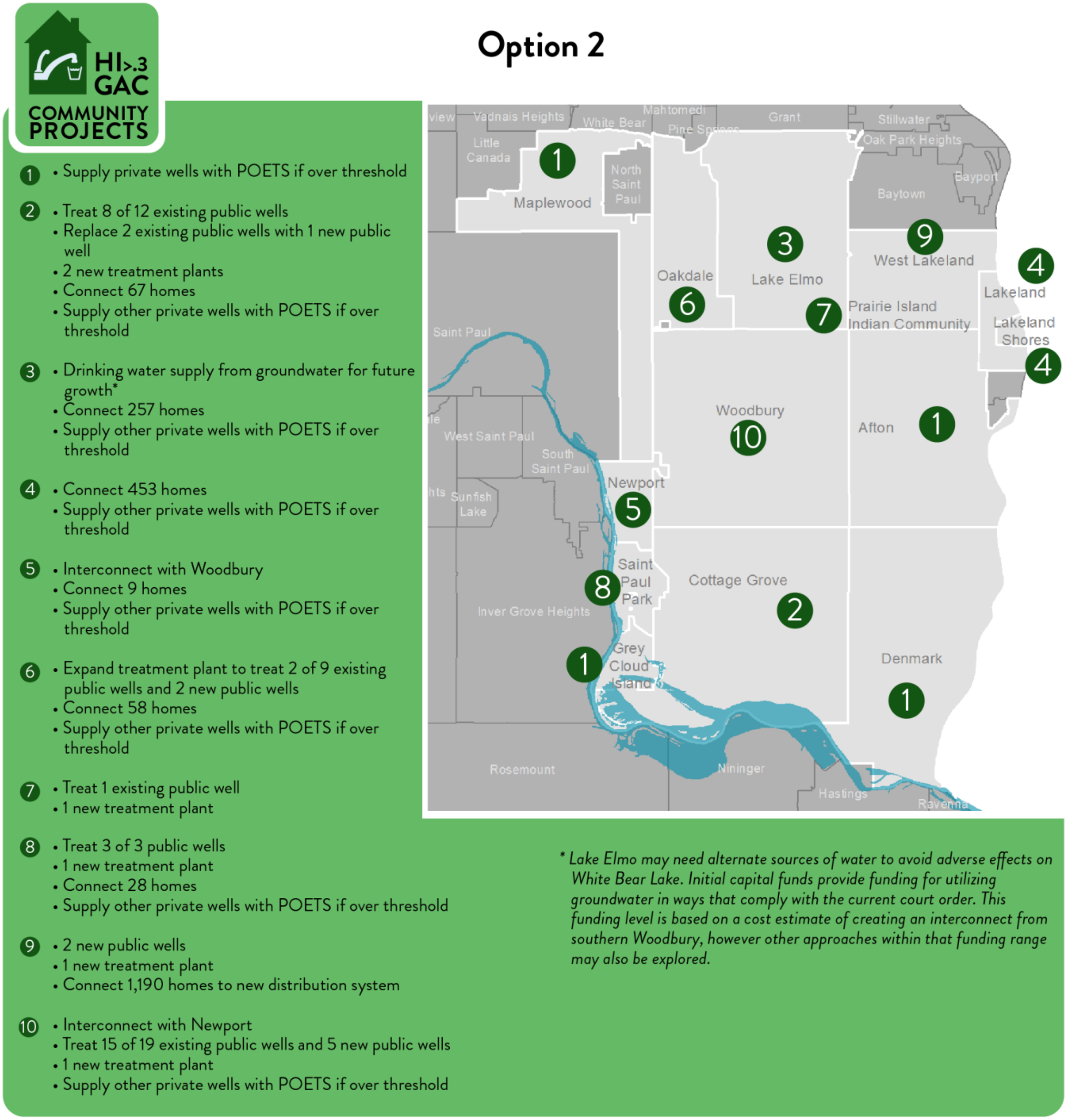


Figure 7.5. Overview of recommended Option 3 – Community projects, except Oakdale and Lake Elmo are supplied by SPRWS, with a treatment threshold of HI > 0.5 and GAC

Key Characteristics

- Treatment to a threshold of HI > 0.5 using GAC
- Funding of public water system O&M for approximately 21 years
- Funding of private well O&M for over 100 years
- Funding for protecting a sustainable water supply into the future
- Oakdale and Lake Elmo are supplied by SPRWS to ensure future water supply
- Drinking water source remains groundwater

Initial Capital Elements

2,062 homes with new connections to municipal public water systems
A total of 236 private wells with POETS (of these, 98 are new wells)
3 new public wells built (1 of these replaces a contaminated well)
6 new treatment plants with a capacity of 23,580 gpm
24 existing and proposed public wells receiving treatment
74.6 miles of water mains

Why Select this Option?

- HI > 0.5 provides a resiliency to potentially lower HRL/HBV PFAS values or changing levels of contamination in the future
- Communities will bear a lesser cost to continue treatment below HI > 1 once Settlement funds are depleted than they would under recommended Option 2 (HI > 0.3)
- Enables a proactive solution for alternate sources of water for Lake Elmo and Oakdale

PFAS-Eligible Costs

PFAS-Eligible Costs	
Initial capital costs	$299.1 million
O&M costs for public water systems	$161 million
O&M costs for private wells	$19 million
Capital costs for potential additional neighborhood hookups	$41 million
Future contingency for HBV/HRL and plume movement, and cost over-runs	$28 million
Drinking water protection	$70 million
Sustainability and conservation	$60 million
State administration	$22 million

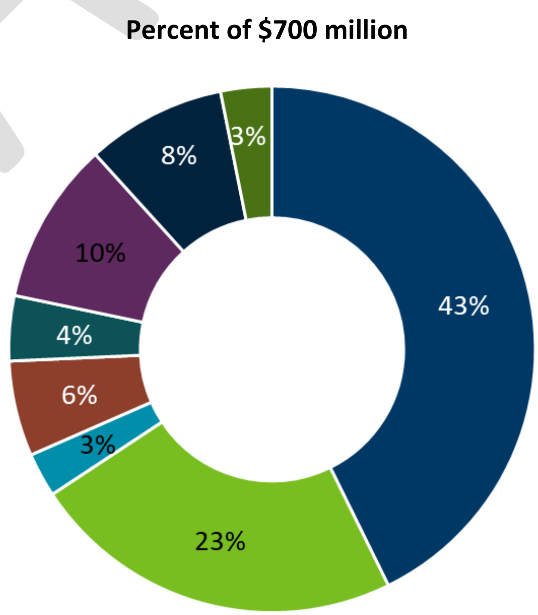
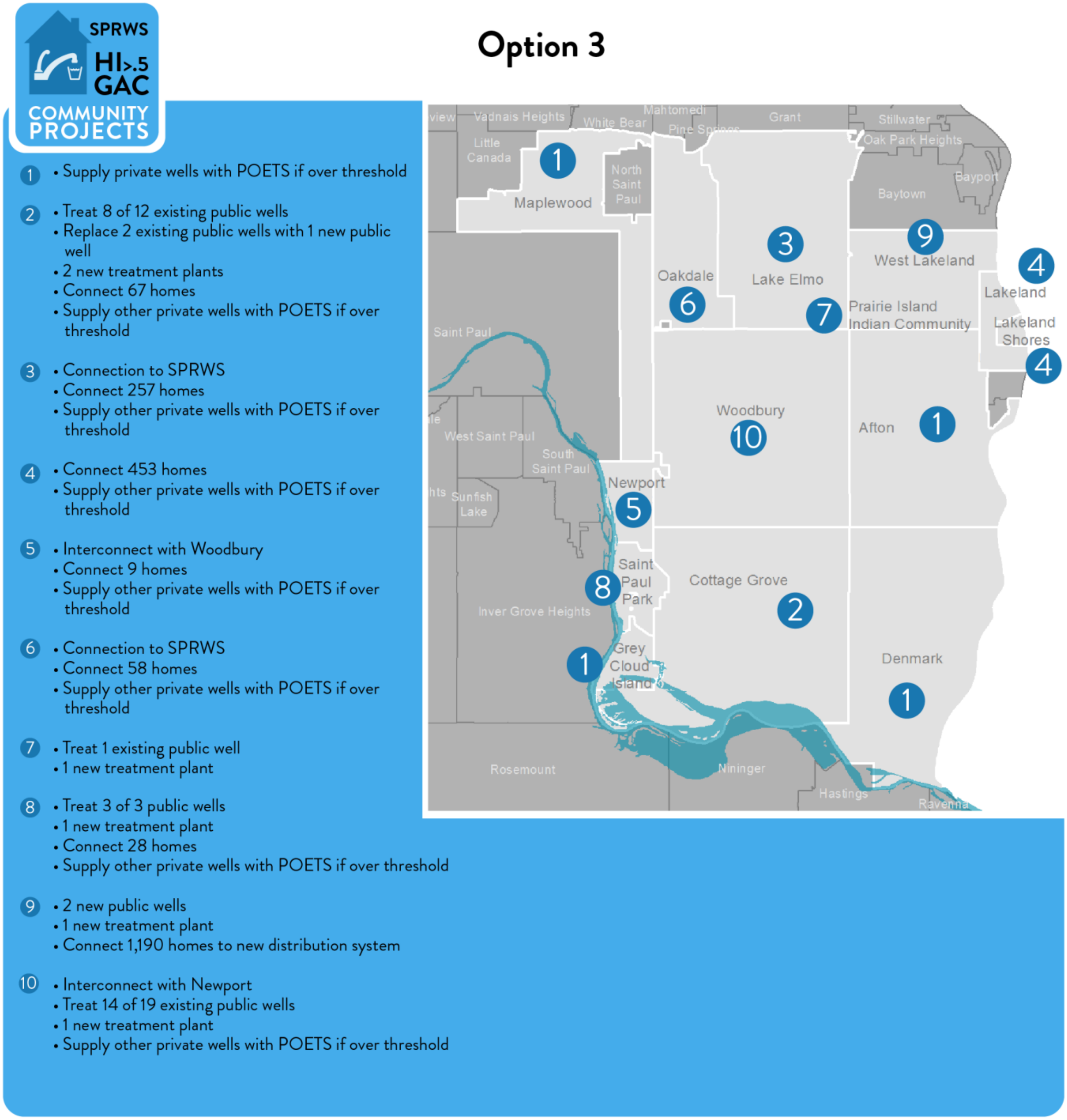


Figure 7.6. Community elements of recommended Option 3 – Community projects, except Oakdale and Lake Elmo are supplied by SPRWS, with a treatment threshold of HI > 0.5 and GAC



7.3.3 Comparison of recommended options

This section provides the same information presented in Section 7.3.2 in a side-by-side format to allow for comparison of the three recommended options. Table 7.1 compares the estimated allocation of costs for the options, Table 7.2 compares the initial capital investments of the options, and Table 7.3 compares the initial capital investments of the options on a community-by-community basis. For explanations of the cost categories in Table 7.1, refer to Section 7.3.2.

Table 7.1. Comparison of cost elements of the recommended options

Funding priorities	Option 1 (preferred) HI>.5 GAC COMMUNITY PROJECTS	Option 2 HI>.3 GAC COMMUNITY PROJECTS	Option 3 SPRWS HI>.5 GAC COMMUNITY PROJECTS
Total	**$700 million**	**$700 million**	**$700 million**
Initial capital costs	$302.5 million	$319.1 million	$299.1 million
O&M costs for public water systems	$147 million for public water systems for approximately *40 years*	$131 million for public water systems for approximately *35 years*	$161 million for public water systems for approximately *21 years*
O&M costs for private wells	$19 million for private wells covering over *100 years*	$24 million for private wells covering over *100 years*	$19 million for private wells covering over *100 years*
Capital costs for potential additional neighborhood hookups	$41 million	$41 million	$41 million
Future contingency for HBV/HRL and plume movement, and cost over-runs	$38 million	$33 million	$28 million
Drinking water protection	$70 million	$70 million	$70 million
Sustainability and conservation	$60 million	$60 million	$60 million
State administration	$22 million	$22 million	$22 million

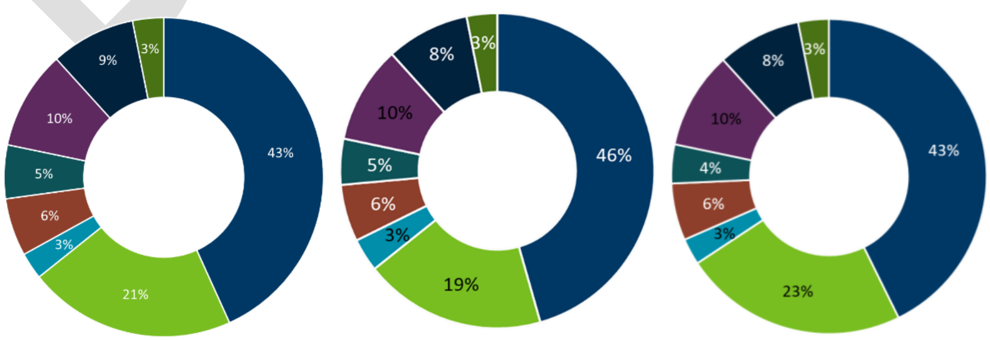


Table 7.2. Comparison of initial capital investments of the recommended options

Category		Option 1 (preferred)	Option 2	Option 3
Source water		All groundwater	All groundwater	Groundwater and SPRWS
Homes receiving treatment	**Number of new POETS proposed**	98	159	98
	Cumulative number of POETS; includes existing and proposed	236	297	236
	New connections to public water systems	2,062	2,062	2,062
Wells	**Total existing and proposed public wells receiving treatment**	33	39	24
	New public wells built	5 new wells (3 of these replace contaminated wells)	5 new wells (3 of these replace contaminated wells)	3 new wells (1 of these replaces a contaminated well)
	Wells sealed; includes public and private wells	2,070	2,070	2,070
Treatment plants	**New treatment plants (total capacity)**	6 (total capacity is 23,580 gpm)	6 (total capacity is 29,580 gpm)	6 (total capacity is 23,580 gpm)
	Modifications to existing treatment plants (additional capacity)	1 (additional capacity is 1,750 gpm)	1 (additional capacity is 1,750 gpm)	–
Miles of water mains; includes raw water distribution, treated water distribution, and neighborhood mains		72	75.3	74.6

Table 7.3. Comparison of community-by-community initial capital investments for the recommended options

Community	Option 1 (preferred) HI>.5 GAC COMMUNITY PROJECTS	Option 2 HI>.3 GAC COMMUNITY PROJECTS	Option 3 SPRWS HI>.5 GAC COMMUNITY PROJECTS
Afton **Grey Cloud Island** **Denmark** **Maplewood**	• Supply private wells with POETS if over threshold		
Cottage Grove	• Treat 8 of 12 existing public wells • Replace 2 existing public wells with 1 new public well • 2 new treatment plants • Connect 67 homes • Supply other private wells with POETS if over threshold		
Lake Elmo	• Drinking water supply from groundwater for future growth[a] • Connect 257 homes • Supply other private wells with POETS if over threshold		• Connection to SPRWS • Connect 257 homes • Supply other private wells with POETS if over threshold
Lakeland **Lakeland Shores**	• Connect 453 homes • Supply other private wells with POETS if over threshold		
Newport	• Interconnect with Woodbury • Connect 9 homes • Supply other private wells with POETS if over threshold		
Oakdale	• Expand public water system to treat 2 of 9 existing public wells and 2 new public wells • Connect 58 homes • Supply other private wells with POETS if over threshold		• Connection to SPRWS • Connect 58 homes • Supply other private wells with POETS if over threshold
Prairie Island Indian Community	• Treat 1 existing public well • 1 new treatment plant		
St. Paul Park	• Treat 3 of 3 public wells • 1 new treatment plant • Connect 28 homes • Supply other private wells with POETS if over threshold		
West Lakeland	• 2 new public wells • 1 new treatment plant • Connect 1,190 homes to new distribution system		

Community	Option 1 (preferred)	Option 2	Option 3
Woodbury	• Interconnect with Newport • Treat 14 of 19 existing public wells • 1 new treatment plant • Supply other private wells with POETS if over threshold	• Interconnect with Newport • Treat 15 of 19 existing public wells and 5 new public wells • 1 new treatment plant • Supply other private wells with POETS if over threshold	• Interconnect with Newport • Treat 14 of 19 existing public wells • 1 new treatment plant • Supply other private wells with POETS if over threshold

a. Lake Elmo may need alternate sources of water to avoid adverse effects on White Bear Lake. Initial capital funds provide funding for utilizing groundwater in ways that comply with the current Court Order. This funding level is based on a cost estimate of creating an interconnect from southern Woodbury; however, other approaches within that funding range may also be explored.

7.3.4 Preferred option

The Co-Trustees prefer **recommended Option 1 – Community projects with a treatment threshold of HI > 0.5 and GAC**. Any of the three options would be reasonable and necessary in response to PFAS releases in the East Metropolitan Area, and not inconsistent with provisions found in Minn. Stat. 115B, MERLA. However, the Co-Trustees believe that recommended Option 1 is preferable because it provides resiliency to potentially lower HRL/HBV PFAS values or changing levels of contamination in the future without overspending on initial capital infrastructure. As a result, it allows for more years of O&M coverage by Settlement funds and a larger contingency fund to address future uncertainty that can be directed where it is needed. Further, once Settlement funds are depleted, the 2007 Consent Order will cover O&M costs for treatment only to HI > 1; all of the options address this concern for private residential wells with POETS by providing O&M funding for more than 100 years; however, recommended Option 1 reduces this additional cost burden for public water supply to continue treatment below HI > 1 relative to recommended Option 2.

7.4 Process for developing a final recommendation

A 45-day public comment period and meetings on the 3 recommendations will be held during September 10–October 26.

The Co-Trustees are planning a series of meetings with communities and the public to explain the recommended options, answer questions, and to continue discussions about community needs. This process will include the following:

- September 9: Briefing for work groups and legislature
- September 10: Release of the draft Conceptual Plan to the public
- September 15: Citizen-Business Group meeting
- September 16: Government and 3M Working Group meeting
- September 22 and 23: Four virtual public meetings (at 3–5 PM and 7–9 PM each day)
- Late September–October: One-on-one technical and leadership meetings with LGUs
- October 26: Close of public comment period.

A recording of one of the public meetings will also be posted on the 3M Settlement website for those who cannot attend a live public meeting. For more information or to submit feedback, please see the 3M Settlement website at https://3msettlement.state.mn.us/.

Once the public comment period has closed, the Co-Trustees will review feedback from the public, and the work groups and communities; finalize the evaluations of the recommended options; and make the final decision. They will then draft Chapter 8 describing the outcome of the Conceptual Plan, and provide the final Conceptual Plan to the public in January 2021.

8. References

AACE International. 2019. Recommended Practice 18R-97: Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries. March 6.

Bauer, E.J. 2016. C-39, Geologic Atlas of Washington County, Minnesota. Minnesota Geological Survey. Available: http://hdl.handle.net/11299/178852.

Berg, J.A. 2019. Groundwater Atlas of Washington County, Minnesota. Minnesota Department of Natural Resources, County Atlas Series C-39, Part B, Report and Plates 7–9. Available: https://www.dnr.state.mn.us/waters/programs/gw_section/mapping/platesum/washcga.html.

DNR. 2018. Minnesota Water Conservation Report 2018. November. Minnesota Department of Natural Resources. Available: https://files.dnr.state.mn.us/waters/watermgmt_section/water_conservation/2018-water-conservation-report.pdf.

EPA. 2019. *EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan*. EPA 823R18004. U.S. Environmental Protection Agency. February. Available: https://www.epa.gov/sites/production/files/2019-02/documents/pfas_action_plan_021319_508compliant_1.pdf.

Metropolitan Council. 2014a. 2040 Thrive MSP 2040 Plan. Available: https://metrocouncil.org/Planning/Projects/Thrive-2040/Thrive-MSP-2040-Plan.aspx?source=child.

Metropolitan Council. 2014b. Twin Cities Metropolitan Area Groundwater Flow Model Version 3.0. Available: https://metrocouncil.org/Wastewater-Water/Planning/Water-Supply-Planning/Metro-Model-3/MM3/MM3-Report.aspx.

Metropolitan Council. 2016a. Regional Groundwater Recharge and Stormwater Capture and Reuse Study, North and East Metro Study Area. Final Report. Prepared by HDR. Metropolitan Council: Saint Paul. May. Available: https://metrocouncil.org/Wastewater-Water/Publications-And-Resources/WATER-SUPPLY-PLANNING/Regional-Groundwater-Recharge-Stormwater-Capture.aspx.

Metropolitan Council. 2016b. Washington County Municipal Water Coalition Water Supply Feasibility Assessment. Prepared by Short Elliott Hendrickson Inc. Metropolitan Council, Saint Paul. October. Available: https://metrocouncil.org/Wastewater-Water/Publications-And-Resources/WATER-SUPPLY-PLANNING/Washington-County-Municipal-Water-Coalition.aspx.

MPCA. 2019. St. Croix River Basin TMDLs. Minnesota Pollution Control Agency. Available: https://www.pca.state.mn.us/water/tmdl/st-croix-river-basin-tmdls.

NPS. 2001. Final Cooperative Management Plan Environmental Impact Statement: Lower St. Croix National Scenic Riverway. National Park Service. Available: https://www.nps.gov/sacn/learn/management/upload/Final_St_Croix_CMP_EIS.pdf.

NPS and Friends of the Mississippi River. 2016. State of the River Report 2016. National Park Service and Friends of the Mississippi River. Available: http://stateoftheriver.com/state-of-the-river-report/.

Sanocki, C.A., S.K. Langer, and J.C. Menard. 2008. Potentiometric Surfaces and Changes in Groundwater Levels in Selected Bedrock Aquifers in the Twin Cities Metropolitan Area, March–August 2008 and 1988–2008. U.S. Geological Survey Scientific Investigations Report 2009–5226.

Washington County. 2014. Washington County Groundwater Plan 2014–2024. Available: https://www.co.washington.mn.us/DocumentCenter/View/794/Groundwater-Plan-2014-2024?bidId.

Washington County. 2018. Washington County 2040 Comprehensive Plan. A Policy Guide to 2040. Available: https://www.co.washington.mn.us/DocumentCenter/View/21955/Washington-County-2040-Comprehensive-Plan-Draft-Submitted-to-Met-Countil.