

EXHIBIT 1

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Sherburne County | Elk River proposed municipal solid waste landfill expansion

Elk River Landfill, Inc. proposes to expand its existing municipal solid waste (MSW) landfill near Elk River. The landfill currently accepts MSW, industrial waste, and construction and demolition waste. It is proposing a 162.36-acre expansion of the MSW fill area, which includes the conversion of 7.21 acres of already permitted construction and demolition fill area. The proposed project will provide approximately 26.67 million cubic yards of MSW disposal capacity.

Our role

The expansion of an MSW landfill of this size requires the project to go through the environmental impact statement (EIS) process. An EIS is a more extensive form of environmental review with more detailed information about the project's potential for significant environmental impacts. The EIS also provides project alternatives and identifies methods to reduce environmental effects. This process begins with the scoping environmental assessment worksheet (SEAW) and draft scoping decision document (DSDD) to inform what is going to be studied in the project's EIS.



Comment on the draft documents

The public is encouraged to comment on draft documents for environmental review that will open for public comment for 30 days starting Tuesday, Oct. 28.

A community meeting is scheduled for 5:30 p.m. on Wednesday, Nov. 19, at the Zimmerman-Livonia Fire Hall and Event Center.

[Review and comment](#)[Community meeting](#)

Elk River Landfill also will have to apply to the MPCA for a certificate of need (CON) to expand its MSW capacity. As part of its application, the landfill will have to show a need to take on more MSW in current county and regional solid waste management plans.

After submitting the CON application, the landfill will then have to apply for a new solid waste permit, which will go on public notice for 30 days during the EIS and CON processes. The solid waste permit and CON processes will take place after MPCA completes the EIS process.

Location

Elk River Landfill is located five miles north of Elk River, adjacent to U.S. Highway 169 in Sherburne County on a 550.24-acre portion of land owned by Waste Management. The proposed expansion will take the landfill north into Livonia Township. It will include the purchase of an additional 175.75 acres from Capital Land Group where sand and gravel mining operations by Martin Marietta are currently taking place. The landfill is located in a mix of industrial, agricultural, and residential areas.



Project information

Elk River Landfill currently accepts waste from 23 counties in central Minnesota and small quantities from Iowa and Wisconsin. The greatest volume of waste hauled to the landfill comes from Anoka and Hennepin counties.

The landfill will reach its permitted capacity in approximately three years. Without additional capacity, area businesses and residents won't have a local facility where they can send their waste. This proposed expansion will extend the operational life of the landfill.

The proposed project will consist of the construction of the expanded MSW disposal area with a special protective layer at the bottom designed to prevent liquids from leaching out and contaminating soil and groundwater. A system of basins and pumps will collect and remove the liquids to a treatment facility. The project will also include construction of a new road for trucks to deliver waste to the site and construction of stormwater ponds to collect and control rainwater runoff from the site. When the landfill is full, Elk River Landfill will cover it with a

durable, waterproof cap and vegetation such as grass to prevent erosion and stop water from getting into the waste.

The SEAW looks at items in the environmental assessment worksheet to determine the scope of the EIS. Some key findings include:

- The SEAW identified climate adaptation and resilience, permits, fish, wildlife, plant communities, sensitive ecological areas, and historic properties as important. The MPCA determined the information provided in the SEAW is adequate for use in the EIS with only minor updates.
- The SEAW identified land use, water resources, air quality, greenhouse gases, and noise as potentially significant issues. Information beyond what is in the SEAW will be included in the EIS.
- The DSDD provides a summary of the items to be reviewed in the EIS.

Next steps

The SEAW and DSDD will open for public comment for 30 days starting Tuesday, Oct. 28, 2025.



Public meeting

The MPCA will host a public meeting for community members starting at 5:30 p.m. on Wednesday, Nov. 19, at the Zimmerman-Livonia Fire Hall and Event Center to discuss the project in detail. There will be an open house and brief presentation on the SEAW and DSDD.

[Meeting details](#)

After the public comment period ends, the agency will review all comments and create a final scoping decision document that will be reviewed as part of the EIS. As the project progresses through the EIS process, the MPCA will offer multiple opportunities for public comment.

Elk River Landfill plans to develop the expanded landfill in phases following a typical landfill sequence with permitting followed by the construction, filling, and capping of individual cells. Construction activity will occur throughout the site's life as new cells become active or as completed cells are capped.

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EXHIBIT 2



Elk River Landfill

Elk River Landfill is a regional facility that provides safe and convenient disposal services for communities, businesses and industries serving Sherburne County and surrounding areas.

Waste Management's approximately 300 disposal facilities employ the latest advances in landfill technology. This facility is engineered with environmental protection systems that meet or exceed rigorous government regulations and are subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and removal, and landfill gas collection and control.

Containment Design

Elk River Landfill utilizes a double-layer, 2-foot clay and a 60 mil geosynthetic liner system to ensure that waste and wastewater (leachate) are contained and isolated from soil and groundwater.

Leachate Collection & Treatment

Leachate is discharged to the local Publicly Owned Treatment Works (POTW).

Groundwater Monitoring

Groundwater is monitored at 31 wells, which are upgradient and downgradient of the waste disposal footprint. The groundwater monitoring network is sampled and analyzed in accordance with the procedures of the facility's groundwater sampling and analysis plan.

Landfill Gas Management

Elk River Landfill collects and manages landfill gas through an extensive flare system with 76 wells, which reduces emissions and minimizes odor. The Landfill-Gas-to-Energy plant produces about 3.2 MW of energy, and powers approximately 2,400 homes in Elk River, Minnesota.

Security

Site security is ensured by controlled, limited access to the facility through the gatehouse as well as perimeter fencing and natural barriers. During non-business hours the gate is locked and monitored by 24-hour electronic surveillance.

ELK RIVER LANDFILL

22460 U.S. 169
Elk River, MN 55330
800 963 4776

HOURS OF OPERATION

7:00 am – 4:30 pm
Monday – Friday
Closed Saturday & Sunday

YEAR OPENED

1972

PROJECTED LIFE REMAINING

49 years

FACILITY ACREAGE

510.5 acres

PERMITTED FOOTPRINT

191.4 acres

REMAINING PERMITTED CAPACITY

15M cubic yards

APPROXIMATE TONS PROCESSED ANNUALLY

300,000 tons

OWNERSHIP

Elk River Landfill, Inc. is owned by
Waste Management of Minnesota, Inc.

PERMIT TYPE & PERMIT

Waste Facility Permit No. SW-74

REGULATORY AGENCIES

City of Elk River; Minnesota Pollution
Control Agency (MPCA); Occupational
Safety and Health Administration
(OSHA); Sherburne County

EMPLOYEES

11

Acceptable Material

- Asbestos – Friable/Non Friable
- Construction & Demolition (C&D) Debris
- Drum Management – Solids
- Industrial & Special Wastes
- Municipal Solid Waste (MSW)
- Tires
- Yard Waste

Unacceptable Material

- Fluorescent Bulbs
- Gas Refrigerators
- Hazardous Waste
- Liquids
- Propane Tanks

Recycling Services Provided

- Appliances
- Batteries
- Electronic
- Metal
- Tires
- White Goods

Risk Mitigation

Waste Management provides the highest level of services, backed with state-of-the-art site design and management systems, to help minimize risks and reduce liabilities.

Community Partnerships and Involvement

Elk River Landfill is proud to be an active supporter of community events and programs that make Sherburne County and its surrounding cities a strong and healthy place to live, work and play.



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COMMUNITIES SERVED

Sherburne County and surrounding cities

EXHIBIT 3



January 2024



Metropolitan Solid Waste Management Policy Plan 2022-2042

A 20-year policy plan for solid waste management that sets goals and policy for the metropolitan solid waste system.

Legislative charge

Minn. Stat. § 473.149 - A metropolitan long range policy plan for solid waste management, prepared by the Pollution Control Agency, sets goals and policies for the metropolitan solid waste system. This plan includes goals and policies for solid waste management, including recycling consistent with section 115A.551 and household hazardous waste management consistent with section 115A.96, subdivision 6. The MPCA shall include specific and quantifiable metropolitan objectives for abating, to the greatest feasible and prudent extent, the need for and practice of land disposal of mixed municipal solid waste and specific components of the solid waste stream.

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Acronyms and initialisms

CII	commercial, industrial, institutional
CON	Certificate of Need
CSWMP	County Solid Waste Management Plans
Demolition debris	construction and demolition debris
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency
EPD	Environmental Product Declaration
EPR	Extended Producer Responsibility
GHGs	Greenhouse gases
GHGe	Greenhouse gas emissions
HERC	Hennepin Energy Recovery Center
HHW	household hazardous waste
ISW	industrial solid waste
LRDG	Local Recycling Development Grants
MLAA	Metropolitan Landfill Abatement Account
MMSW	mixed municipal solid waste
MN USGBC	Minnesota U.S. Green Building Council
MPP	Metro Policy Plan
MSW	municipal solid waste
MnDOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MRF	materials recovery facility
PFAS	Per- and polyfluoroalkyl substances
PUC	Minnesota Public Utilities Commission
RDF	refuse derived fuel
RMD	recycling market development
ROD	restriction on disposal
SMM	Sustainable Materials Management
SSO	source separated organics
TCMA	Twin Cities Metropolitan Area
WARM	waste reduction model
WMA	Waste Management Act
WTE	waste-to-energy

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Part one: Introduction and background

In 1980, the Minnesota Legislature recognized the importance of waste management with the passage of the Waste Management Act (WMA) in Minn. Stat. § 115A. This statute's purpose is to protect the state's natural resources and public health by improving integrated solid waste management. The statute establishes the following hierarchy of preferred solid waste management practices, in order from most to least beneficial to the environment:

1. Waste reduction and reuse
2. Waste recycling
3. Composting of source-separated compostable materials, including but not limited to, yard waste and food waste
4. Resource recovery through mixed municipal solid waste (MMSW) composting or incineration
5. Land disposal which produces no measurable methane gas, or which involves the retrieval of methane gas as a fuel to produce energy to be used on-site or for sale
6. Land disposal which produces measurable methane, and which does not involve the retrieval of methane gas as a fuel to produce energy to be used on-site or for sale

The above hierarchy was established to achieve the following goals, as provided in Minn. Stat. § 115A.02(a):

1. Reduction in the amount and toxicity of waste generated
2. Separation and recovery of materials and energy from waste
3. Reduction in indiscriminate dependence on disposal of waste
4. Coordination of solid waste management among political subdivisions
5. Orderly and deliberate development and financial security of waste facilities including disposal facilities

To avoid confusion as to which types of plans are being discussed, this document will be referred to as the Metro Policy Plan (MPP); the plans the counties develop will be referred to as County Solid Waste Management Plans (CSWMP). The language in the statutes, where quoted, is not changed and is italicized for clarity.

Purpose of this Plan (MPP)

This MPP establishes the framework for managing the Twin Cities Metro Area's (TCMA) solid waste for the next 20 years (2023-2043). It was prepared in accordance with the requirements of Minn. Stat. § 473.149. It will guide the development and activities of solid waste management and must be followed by the counties in the TCMA. In addition to the counties, the MPCA, solid waste facilities, haulers, businesses, and residents all have a role in implementing the MPP. The MPP supports the goals of the WMA hierarchy, improving public health, reducing the reliance on landfills, conserving energy and natural resources, and reducing pollution and greenhouse gas emissions (GHGe).

The TCMA includes Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington counties. Excluded cities from the TCMA are Northfield, Hanover, Rockford, and New Prague.

Participants in the process

The MPCA staff held several meetings with stakeholders in advance of the release of the draft MPP. Several public meetings were also held after the release of the draft MPP to gather input from other MPP stakeholders, including members of the recycling and waste industry, counties, non-governmental organizations (NGOs), and members of the public.

Figure 1. TCMA County map



How the MPP will be used by stakeholders

The MPP will guide all stakeholders in their roles to ensure that waste is managed to the highest and best use.

The MPP will:

1. Inform waste generators (residents, businesses, public entities) about their roles and responsibilities in waste management.
2. Educate generators about solid waste issues and services (both public and private) available to them.
3. Identify and direct state agencies and county governments that provide assistance.

The MPP will outline the responsibility of the waste industry in providing future solid waste facilities and services. For the purposes of this MPP, the “waste industry” includes all entities, public and private, that collect and/or manage solid waste in some form, including recyclables, household hazardous waste (HHW), and problem materials.

The MPP will rely upon organizations that support the reuse industry, including repair organizations and non-government organizations, such as thrift stores.

The MPP will:

1. Provide guidance to counties and regional governmental entities in developing county solid waste ordinances, work plans, and budgets.
2. Direct the MPCA oversight responsibilities, including administration of the Metropolitan Landfill Abatement Account program, CSWMP reviews, and the MPCA’s approval of solid waste facility permits and landfill certificates of need (CON).
3. Assist the MPCA in its regulatory, enforcement, and technical assistance functions that affect the TCMA.
4. Contribute to policy discussions regarding solid waste legislation affecting the TCMA.
5. Influence local jurisdictions in the planning and provision of services to residents and businesses.
6. Manage waste in a way that minimizes adverse impacts on the environment including, but not limited to, GHG reduction, resource conservation, and long-term legacy impacts as a result of land disposal.

Current system status

The TCMA solid waste system is the result of planning and development that began with the 1980 WMA. Since 1980, much has been accomplished.

- The TCMA recycles 45.2% of the MMSW generated. The recent improvement is largely due to advances in organics collection for food to people, food to livestock, source separated organics (SSO) management, and yard waste composting.
 - Reuse and recycling activities contribute significantly to the economy of the region.
 - Resource recovery facilities that serve the TCMA are now operating at full capacity.
 - Resource recovery facilities manage 28% of the MMSW generated.
 - Land disposal has decreased by 18% since 2008.
 - Problem materials such as major appliances, mercury-containing products, and electronic waste are banned from the MMSW stream, and infectious wastes are separately managed.
 - A system to collect and manage HHW is available to all residents, and all seven counties participate in an arrangement of shared reciprocity.
- As a region, we should be proud of the advances we have made because of the efforts from product producers, waste generators, waste industry, residents, and government.

What challenges still exist?

The Minnesota solid waste system has faced several challenges over the past six years. A few large issues have indirectly affected the solid waste system in a negative way. These have slowed progress toward the objectives in the previous MPP. To meet our environmental goals, the following challenges will need to be further addressed.

The COVID-19 pandemic significantly disrupted all systems in Minnesota in 2020 and 2021. Transmission of the virus among solid waste workers was a safety concern, and outbreaks among staff at materials recovery facilities (MRFs) resulted in operational shutdowns. MRFs excelled at maintaining operations to the extent possible. However, requests for disposal allowances were yielded during this time.

The TCMA experienced social unrest following the murder of George Floyd. Some of the large Minneapolis MRFs shut down temporarily as a precautionary measure. Limited capacity exists in the region to absorb the material processed at those facilities. This led to a request to dispose of recyclable material. Permission was granted for the one-time disposal of 59.7 tons of recyclables, which represents .000006% of the 1,000,000 tons of recyclables generated in the TCMA in 2020.

These events highlighted the lack of contingency plans the TCMA has for recyclable, reusable, and compostable materials. Maintaining and developing new end markets will continue to be important for

A new name for this plan

The MPCA expects the fair treatment and meaningful involvement of communities of color, Indigenous communities, and low-income communities in agency actions and decisions that affect them. As the state takes initial steps to acknowledge its role in systemic racism, we recognize the power of language. Current Minnesota statute refers to the solid waste plans that metro counties develop as “master” plans. The term “master”, which is often defined as commanding control or being eminently skilled, has been identified as a word to remove in certain contexts due to its connection with the history of masters and slavery in the United States. While this statute remains unchanged as of the release of this plan, where possible, this plan uses the name “county solid waste plan” in place of “county master solid waste plan”. A noted exception is the use of “county master plan” in Appendix D, to remain consistent with current statute language. An additional benefit to using the term “county solid waste plan” is that it harmonizes the language with the term used for Greater Minnesota counties.

Minnesota's long-term success. A recent example of this is WestRock's unexpected closing of its corrugated cardboard line, resulting in a reduction of 600 tons of daily capacity, creating a major impact to local MRFs and haulers.

Success creates challenges, too. For example, an increase in organics collection programs throughout the TCMA point to the need for more planned programs in the coming years. Despite anticipated increases in feedstock, there is not a corresponding increase in organics processing capacity in the region. To meet our organics objectives, additional capacity to process organics will be necessary.

Minnesota's changing climate is creating stresses for the solid waste system, as severe weather events increase in frequency. Structural damage from flooding, tornados, and strong hail-producing thunderstorms generates large amounts of solid waste. Downed trees put pressure on the yard waste and composting facilities. The rise of EAB and other tree diseases compounds this issue as trees in Minnesota are dying at an increasing rate. The wood from the trees affected by EAB cannot be transported out of quarantine zones, leaving local entities to handle large volumes of wood waste without perpetuating the spread of the EAB. The TCMA will need to identify ways to manage the onslaught of wood waste over the coming years. Management solutions are needed to handle generated wood safely and efficiently.

Per- and polyfluoroalkyl substances (PFAS) are a significant challenge. Invented in the 1930s, PFAS are still commonly used for their water- and grease-resistant properties in many industrial applications and consumer products such as carpeting, waterproof clothing, upholstery, food paper wrappings, cookware, personal care products, fire-fighting foams, and metal plating. PFAS are persistent and can bioaccumulate, meaning the amount builds up in the body over time. When landfilled, PFAS migrates into the leachate, which is treated at a wastewater treatment facility. With no existing removal systems installed at landfills or wastewater plants to remove PFAS, the treated wastewater is discharged into surface water. It is not clear if waste-to-energy (WTE) facilities maintain the high temperatures required to destroy PFAS. The waste industry is in the process of identifying ways to address this unusual class of chemicals. As the solid waste system continues to evolve, adaptations are needed to safely manage new materials.

Establishing reuse and recycling markets for new additional materials is imperative to meet reuse and recycling goals and other objectives in the MPP. Market development is a complicated task requiring considerable lead time. New materials that can be recycled must be generated with enough volume to justify and sustain a business model.

Finally, the closure of the Great River Energy (GRE) processing and WTE facility has resulted in more than 250,000 tons of waste going to landfill. This closure directly increased landfill expansions in the TCMA. In many ways, the GRE closure was the result of an intersection of waste and energy policy. Minnesota needs to figure out how to manage the policy nexus for these facilities. The energy created at these facilities is not cost competitive with wind and solar and is not universally viewed as a clean energy source. However, the important role they serve in solid waste management should not be underscored. Left unresolved, other resource recovery facilities may follow suit. Without achieving greater waste diversion and reduction rates, that will result in an increased amount of waste being land-disposed.

Part two: Framework for change

This section of the MPP lays out a framework for a regional vision, key themes, goals, and policies. This framework will guide all decisions of the MPCA, regional governing entities, metropolitan counties, solid waste facilities, haulers, and other stakeholders with respect to the TCMA solid waste system.

Vision

This MPP is designed to help stakeholders exceed the benchmarks established in state law. The vision is that the TCMA will put more emphasis on the following:

- Pollution prevention
- Sustainable materials management (SMM)
- Conservation of natural resources and energy
- Reduced reliance on landfills and WTE
- Reduced toxicity of waste
- Equitable improvement in public health for all residents
- Supporting the economy
- Reducing GHGe and the impacts of climate change

The MPP sets forth a vision of sustainability for the TCMA solid waste management system. The TCMA is a sustainable community that minimizes waste, prevents pollution, promotes efficiency, reduces GHGe and the impacts of climate change, saves energy, reduces toxicity, and develops resources to revitalize local economies. The integrated waste management system is an essential component of the infrastructure of a sustainable community.

Solid waste is managed according to the principles of SMM that support sustainable communities and environments. The benefits of sustainable and healthy communities are shared equally throughout the region by all residents. The solid waste management hierarchy is central to attaining the twin objectives of sustainability and proper solid waste management because it emphasizes the higher end management methods.

Figure 2. Minnesota's solid waste management hierarchy of preferred methods



Key themes

The following key themes underlie all elements of the MPP.

SMM offers a systematic approach to using and reusing materials more productively over their entire life cycles. SMM considers the environmental impact of the entire life cycle, not just disposal. This holistic approach emphasizes management methods at the top of the waste hierarchy as well as reducing toxicity. These methods have greater environmental benefits. For example, preventing food waste is more impactful than increasing glass recycling rates.

GHGe reductions can be found throughout the solid waste management system. There are potential reductions in GHGe to be found throughout the life cycle of products and in the waste management system. This is particularly true at the top of the hierarchy and the design phase of a product when GHGe can be avoided altogether. Other system changes can affect GHGe in other sectors. For example, organized collection reduces the number of heavy truck miles and emissions.

The benefits and burdens of the solid waste management system must flow equally to everyone. The MPCA is committed to ensuring that pollution does not have a disproportionate impact on any group of people. This is a principle of environmental justice. Decisions about siting solid waste facilities should include all stakeholders. Translating educational materials into the languages spoken in the TCMA is important, as is including people who have not traditionally had a voice in decisions that affect them.

EPR presents great opportunities for shifting the burden of management from the counties and cities to the producers. Product stewardship and extended producer responsibility (EPR) is a policy approach to extend the producer's responsibility to include environmental impacts from all stages of the product's life cycle. This includes incentives for durability, reusability, toxicity reduction, and finding the highest and best use of materials and waste. In current practice, product stewardship requires manufacturers to share in the physical and financial responsibility of collecting and recycling products at the end of their useful life.

Minnesota has several product stewardship laws for paint and electronics and has been a leader in product stewardship efforts. Other states such as Maine, Colorado, Oregon, and California have adopted extensive EPR programs from which we can learn.

Goals and policies

The following goals and policies provide the basis for improving solid waste management in the TCMA. For the purposes of this section, "goal" is defined as a desired result; "policy" is defined as a course of action adopted by a government, party, business, or individual.

Goal 1: Protect and conserve. Manage materials in a manner that will protect the environment and public health, reduce GHGe, conserve energy and natural resources, and reduce toxicity and exposure to toxics.

The goal of the WMA is to protect Minnesota's land, air, water, and other natural resources, and public health by improving waste management to serve the following purposes: reduce the amount and toxicity of waste generated; increase the separation and recovery of materials and energy from waste; and coordinate the statewide management of solid waste and the development and financial security of waste management facilities, including disposal facilities. This goal recognizes a prevention-based approach to waste management to reduce, to the extent feasible, adverse effects on human health and the environment.

Policy 1: Challenge current waste management practices to identify materials with opportunities for management methods that fall higher on the waste hierarchy.

Policy 2: Focus on reuse and prevention. Apply SMM framework to decision making to decrease the environmental impact. Hold manufacturers responsible to design for repair, reuse, and recyclability.

Policy 3: Support and strengthen reuse and recycling markets to increase demand for reusables and recyclables.

Policy 4: Ensure systems are in place that foster the growth of organics recovery.

Policy 5: Promote recovery of energy when disposing of waste through WTE.

Policy 6: Strengthen compliance with cornerstone environmental statutes.

Policy 7: Increase public participation in decisions that impact them with special emphasis on Environmental Justice.

Policy 8: Account for all phases of a material's life cycle, including environmental and economic impacts.

Policy 9: Reduce toxicity by working with manufacturers to eliminate the use of hazardous components in packaging and products.

Goal 2: Whether public or private, hold all members of the solid waste system accountable for meeting the goals of this MPP.

To achieve the aggressive goals established in this MPP and by the Legislature, all parties in the solid waste system must be held accountable, and the MPCA must provide oversight of the system. Cities and counties must ensure the systems are in place for the proper management of waste, emphasizing managing it higher on the hierarchy. Generators must use the tools provided to properly manage the waste they create and to reduce the amount of waste created. Haulers and facility operators must ensure that waste is managed properly upon collection and look for opportunities to shift materials up the hierarchy.

Policy 10: Support the collection of reliable data to ensure that all parties in the solid waste system accurately measure progress toward achieving the objectives of this MPP.

Policy 11: Ensure that demolition debris and industrial wastes are categorized and are managed according to the applicable Statutes and Rules. Measure more accurately the composition of non-MMSW generated in the TCMA and being landfilled in Minnesota.

Policy 12: Increase opportunities for cities to implement organized collection for recycling and MMSW.

Policy 13: Cities and counties hold haulers and businesses in their communities accountable for managing waste according to the MPP via their licensing agreements.

Policy 14: The MPCA provides oversight of the system by holding counties and private businesses accountable. The Legislature holds the MPCA accountable for meeting waste management goals.

Policy 15: Hold producers responsible for the treatment or disposal of post-consumer products.

Policy 16: Set goals and performance standards following consultation with stakeholders on product stewardship.

Goal 3: Systematically and steadily promote more regional cohesiveness and collaboration to foster a synergistic, regional approach.

To achieve our goals of reducing the amount of solid waste generated and recycling/composting 75% of our solid waste by 2030, it is imperative that the counties work in concert and avoid duplication of efforts. This includes consistent uniform ordinances, greater collaboration between staff and leaders in each of the seven metro counties, and planning for facilities through a regional lens.

Policy 17: Develop model ordinances that could be enacted by all counties.

Policy 18: Local governments work together to develop a consistent ordinance structure that allows private entities to smoothly operate across the region.

Policy 19: Promote efficiencies and cost effectiveness and reduce environmental costs in the delivery of integrated solid waste management services.

Policy 20: Assure elected county officials understand the importance of supporting and maintaining WTE facilities.

Part three: MPP 2022-2042

The MPP provides guidance to all stakeholders responsible for TCMA solid waste management and was developed in accordance with the requirements of Minn. Stat. § 473.149, subd. 2d. for a land disposal abatement plan. It describes broad regional system objectives, a landfill diversion goal, and the strategies necessary for solid waste programs and services to meet the region's needs for the next 20 years. The MPP recognizes the inter-county complexity of the TCMA solid waste system and the value of and need for regional approaches. Specific details associated with implementing the MPP on a local level will be refined in the CSWMPs and any regional plan developed by the metropolitan counties. The MPP identifies where specific stakeholder actions are necessary to implement the objectives and strategies.

The MPP:

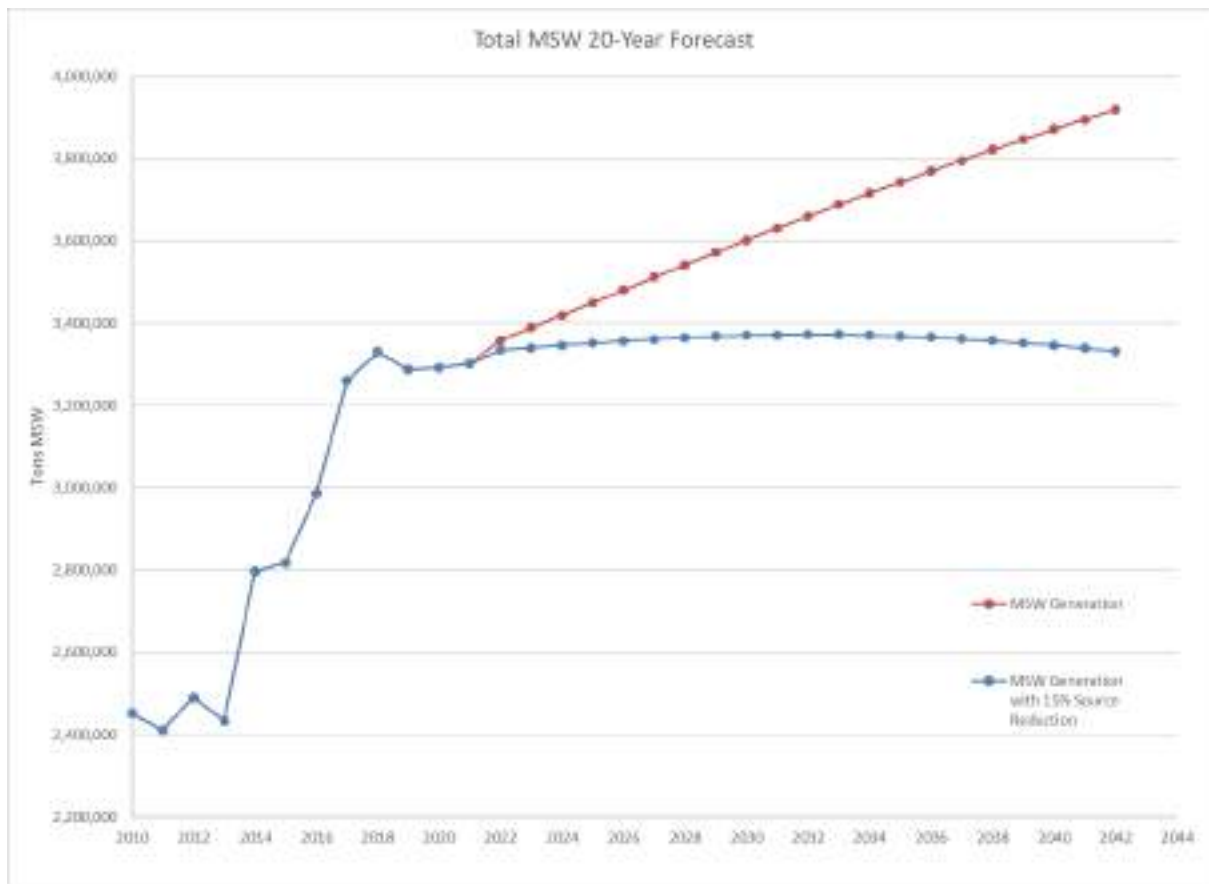
1. Places emphasis on the upper end of the hierarchy (waste reduction, reuse, recycling, and organics recovery).
2. Establishes objectives for each waste management method.
3. Achieves full use of resource recovery facility capacity and implements the Restriction on Disposal (ROD) of MMSW requirements.
4. Establishes a goal to minimize the amount of metro MMSW land disposal that will occur.

The MPP includes numerous strategies for reducing waste and increasing recycling and organics recovery. All stakeholders in the system have roles and responsibilities to ensure successful implementation of these strategies. A table that identifies each strategy is provided in Appendix G.

Regional waste generation forecast

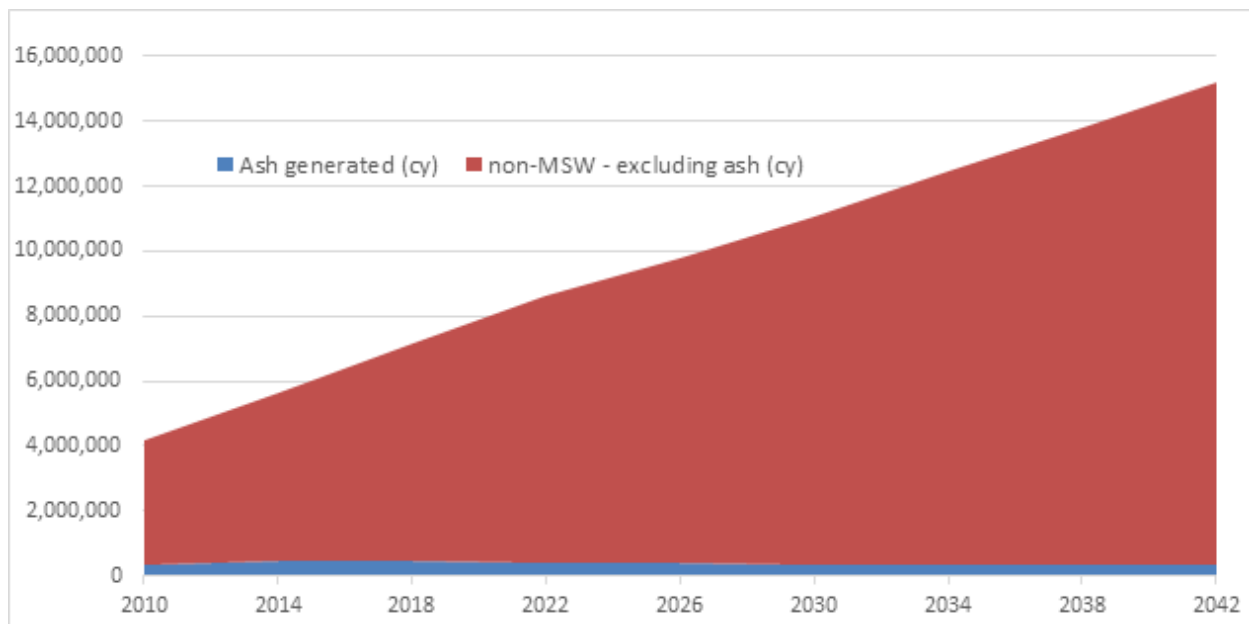
In 2021, the TCMA generated 3.3 million tons of MMSW. Metro MMSW generation is forecasted to grow to 3.92 million tons by 2042 (see Figure 3). The figure also includes the 15% reduction strategy to help visualize the intent of source reduction. Achieving a 15% reduction from the forecast amount will require waste generation to remain equal to the current generation going forward. This forecast does not include the non-MMSW waste stream (i.e., construction, demolition, and industrial wastes). The MMSW forecast was generated using waste generation amounts from 2010-2021. This period was chosen because the 2007-2009 recession created a new baseline.

Figure 3. Total MSW Generation Forecast with the 15% source reduction objective



Non-MSW like demolition debris, contaminated soil, and industrial waste continues to experience growth in generation of industrial and demolition debris (see Figure 4). It is forecasted that annual generation of non-MSW will increase by 6,000,000 cubic yards over the next 18 years. Reduction of non-MSW is vital to reach environmental goals in the future. Ash generation is forecasted to remain consistent over the next 20 years. Reducing or ceasing operations at Hennepin Energy Recovery Center could lower the amount of ash being land disposed but would greatly increase the need for MMSW disposal over the life of the plan.

Figure 4. Non-MSW and Ash Forecast



Sustainable Materials Management (SMM)

SMM overview

SMM identifies the best use and management of materials, considering the environmental impacts throughout the life cycle of materials. The major stages in a material's lifecycle are:

- Raw materials extraction
- Product manufacturing
- Product use
- Transportation
- End of life management

To protect the environment and human health, an understanding of “waste” must broaden. The impact of materials and waste include GHG emissions, pollution to land, air, and water, and resource depletion. These impacts happen throughout the entire life cycle of a product. All phases of that cycle must be considered, not simply end of life.

SMM includes traditional solid waste management. Management of the upstream impact of materials and the toxic chemicals used to manufacture those materials are also considered. The MPCA and EPA concede that an SMM approach seeks to:

- Use materials in the most productive way with an emphasis on using less.
- Reduce toxic chemicals and environmental impacts throughout the material life cycle.
- Ensure we have sufficient resources to meet today’s needs and those of the future.

An SMM approach invites more interested parties involved throughout the life cycle of a product to provide perspective and provide a broader scope of impact. These potential partners include, but are not limited to, primary chemical formulators, academic researchers, brand owners, retailers, product designers, and consumers.

Life Cycle Assessment

SMM uses Life Cycle Assessment (LCA) to inform decision-making. LCA is a way to model the environmental impacts associated with a material or process from resource extraction through end-of-life management. This yields information on environmental impact indicators, such as GHGe, toxicity, and acidification. These metrics help policymakers focus efforts on high leverage opportunities. At this time, the most widely used environmental indicator is GHGe. According to the EPA, materials can account for up to 42% of GHGe in the U.S. Most of that impact happens in the production lifecycle phase. In alignment with the waste hierarchy, the least environmentally impact action is to produce and use less.

Figure 5. LCA: a methodology for modeling the environmental impacts of a material or product from raw material extraction through end-of-life management



LCA modeling can compare environmental impacts associated with one material versus another. LCA modeling can also compare the impact of different management methods of the same material. Designers and manufacturers can use LCA modeling to determine the life cycle phase(s) in their products' lifecycle with the greatest specific impacts (e.g., water, air, and human health). For instance, electronics manufacturers may find that the use phase impacts are the energy usage by the consumer. The manufacturer can design the product to use less energy. They could also design the product to last longer and be repairable by producing replacement parts.

The ability to track and report on the environmental impacts of our materials management system is critical. Measuring repair activities as a waste reduction activity will be important to support this activity.

SMM for recycling

If Minnesotans recycled and composted all waste, GHGe would be reduced by only 3%. Recycling is important but recycling alone is insufficient. Moreover, material attributes like recyclability do not necessarily correlate with the greatest reduced environmental impacts. It is important to keep in mind that if something is marketed as “compostable” or “recyclable” that does not necessarily mean that it provides the best environmental outcome. For example, a steel coffee can is recyclable, so it may seem like the best packaging choice. LCA modeling comparing steel cans to other coffee packaging types shows that is not the case. Foil pouches result in fewer GHGe, despite having no material end market. That said, recycling plays an important role in the waste management system. If light weight packaging brings the greater environmental benefit, we should support developing recycling markets for packaging like foil pouches. Volatile recycling markets require innovative solutions to remain relevant.

SMM tends to favor prevention and reuse yet also reaffirms the importance of recycling. Recycling is commonly lauded for its ability to decrease demand for landfilling. However, there is a greater demonstrated environmental benefit in recycling when the byproduct alleviates the need to extract virgin materials by mining. The environmental degradation from extraction, energy use during processing, and transportation often tip the scales in favor of recycling. Identifying the highest and best use for each material is the primary consideration under this framework.

SMM and toxicity

Using an SMM approach also sheds new light on the use of toxic chemicals in manufactured materials. The policy and purpose of the Waste Management Act calls for a reduction in the toxicity of waste generated. Reducing toxics in the products we purchase reduces the overall toxicity of waste generated. In the past, the State of Minnesota Office of State Procurement prioritized recycled-content products on merit of recycled content alone. For example, a problem with the statewide flooring contract emerged when the vinyl flooring with recycled content was found to contain legacy heavy metals. The contract now restricts recycled content containing resilient flooring products unless they are third-party certified to conform with NSF/ANSI Standard 332: Sustainable Assessment of Resilient Floor Covering. This highlights the need to look at all material properties, not just recyclability.

Solid waste abatement objectives

Tables 1 and 2 set specific quantifiable objectives for abating the need for and practice of land disposal for the TCMA region over the next 20 years, pursuant to Minn. Stat. § 473.149, subd. 2d. Landfill abatement is best achieved through an integrated solid waste management and SMM approach. Therefore, the statute requires “objectives for waste reduction and measurable objectives for local abatement of solid waste through resource recovery, recycling, and source separation programs.”

Table 1 defines the waste reduction objectives by percentage and tons reduced from forecast expectations. The forecasted trend in waste generation accounts for much of the reduction that

currently is occurring such as light weighting of materials. This plan calls for a 15% improvement on that trend-line following many comments that state that the waste reduction goal needs to be much more aggressive.

Table 2 defines the objectives by percentages of waste generated, and Table 3 defines the objectives in tons. Table 3 shows the objectives in tons based on the current waste forecast in this MPP and is subject to change if the forecast is updated. Several factors were considered when setting the objectives, including:

- Current statutory goals
- The regional waste forecast highlighted at the beginning of Section 3.
- Metro counties will achieve the 75% recycling rate as laid out in Minn. Stat. § 115A.551 by 2030.
- Total compliance with Restriction on Disposal (ROD) is assumed.
 - Additional capacity at any given WTE facility will be used regardless of originating county for MMSW.
- Landfilling is assumed to be a minimum of 5% given the need to manage non-processible waste, bulky items at WTE facilities, and residuals and rejects from recycling and composting facilities.
- Baseline is the last year of observable data (2021) since the latest year of data represent the best data available to the counties and their current education and diversion practices.

Currently, Hennepin County is the sole provider of MMSW to the Hennepin Energy Recovery Center (HERC) facility while Ramsey and Washington split the capacity of the Ramsey-Washington Energy Center. Each of these facilities is assumed to be at capacity due to ROD compliance. Dakota County will continue to send MMSW to the Red Wing processing facility, estimating 10,000 tons in 2020 and 13,000 tons in all subsequent years.

Meeting the objectives will reduce GHGe, conserve resources, reduce land disposal, and recover energy. The goals for recycling, organics, WTE, and landfilling do not change after 2030. The 75% recycling goal will be difficult to reach, so it will remain a relevant target beyond 2030. To continuing making progress, it is prudent to widen our regional focus to include waste reduction, given that the greatest environmental gains occur through reducing waste. Reduced upstream impacts contribute to a common goal with the recycling rate. The Hennepin County Board recently issued a resolution to create a plan for closing the Hennepin Energy Recovery Center sometime between 2028 and 2040. Due to the uncertain timeline, the MPCA is not revising the assumptions in the objective tables. However, history shows that the closure of a WTE facility leads to increased landfilling. MPCA expects that currently projected waste going to HERC would go to landfills if the facility closes. A robust plan to divert additional material and an influx of resources to improve programs and infrastructure may reduce the volume of waste that would be landfilled if HERC is closed. Without aggressive programs to replace HERC an additional 365,000 tons of material would be landfilled per year, which is equivalent to the largest landfill in Minnesota.

Table 1. Waste reduction system objectives in percentages and tons (2021-2042)

Management method	Current system (2021)	2025	2030	2036	2042
Waste Reduction	0%	2.9%	6.4%	10.7%	15.0%
Waste Reduction Tons	0	98,577	231,557	403,919	587,984

Table 2. MMSW management system objectives in percentages (2021-2042)

Management method	Current system (2021)	2025	2030	2036	2042
Recycling	28.6%	36.9%	47.4%	47.4%	47.4%
Organics	16.6%	21.5%	27.6%	27.6%	27.6%
WTE	21.4%	24.0%	20.0%	20.0%	20.0%
Landfill	33.4%	17.6%	5.0%	5.0%	5.0%

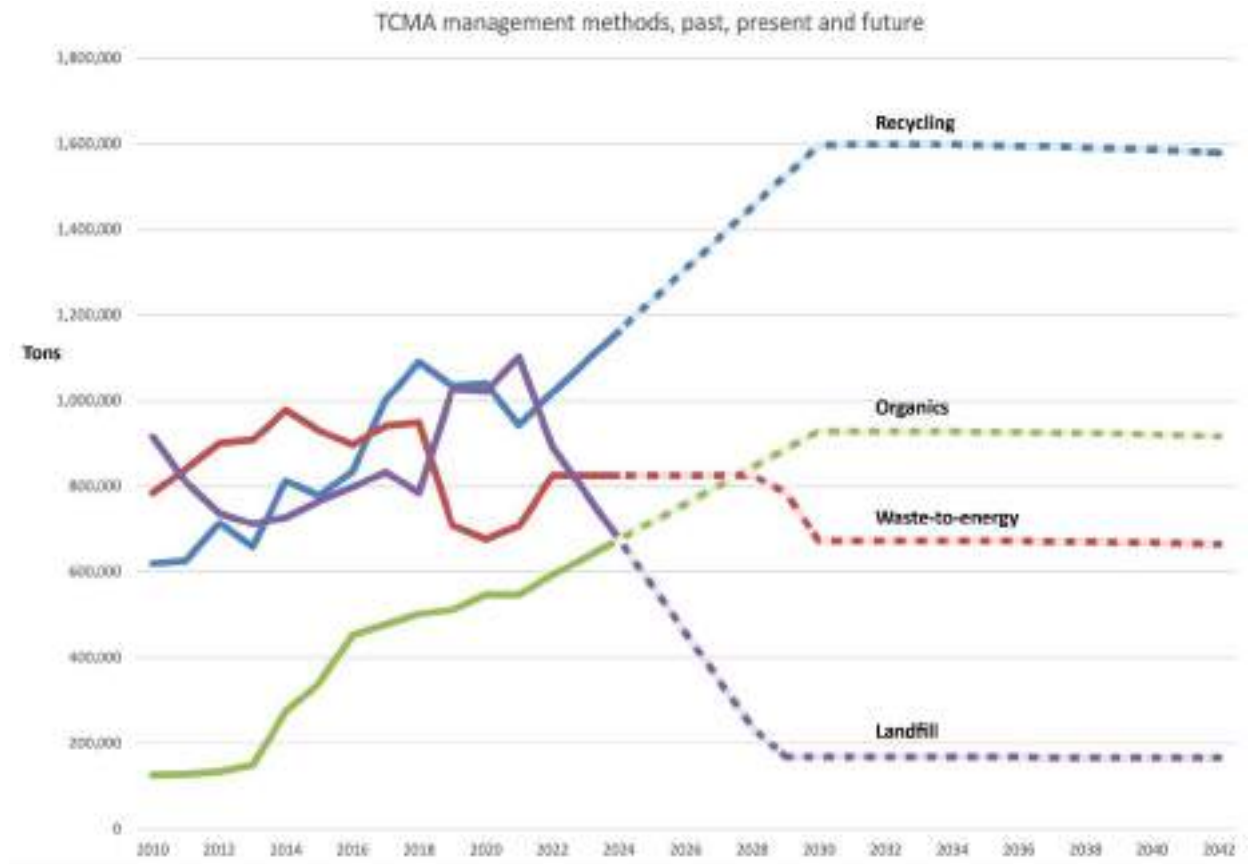
The table above shows the percentages of how waste is managed currently and projections for future years. The data under 2021 is from the latest SCORE report. Projections are based on the assumptions found in Appendix F.

Table 3. MMSW management system tonnages (Based on objectives in Table 2 in thousands of tons [2010-2030])

Management method	Current system (2021)	2025	2030	2036	2042
Recycling	944,968	1,237,436	1,598,496	1,596,691	1,580,830
Organics	547,931	719,166	929,331	927,801	918,102
WTE	707,268	828,000	674,087	673,198	666,382
Landfill	1,102,165	567,014	168,522	168,299	166,595
Total	3,302,332	3,351,615	3,370,437	3,368,899	3,331,909

The table above shows the same data and projections in thousands of tons to give context to the percentages in Table 3 and illustrates the amount of waste that needs to be managed in the TCMA.

Figure 6. TCMA MMSW management methods: past, present, and projection (SCORE and Certification Reports)



Evaluation of the system objectives

The MPCA will evaluate progress toward achieving all the system objectives through the [annual SCORE Report](#) submitted by the counties every April. The MPCA recognizes the challenges associated with measuring progress and measurement in general. Measuring waste reduction has posed challenges for years. See the [Environmental impact target section](#) for a discourse on a more robust way to measure environmental impact. Using data the counties currently provide, the MPCA has begun to calculate the environmental impact in the annual SCORE report. MPCA intends to continue to improve those efforts to better quantify the impacts of county programs on the environment. The environmental impact target does not require the counties to submit additional information to the MPCA. The MPCA will continue to work with local governments, haulers, and others to assure the data collected is necessary and relevant and will continue to collect data on a statewide and regional basis. The MPCA has historically used the SCORE Report as the method of tracking annual progress toward the objectives and has used the Solid Waste Policy Report to recommend needed policy changes to the legislature.

Emphasis on the upper end of the hierarchy

Handling materials using methods on the upper end of the hierarchy should be measured and reported. This includes an emphasis on waste reduction and reuse. There has been an emphasis on the legislative recycling goals, and while recycling plays an important role in the waste management system, measurement of success should be based on all impactful efforts. Reduction and prevention need to be organized and implemented through the TCMA.

Aggressive objectives for waste reduction and reuse, recycling, and organics recovery

All stakeholders, including the MPCA, will be held accountable for meeting these objectives. The MPCA believes the objectives are achievable, but to reach them, the TCMA will need new tools, enhanced infrastructure, and increases in funding. The current rate of increases in recycling and compost will not get the TCMA to the 75% recycling objective. New approaches to meeting the goal and other objectives in the MPP are needed for environmental protection.

Waste reduction and reuse

According to the EPA, waste prevention is the most environmentally preferred strategy to reduce impacts. Waste reduction and reuse methods are the most effective waste prevention strategies. Meeting waste reduction and reuse objectives will reduce the amount of MMSW that needs to be managed. Forecasting the projected MMSW generation for each county will deduct the tons of material reduced or reused.

Benefits of achieving success

In 2021, the TCMA achieved a 45.2% combined rate for traditional recycling and organics diversion. Minnesota would benefit from exploring additional methods to achieve the intended environmental and human health outcomes of the 75% recycling goal. Environmental and human health impacts of management methods should be considered. Minnesota needs to modernize data collection, measurement, and reporting. Other priorities should include identifying the highest return on investments in how staff time is allocated, introducing the most impactful policy changes, and investing in strategic infrastructure needs.

Oftentimes, waste reduction and reuse efforts can be cheaper than handling the same materials as waste. Incentivizing and tracking waste reduction and reuse separately ensures that county partners receive recognition for those efforts. Some counties have reported prevention and reuse in their CSWMPs and programming. Historically, reuse activities have counted towards the recycling rate via SCORE reporting.

An analysis of the 2018 SCORE report “recycling” data for accuracy revealed that, statewide, 79 of 87 counties reported reuse activities. This illustrates the need for counties to be recognized for investing in reuse. In response, the MPCA modified the 2021 SCORE reporting form to track reuse activities. Prevention and reuse programming result in fewer emissions. They are not and should not be treated as equal to recycling. The state should transition to a reporting structure that documents the increased climate and other pollution reductions from handling materials using methods higher on the waste management hierarchy.

Environmental impact target

To prioritize waste reduction and solid waste management with environmental and human health benefits, MPCA is setting an environmental impact target for TCMA counties based on full LCA. Under this environmental impact target, weight-based accounting for waste reduction, reuse, recycling, WTE, and landfill disposal is translated into GHGe generated or avoided. In this way, counties still report and work to meet their 75% recycling rate goal, but the environmental impact target documents overall changes in GHGe based on all county efforts and programming. By tracking progress with GHGe (currently the most accessible proxy for environmental impact), in addition to the recycling rate,

counties can invest in upstream activities, report on those efforts, and reach their environmental impact target through waste reduction and reuse programming as well.

The environmental impact target is defined by calculating the emissions avoided if the county were to reach the materials management goals set forth in the Metro Policy Plan by 2030. This means totaling the emissions associated with:

- Achieving a 15% waste reduction goal.
- Achieving a 75% recycling rate goal as established by the Minnesota Legislature.
- Achieving complete compliance with Restriction on Disposal, resulting in WTE facilities capturing most of the remaining materials.
- A minimum of 5% of material sent to landfill.

The value of setting a comprehensive environmental impact target that counts emissions reduction from the entire materials management system as all strategies become opportunities for meeting the target. This means a county can choose to do more waste reduction or reuse to reduce their GHGe more significantly and progress further on meeting their environmental impact, than solely focusing on recycling to achieve their 75% recycling rate. If a county is already meeting or exceeding their environmental target, the MPCA would recommend adjusting their target to be more ambitious and support continued work on reducing impacts from materials being handled. County-specific calculations will be made using 2021 SCORE data.

Each county will be able to work with their MPCA Planner to review their current progress and identify options for meeting their environmental impact target, determining which programs will have the greatest benefit. For example, counties will be able to see how the amount of emissions reduction achievable by focusing on food rescue versus composting. The target will not replace the 75% recycling goal already in statute.

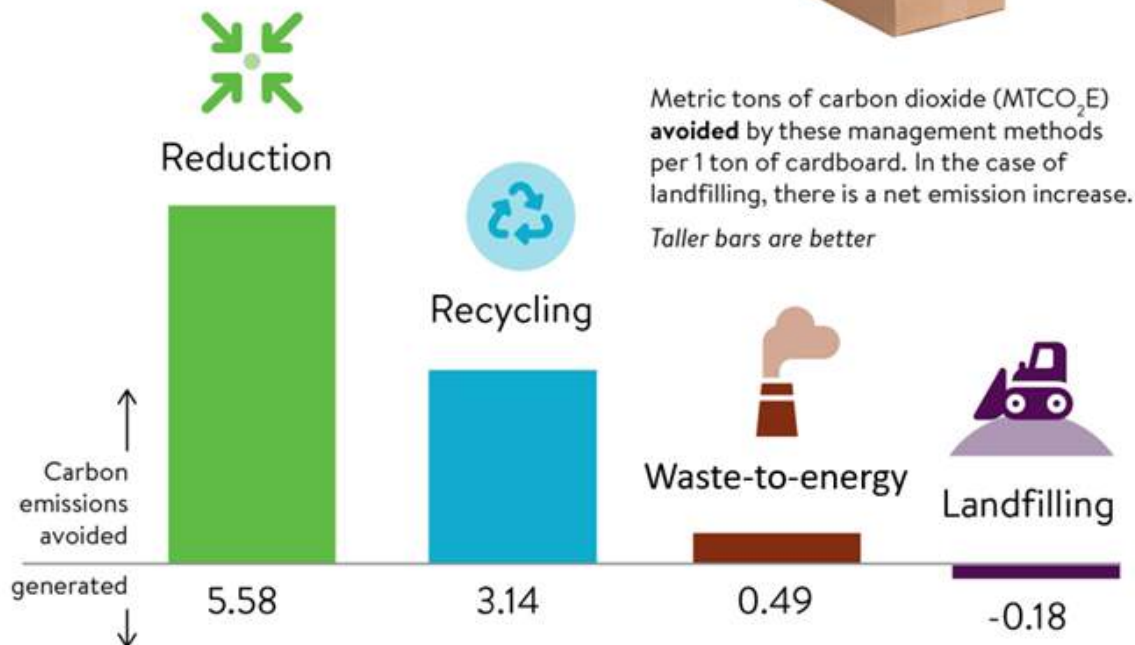
The following example, using data from Scott County, illustrates how the environmental impact target will be implemented and shows two potential scenarios. In the first scenario, Scott County meets the 75% recycling rate goal by 2030 as required by the Minnesota Legislature. The rest of their materials are handled business-as-usual, meaning the county didn't implement additional waste reduction, reuse, or WTE strategies. The total GHGe savings is 234,037 metric tons of carbon dioxide equivalent (mtCO₂e).

In the second scenario Scott County maintains their current 55% recycling rate until 2030. However, they invest in waste reduction strategies and reduce materials by 10%. The county accomplished this by focusing on preventing food from going to waste, reducing paper use, and eliminating a small number of single-use items and replacing them with durable reusable systems. The total GHGe savings is 224,060 mtCO₂e. In the second scenario, only 10% of the waste is being source reduced. Yet, compared to a 20% increase in recycling in the first scenario, the amount of GHGe is very similar. How materials are managed makes a big difference. Scott County can achieve nearly twice the environmental and human health benefit by reducing materials than recycling in this scenario. This affirms the waste management hierarchy and emphasizes the importance of first reducing, then reusing, and then continuing to manage materials down the hierarchy as needed if the first two strategies are not feasible.

The MPCA staff will work with counties to assess their options for meeting the environmental impact target using an interactive tool based on EPA's WARM. The MPCA will be able to model county-specific scenarios for materials management using data that the counties currently provide. The MPCA will not be requesting additional information from the counties to track this new goal.

Figure 7. Carbon emissions impact of different management types

Example: Recycling one ton of cardboard has a significant **carbon emission** benefit compared to incineration or landfilling. Reducing cardboard use (i.e making the box lighter or replacing it with a reusable system) has an even greater benefit.



Strategies and best management practices to achieve the objectives of the MPP

There are various approaches to meet the system objectives of this MPP. The TCMA waste management system is governed by multiple public and private entities, and a variety of strategies provide the flexibility to meet the needs of each program or situation. The state, counties, cities, businesses, nonprofits, communities, and residents all have specific roles and responsibilities for improving solid waste management. To minimize conflicts and inefficiencies, it is important to select strategies that align public and private objectives, to work together to identify necessary changes to existing strategies, and to indicate where new strategies are needed. Counties can propose alternative strategies if they see fit. Proposals must achieve comparable objectives and will be subject to agency approval. The point value of alternative optional strategies will be determined by the MPCA. Many of these strategies will require investment and additional funding. The MPCA will advocate for additional funding for the system when appropriate and asks the counties to do the same.

County solid waste plan evaluation point structure

Each topic below includes key strategies that will be instrumental to reaching the objectives of this MPP. Certain strategies are required to be incorporated into CSWMP. Optional strategies are assigned a point value. The counties will pick from any of the optional strategies to reach a minimum of 75 points.

The strategies are weighted by difficulty and by management strategy in accordance with the Waste Management Hierarchy. This places an incentive on environmental and human health outcomes while

allowing counties the flexibility to design and adapt their solid waste programs. The various optional strategies are worth 4-9 points. The optional strategy point total is 194 points, and the counties must have a minimum of 75 points for their CSWMP to be approved. Appendix G houses a strategy spreadsheet for counties to use in designing their solid waste plan.

Costs implications of strategies should be estimated by county staff when considering feasibility of implementation. The MPCA is committed to achieving the objectives established in this MPP and intends to assist with strategy implementation as noted below.

Improving the reliability of the data

The MPCA strategic plan calls for the Agency to “accelerate the availability of data and information in a self-service format.” From a solid waste perspective, one of the best ways to accomplish this is to ensure that data is consistently collected through the most reliable sources and that all waste and waste reduction be tracked. The MPCA and the counties have historically focused on only MMSW. Little attention has been directed toward the measurement of demolition debris and industrial waste (ISW).

The SCORE program created a strong framework for tracking progress toward the goals and objectives of the WMA. Over the past 30 years, there have been some problems identified with traditional measurement methods. Like the MPCA and counties, SCORE historically focused on only MMSW, with no data on ISW reported or requested. In addition, the success of county programs has been measured through a weight-based system that treats all material tons equally.

Our improved ability to understand the environmental and human health impact of different material types has exposed the limitations of weight-based measures. Weight-based measures are important but have limitations. Data analysis can be enhanced by collecting additional data in addition to the weight-based measures. A moving target of what counts as recycling has added to inconsistencies. In recent years, yard waste and compost have been added to the recycling side of the ledger.

Ultimately, a large focus has been placed on recycling in county programs to the detriment of waste reduction and reuse. As discussed above, the greatest environmental and human health benefits are not realized through recycling. Improved reporting provides the information needed to understand how to achieve better environmental and human health outcomes. The added reuse component to the SCORE report captures the reuse activities within counties. The intended outcome is to fill a data gap that has existed since the inception of the program in the early 1990s. Hauler reporting requirements were added in 2016, but inconsistent compliance from the haulers, inconsistent support from counties, and staffing issues at the MPCA have led to lax enforcement and limited follow-up.

As previously mentioned, SCORE is only focused on MMSW, with no requirements to track other waste streams. Landfills report amounts of demolition debris and industrial waste annually. Yet, there is limited data regarding recycling rates of those two material streams. We also have limited data about non-MMSW landfill diversion such as recycling. To improve the management of non-MMSW materials, it is critical to have a better reporting for this waste sector. Despite these challenges, there are several strategies that can be pursued that will improve the management of data in the TCMA.

Required strategy:

The strategy listed below is required to be incorporated into the CSWMP because it is relatively simple or has significant environmental benefit.

1. **Increase compliance with hauler reporting per Minn. Stat. § 115A.93.** Compliance with hauler reporting in metro counties has been mediocre. In 2021, these compliance rates were between 45% and 68%, within the TCMA. There are several challenges regarding the compliance numbers. Some

haulers may be misreporting to counties. In these cases, counties should hold haulers accountable for completing their reporting accurately. Reliable hauler reporting provides a benchmark for the objectives of this MPP. Hauler reporting is a shared responsibility for the state and county. Cooperation from counties to maintain accurate license lists will allow the MPCA to trust the information collected. Both the state and counties benefit from the collection of this data. Sharing in the responsibility ensures accuracy and efficiency. Best practices in the promotion of compliance with hauler reporting include:

- Sending quarterly reminders to all licensed haulers
- Reviewing submitted data in ReTRAC
- Active communication and follow-up regarding incorrect or missing hauler data
- Requiring proof of data submittal prior to license renewal
- Cleaning up the regional license data to ensure that haulers are truly operating in the counties

Improved compliance and data integrity would facilitate the mapping of waste flow in the TCMA from origin point to end destination. We need to understand the breakdown of residential and commercial tonnage and the scope of material exports. Dakota County demonstrates that improving compliance with the haulers is possible when county staff are persistent. Compliance rates for haulers in Dakota County is 68%, compared to 45-55% in other counties in the metro.

2. **Provide required county reporting.** Ensure the MPCA receives all data in the state-issued format. Counties should collaborate on creating best data practices for soliciting data from organizations. The MPCA and counties shall standardize waste composition sorts for consistency. SCORE, certification, and the metro county annual reports are also targeted in this strategy.
3. **Require waste composition study at least once every 5 years at all landfills that are located within your county.** Waste composition study data helps identify important trends on waste types and quantities. Landfill information will help policy, planning, and implementation, such as assessing capture rates. Counties with landfills receiving TCMA waste should introduce an ordinance to reinforce this requirement. Waste composition studies shall include MMSW, ISW, and demolition debris disposal streams. The MPCA seeks to assure all landfills receiving metro waste operate with equal requirements. Dakota County ordinance no. 110 establishes a requirement for waste composition studies to be performed every five years at all land disposal solid waste facilities. Performing waste composition studies on a regular schedule will help determine generation rates, aid in capture rates, and provide material type breakdown.

Optional strategy:

The following strategy is optional and may be incorporated into a CSWMP. Each strategy has been assigned a point value, which is added to the total amount of points the county must achieve for approval of their CSWMP by the MPCA.

4. **Improve recycling data collection at businesses within the county.**

Point Value: 7

Commercial buildings required to recycle in Minn. Stat. § 115A.151 should report their recycling tonnages to the county in which business is conducted. Exempted businesses can provide documentation of their licensed hauler's reports to the MPCA. Develop an ordinance that requires businesses to assign a recycling manager. The recycling manager shall report weight, material type, and management method for self-hauling. Self-hauling shall include contracted services outside of licensed haulers. Alternative to development of an ordinance would be developing a surveying approach. Create a survey method resulting in a statistically significant number of annual responses.

Review and analyze to assure reliable commercial data are being collected. Carver County conducts an annual survey of businesses to collect data from generators who self-haul. Replicating this approach would fulfill this strategy.

State-led strategies:

The following strategies are the responsibility of the MPCA and will support the efforts by the counties.

5. **Require waste composition study at all landfills.** Understanding the composition of MMSW, demolition debris, and ISW streams is critical to perform GHG calculations and to quantify other environmental impacts. Resource recovery facilities are currently required to conduct waste composition studies every five years. This requirement should be extended to all disposal facilities for consistency and equal treatment, and to have comparable information from the data. Waste composition study data provides important trend information on waste types and quantities. The addition of landfill information will help policy, planning, and implementation efforts, such as assessing capture rates. The State will work to require waste compositions across the state with the express purpose of obtaining better data.
6. **Develop appropriate and consistent waste reporting systems to measure all waste.** Measuring and reporting all waste (including MMSW, demolition debris, and ISW) through annual reporting is necessary for the state and counties to effectively manage waste to its highest and best use. Alternative measures to weight-based reporting that encompass the environmental impacts of a material should be researched and considered. This could include using SMM tools such as capture rates and human health impact data that focus more on the impact of a material throughout its life cycle. The MPCA will continue to build on initial efforts to report on the environmental and human health impacts utilizing the data that counties currently submit. High quality data will result in the development of strong statewide policy. Developing a system will support evidence-based decision making for future laws, policies, rules, and program planning. Commonly recovered materials from demolition sites are concrete, shingles, wallboard, carpet, and lumber. A robust system for evaluating these materials will help counties and the state prioritize our efforts.
7. **Continue to explore options for growing the agency's LCA data, modeling, and resources to better support counties in measuring and tracking environmental and human health impacts.** This includes translating county solid waste measures from weight-based measures to GHGe and other environmental and human health impacts and periodically updating the state's consumption-based emissions inventory to complement the current in-boundary emissions inventory. It also includes incorporating environmental impact data across agency materials management and solid waste management programs to identify priority materials and strategies to target the highest-impact categories.
8. **Continue to engage with counties in the development of an environmental target that better accounts for and incentivizes programming and actions higher on the hierarchy.** The recycling rate serves a specific purpose and there is an opportunity for the MPCA to evaluate and develop an approach to represent county SMM efforts more holistically.

Regional solutions

The TCMA counties do not have a formal regional waste management district. Yet, it is practical to implement certain strategies at the regional level. Collaboratively designing and modernizing a materials management system will benefit all TCMA counties.

Required strategies:

The strategies listed below are required to be incorporated into the CSWMP because they are relatively simple or have significant environmental benefit.

9. **Participate in an annual joint commissioner/staff meeting on solid waste.** This annual or semi-annual meeting will provide an opportunity to get a county commissioner and lead staff from all seven counties together to discuss relevant waste topics. The purpose of this strategy is to help ensure that all seven county boards understand the challenges that each county faces, learn from the CSWMP of other counties, and examine places to collaborate to meet the regions solid waste goals. MPCA will take the lead in organizing this meeting at the inception.
10. **Commit to standardized outreach and education.** The seven counties in the TCMA must coordinate on their recycling messaging to avoid confusion among residents. To coordinate, each county should attend the Recycling Education Committee (REC) meetings and use REC communications calendars. If a deviation is made from the REC materials, the TCMA counties all must agree. Counties should utilize or adapt the MPCA-designed library exhibits on food storage tips and the impacts of food choices to educate residents on preventing food waste. To create regional consistency, counties should acknowledge organics recycling and food scraps are both in use in different areas of the TCMA. Counties should coordinate to reduce confusion associated with the use of different terminology within the region. Outreach and education efforts should include how to handle materials not accepted in curbside collection bins. These materials should include lithium-ion batteries, scrap metal, and other materials accepted by environmental centers and household hazardous waste drop-off sites.
11. **Engage in efficient and value-added infrastructure planning.** TCMA counties should seek to eliminate system redundancy by sharing and co-developing CSWMP for managing all material types. This collaboration includes the use of emerging technologies that have the potential to reduce or manage waste higher on the waste hierarchy and that have the potential to impact materials and processes that have a greater environmental impact. TCMA counties should foster a space for counties and private partners to work cooperatively and not competitively to build system resiliency. More processing capacity to assure materials with useful life are routed appropriately is imperative. Food-derived composting and food rescue are high priorities for infrastructure planning. MRFs face pressing issues such as overflow of materials and a need for fire suppression.
12. **Develop plans for large facility closures to reduce landfill reliance.** The plans must include:
 - Develop a plan that identifies alternatives that can manage the waste currently managed at the facility. This plan must include landfills, transfer station infrastructure, recycling and composting infrastructure and other logistical solutions to manage MMSW.
 - Identify a plan to push waste up the hierarchy including an effort to prioritize reduction.
 - Issue a letter assuring waste to one or more of the alternative locations suitable as part of the CON process for landfill expansions when necessary.
 - Include in the plan acknowledgement of liability associated with increased landfilling including the understanding that at some point in the future the county may be identified as a responsible party for a superfund clean-up investigation.
 - Identify and evaluate potential locations within the county or region for a disposal facility that can be developed within the timeline of the facility closure.
 - Any new facilities that are sited should take clear and effective measure to ensure that they are not located in environmental justice areas.
 - A list of policy, program, infrastructure changes needed to eliminate reliance on WTE and/or landfilling.
 - Consideration of where money saved by closing the facility could be reinvested to benefit the region.

Waste reduction

In accordance with Rule 9215.0580 and Minn. Stat. § 115A.02, counties are responsible for advancing prevention and reuse along with other solid waste management strategies. Waste reduction means not generating any materials that require further recycling, composting, disposal, or other management. Waste reduction includes reducing the amount and toxicity of materials generated. It is at the top of the hierarchy, because it is the best option for the environment. Using an SMM framework, counties can design programs that direct limited resources toward waste reduction programming and infrastructure to have the greatest impact on their communities. To quantify this impact, counties can now report their waste reduction activities by material type to the MPCA. Related GHGe savings can be found in the SCORE report.

Waste reduction is the most effective way to lessen the need for resource extraction, reducing pollution at the source and conserving materials for future generations. Measuring waste reduction requires setting a baseline of consumption and comparing all future consumption to that baseline. One example of doing this on a broad scale is represented in the SCORE report.

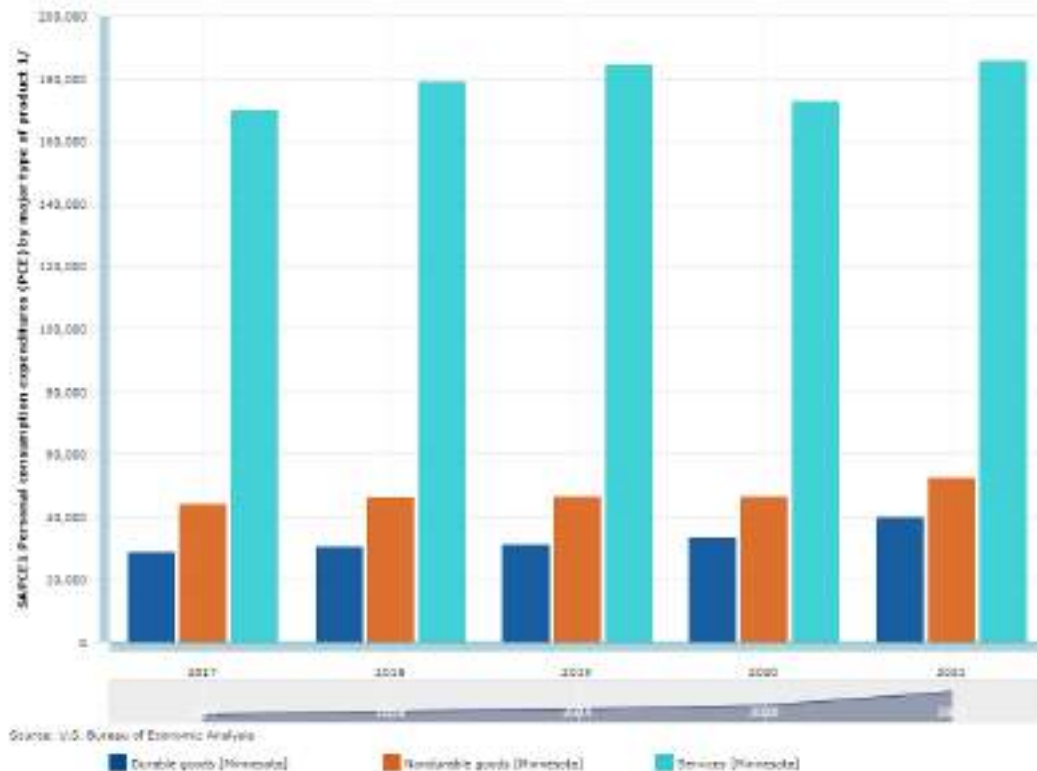
Based on statewide waste generation data, starting in 2008, Minnesotans are generating less waste than expected based on projections using the 1997 rate. There was a dip in the actual waste generated during the national 2008 recession that extends into 2010, mirroring the economic recovery period. There has since been a steady upward trend in waste generation. In 2020, however, expected waste generation sharply declined while actual waste generation continued to increase. This anomaly in expected waste generation is primarily due to a large drop in per capita expenditures in the “Services” consumption category, including food services and accommodations, recreation services, and transportation services. Spending in both the consumption categories of “Durable Goods” and “Nondurable Goods” remained consistent with the trends from previous years. This can be explained by changes in purchasing due to the COVID-19 pandemic, in which the service industry was most affected by periods of lockdown and residents spent more time at home. However, because “Durable Goods” and “Nondurable Goods” did not see the same decline, resulting waste generation will continue to increase in future years as those purchased items in 2020 are disposed of at the end of their useful life.

Waste reduction in real life



MN Waste Wise utilizes the Leanpath Food Waste Prevention Platform. This an online software helps staff identify and dramatically reduce food waste and operate a more sustainable facility. The results were determined by measuring and tracking purchasing of food items throughout several months. Overall, three restaurants reduced their food waste by 29% in value, totaling \$40,110. Additionally, the offered solutions allowed the participating restaurants to decrease their waste bills.

Figure 8. Personal consumption expenditures



Increase and document prevention of wasted food and food rescue

Up to 40% of the food in the United States goes uneaten, according to a Natural Resources Defense Council (NRDC) report. At the same time, one in thirteen Minnesotans face hunger. The greatest environmental benefit—in terms of reductions in energy use and GHGe—is made when we can prevent food from being wasted rather than managing or disposing food waste.

The MPCA recently conducted a sort of food in the MMSW stream. The waste sort uncovered that almost half of the food Minnesotans threw in the trash could have been eaten. There is a significant opportunity for counties to work with residents and businesses on systems improvements and behavior changes that promote the prevention of wasted food.

Wasted food wastes the resources used to produce it, such as agricultural land, water, and energy, and generates significant environmental impacts, such as GHGe contributing to climate change, consumption and degradation of freshwater, degradation of soil quality, and degradation of air quality. According to EPA's 2021 report, "From Farm to Kitchen: The Environmental Impacts of U.S. Food Waste," uneaten food in the United States annually embodies:

- 140 million acres of agricultural land – an area the size of California and New York combined
- 5.9 trillion gallons of fresh water – equal to annual water use of 50 million American homes
- 778 million pounds of pesticides
- 14 billion pounds of fertilizer – enough to grow all the plant-based foods produced each year in the United States for domestic consumption
- 664 billion kWh of energy – enough to power more than 50 million U.S. homes for a year
- 170 million MTCO₂e GHG emissions (excluding landfill emissions) – equal to the annual CO₂ emissions of 42 coal-fired power plants

Reducing one ton of food saves about twenty times more GHGe than composting that same amount of food waste. Households are the biggest contributor to this waste. Preventing wasted food is one of the more impactful ways that everyday Minnesotans can mitigate climate change. Addressing this issue would impact not only the environment but has the potential to support the needs of TCMA residents experiencing food insecurity. According to the NRDC, redirecting one-third of the food currently being thrown out would be more than enough to cover unmet food needs across the country. Nearly 1 in 10 households in Minnesota experience food insecurity, as reported by the Minnesota Department of Health.

Purchasing

Minnesota's Sustainable Procurement Program is a partnership between the MPCA and the Department of Administration. The Sustainable Purchasing Program currently prioritizes 19 state contracts for the inclusion of sustainability requirements. As of fiscal year 2020, 53% of priority contracts are considered "100% sustainable." Allocating funds toward sustainable materials is key to ensuring support for sustainable, non-toxic, and closed-loop markets. Sustainable purchasing considers environmental, social, and economic factors by considering the lifecycle impacts of a product — from raw material extraction through end-of-life management. This approach allows buyers to decrease the impact of their purchases more strategically and effectively. Local governments can save money and identify where the greatest reductions in impacts. Purchasing from the 19 priority state contracts available through the Cooperative Purchasing Venture (CPV) program allows counties to easily expand the impact of the state's sustainability efforts.

Environmental product declarations (EPDs) are another tool to influence purchasing power at the state level. An EPD provides transparency about the environmental life cycle impacts of a product. EPDs are increasingly being used to account for the full scope of impact for building materials.

Required strategies:

The strategy listed below is required to be incorporated into the CSWMPs. It is required because it is relatively simple or has significant environmental benefit.

13. **Provide grants for or access to software that can track food waste.** By 2025, implement county programs that prevent wasted food to businesses and institutions that produce food waste. According to the EPA, one-third of all food in the United States goes uneaten, of which a majority ends up in landfills or WTE facilities. Food waste tracking software can aggregate data that can be easily reported as a reduction in SCORE. Most software can also provide environmental metrics, which could be used to further determine impacts. These metrics can be shared with customers and users to educate them based on real-time results, which can have impacts on the users' behavior outside of these facilities. Hennepin County has previously provided some limited grant funding for businesses to utilize software for preventing food waste. Additionally, Minnesota Waste Wise has assisted businesses with implementing programs that rely on food waste tracking software.
14. **Establish partnerships between food rescue organizations and restaurants/stores to increase food rescue.** Developing reliable networks between institutions with excess food and institutions that can rescue the food is imperative to the success of these programs. Established organizations such as Second Harvest Heartland can assist with [food rescue efforts](#). This could be accomplished by assigning county staff or a GreenCorps member to build these networks. MPCA can be contacted to learn more about how to host a GreenCorps member to help with these types of efforts.
15. **Launch bi-annual sustainable consumption challenges for residents.** These challenges should focus on reducing waste produced by residents. Organize and run these challenges for residents that encourage them to reduce their own waste in various areas. Examples include Zero Waste

Challenge, [EPA Get Smart Challenge](#), and [Track Food Waste at Home – Hennepin County](#). The campaigns should also incorporate messages that encourage buying more durable products and repairing these items to extend their useful life (including textiles, electronics, and furniture.). These products may cost more, so it is important to frame these campaigns in a way that acknowledges how the cost can be a barrier.

16. **Implement a formal county sustainable purchasing policy using [MPCA guidance](#).** Sustainable purchasing policies shows a commitment to reducing environmental, social, and economic impacts. The policy should increase county purchases of goods that are reused, remanufactured, and designed for durability and repairability. Identify purchases that are not necessary and eliminate them. County-wide spending should be analyzed for redundancies. Those redundancies should be eliminated. Procurement professionals should collaborate and forecast purchases whenever possible.
17. **Participate in Responsible Public Purchasing Council meetings.** This bi-annual meeting connects county, city, township, and other Cooperative Purchasing Venture member organization purchasers. The purpose of this group is to support purchasing leaders to be good stewards of public dollars and to share information about sustainable criteria developments throughout purchasing sectors. Each county shall plan and host two Responsible Public Purchasing Council meetings by 2030 and send a representative to attend each meeting.

Optional strategy:

The following strategy is optional and may be incorporated into a CSWMP. Each strategy has been assigned a point value, which is added to the total amount of points the county must achieve for approval of their CSWMP by the MPCA.

18. **Work with health inspectors to educate restaurants and other establishments that have excess prepared food to donate.**

Point Value: 7

There is widespread concern over the liability of donating prepared food. Enlisting county and city health inspectors to help willing restaurant operators navigate the laws, statutes, and ordinances for food donation can help to support the growth of additional sources for donations. This strategy prevents wasted food and proposes a solution to food insecurity, which is something 1 in 17 Minnesotans face (according to Feeding America). Partner with the health inspectors in your county to distribute information on food donation and food waste avoidance.

Reuse

Reuse is a waste reduction strategy as it extends the useful life of items or materials. This keeps materials in use and decreases the demand for new production. Compared to recycling, reuse further reduces environmental harms. It accounts for embodied emissions and impacts from the upstream manufacturing of materials and products. Recycling still requires energy and resource inputs to convert an existing product into a material stock. Only then can it be incorporated into new production. This generates additional environmental impacts and wastes that are not created when a product is reused.

The state of Minnesota also benefits economically and socially from reuse. According to a [report](#) published by Reuse Minnesota, the reuse economy generates between \$3.1 and \$4.7 billion in revenue each year. At the time of the report publication, there were more than 13,000 reuse businesses, accounting for more than 45,000 jobs. Reuse jobs are usually not outsourced because they handle existing products within a community or region, making reuse inherently local. The report estimates that reuse contributes \$2.4 billion in social value (i.e., benefits such as taxes, wages, and shareholder profits). Resale, rental, repair, and sharing also expand access to items that may otherwise be unaffordable or

impractical to individually own. Reuse training, skills development, and local events contribute to a strong sense of community. A thriving reuse economy often depends on established networks. It subsequently bolsters collaboration between businesses, educational institutions, organizations, and residents.

For these reasons, it is critical that reuse strategies and programming be a higher priority and receive significant investment at the state and local levels. Recycling and composting strategies are more familiar and comfortable in most systems. Without distinct reuse targets, guidance, and goals, it is often the default to fall back on end-of-life management and primarily direct resources and infrastructure investment towards recycling and composting.

Some of the most successful and impactful reuse strategies are not new, innovative, or expensive technologies. Revitalizing these strategies, determining the requirements or incentives that best support them, and raising awareness or comfort with them is an important path forward for TCMA counties. When proposing these strategies, take the time to engage across the community. This ensures they are developed in an inclusive way so that implementation does not disproportionately impact certain businesses or neighborhoods and participation increases. Particularly when passing policies that require new actions or fees for specific entities, allow time for outreach and create support systems that aid in that transition.

Required strategy:

The strategy listed below is required to be incorporated into the CSWMP because it is relatively simple or has significant environmental benefit.

19. Offer grants or rebates for organizations to transition to reusable food and beverage service ware.

Reusable service ware is any product designed to be used for serving, consuming, or transporting prepared food and raw food, including but not limited to reusable plates, bowls, trays, wrappers or wrapping, platters, cartons, condiment containers, cups or drink ware, or any container in or on which prepared foods and raw foods are placed or packaged for consumption. Reducing or removing the barrier of the cost of investment for reusable service ware can help institutions to make this change. Assistance should cover both the cost of materials and building modifications to support the cleaning, storage and maintenance of reusable food and beverage service ware.

20. Offer grants for waste reduction, reuse, and repair. Shifting more funding into this focus area can support the goal to minimize the need for disposal or recycling. Consider broad eligibility including public, private, and non-profit entities. Do not specifying that projects need to be innovative as organizations may already be contributing positively with their current reuse and repair offerings and simply need the additional funding to support or expand their existing operations. Consider expanding support offerings for grant applications and documentation as many reuse and repair organizations may be smaller operations that have limited capacity and staffing for grant administration.

21. Implement a green meeting policy. A "green" meeting is one that is organized and implemented in such a way as to minimize negative impacts on the environment and promote a positive social impact for the host community.

Optional strategies:

The following strategies are optional and may be incorporated into a CSWMP. Each strategy has been assigned a point value which is added to the total amount of points the county must achieve for approval of their CSWMP by the MPCA.

22. Implement a county policy encouraging the use of reusable food and beverage service ware.

Point Value: 6

This can be done as a “green event policy” or as a part of a sustainable government purchasing requirement. This policy should include tracking and reporting to ensure it is being implemented. This should be required of all county events and meetings.

23. Adopt an ordinance with a mandatory consumer charge or ban for single-use items.

Point Value: 9

The “Bring Your Own Bag” ordinance in Minneapolis can serve as an example of how to roll out an ordinance to set a fee for single-use items. A set fee for each container type should be determined by the ordinance. The ordinance may allow BPI-certified compostable and recyclable take-out service ware. The fee will serve as an incentive for customers to participate in reuse behavior. Alternatively, the ordinance can ban certain single-use items.

24. Join and/or actively participate in a reuse network, like Reuse Minnesota, to provide county and city staff with learning opportunities to broaden their reuse expertise.

Point Value: 6

The most effective way to reduce waste is to not create it in the first place. As a result, reduction and reuse are the most effective ways you can save natural resources, protect the environment, and save money. County staff participation in this type of network also supports the development of statewide resources, helps develop county programs, improves advocacy, and strengthens connections for reuse organizations.

25. Establish a Repair Ambassador program, like the Recycler/Composters (RCAs) Ambassador programs.

Point Value: 7

Programs exist in several counties and can be a collection of connections between skilled individuals, for-profit and non-profit organizations, and a volunteer coordinator. Fix-It Clinics offer free, guided assistance from volunteers with repair skills to disassemble, troubleshoot, and potentially fix small household appliances, clothing, electronics, mobile devices, and more. Fix-It Clinics teach valuable troubleshooting and basic repair skills, build community connections, and reduce the number of repairable items that are thrown in the trash. These groups should have goals to grow the volunteer base and offer regular fixer trainings to support Fix-It Clinics or Repair Cafes.

26. Establish a reuse location for residential drop-off and pick-up.

Point Value: 7

Some items are not accepted by reuse businesses in the region because they don’t have significant resell value. Those items not desired by the reuse businesses in the region could be made available to the public for free (reuse warehouse at the drop-off/transfer locations) or donated to other non-profit thrift operations in the area. Items in poor condition would be managed through the existing county solid waste and recycling channels.

27. Establish a curbside set-out day to allow residents to set out used items for reuse.

Point Value: 7

Coordinate this day to occur 1-2 days prior to curbside, large item pick-up by haulers and with reuse businesses to pick-up unclaimed items. In 2021, the Bloomington City Council passed a plan to partner with Better Futures Minnesota for collection of reusables from curbside. The [pilot program](#) has been in place since November 2022.

State-led strategies:

During information-gathering sessions with MPCA staff, metro counties noted that two of the main barriers to working on waste reduction and reuse are lack of statewide legislation that support or

advance these strategies and lack of consistent and clear measurement, including both standardized methodology and access to environmental data. The following strategies address this input and are the responsibility of the MPCA.

28. Develop standardized guidance and methodology for tracking waste reduction and reuse activities and their resulting benefits. With the 2021 SCORE reporting, the MPCA added a reuse table for counties to enter data for material and product reuse by the county or by organizations/businesses in the county. These additional resources can be developed to further support and better acknowledge reuse programming that counties implement going forward.

29. Research and pursue financial strategies to best incentivize waste reduction and reuse, such as grants and loans. In the shorter term, the MPCA continues to explore opportunities for ongoing funding for reuse by expanding eligibility with current grant programs and pursuing the development of a reuse-specific program.

Collection best practices

A variety of methods are used to collect recyclables, organics, and trash. There is some room for diversity in methods used from one community to the next. However, implementing best management practices will increase the recycling rates in the region.

Required strategies:

The strategies listed below are required to be incorporated into the CSWMPs because they are relatively simple or have significant environmental benefit.

30. Collect recyclables, organics, and trash on the same day. Same day collection of recycling and trash makes it easier for residents to remember. Tracking different collection schedules can be challenging, especially if change occurs often. Implementing same-day collection for recycling and trash helps residents increase waste diversion. Counties should work with their cities to implement same day collection for recyclables and trash. Counties or cities can implement this through licensing or ordinance provisions.

Optional strategies:

The following strategies are optional and may be incorporated into a CSWMP. Each strategy has been assigned a point value, which is added to the total amount of points the county must achieve for approval of their CSWMP by the MPCA.

31. Collect recycling weekly by 2030.

Point value: 7

Recycling is collected bi-weekly in most cities with single stream recycling programs. Since recycling carts often reach capacity during the two-week interval between collections, some residents throw the extra recyclables into their garbage container. By offering weekly collection, the recycling carts are less likely to exceed capacity. Residents who miss a bi-weekly recycling collection find themselves with a month's worth of recyclable material to fit into a cart that many times is completely full after two weeks. If current driver shortages are affecting the ability to meet this practice, the county should collaborate with haulers to develop a solution until the driver shortage is resolved. Counties should work with their cities to implement weekly collection for recyclables. The county can require weekly collection, or make sure that cities require it in their respective ordinances or license provisions. Establishing a system that allows for free additional recycling bins could also fulfill the objective of this strategy if residents are likely to have space for additional containers and/or other local circumstances make weekly collection untenable.

32. Pair the option of bi-weekly trash collection with weekly recycling and organics collection.

Point value: 7

By pairing weekly recycling and organics collection with bi-weekly trash collection, communities can achieve greater recovery rates. Since most residential waste is recyclable or compostable, very little waste remains in the trash when curbside recycling and organics programs are provided. Organics collection removes the portion of the waste stream likely to decay, which causes bad trash odor, so trash does not need to be collected as frequently. Offering recycling and organics collection weekly allows for a transition to bi-weekly trash collection for residents that may want to, leading to potential cost savings for haulers and residents. Bi-weekly trash collection incentivizes residents to place all recyclable and compostable materials in the weekly containers and can result in greater recovery rates. Counties should work with their cities to have the option to pair bi-weekly trash collection with weekly recycling and organics collection.

33. Contract for residential recycling and organics by 2030.

Point Value: 7

Research has shown that organized recycling collection programs yield a higher recycling rate when compared to non-organized recycling programs (The Benefits of Organized Collection, MPCA, February 2012). Roughly 60% of communities in the TCMA offer organized recycling collection. However, many cities still rely on subscription service provided by licensed haulers. While some of these non-organized programs have been successful, the results from communities with organized recycling are consistently stronger. By 2030, cities in the TCMA should provide organized recycling collection for residents. To implement this strategy, counties may:

- Require that cities offer organized residential recycling collection to receive funding for recycling programs.
- Provide technical assistance to cities developing and implementing an organized recycling program.

The MPCA also plays a role in implementing this strategy and may provide technical assistance to cities developing and implementing a new, organized recycling program.

34. Contract for residential MMSW collection by 2030.

Point Value: 7

In the TCMA, 37% of cities currently contract for residential MMSW collection, compared with approximately 70% of cities nationwide. However, over the last few years, several communities followed the process required by Minn. Stat. § 115A.94 and successfully implemented organized MMSW collection programs for their residents. Although transitioning from an open MMSW collection system to an organized MMSW collection system is not simple, there are many environmental benefits of organized collection, and counties should work with cities to make this transition.

In addition to the environmental benefits associated with increasing recycling, creating efficiencies in waste collection can reduce both fuel consumption and emissions. Fuel consumption during collection activities in cities with open collection systems is typically much higher than that of cities with organized systems. The number of haulers and their market share can affect overall fuel consumption and emissions. In an open system, trucks from many haulers travel the same alleys or streets. In an organized system, there may be the same number of haulers, but only one truck travels down each alley or street, resulting in lower fuel use because fewer miles are traveled to collect the same amount of material. Simplifying the hauler routes leads to efficiencies that would lighten the driver shortage. Open cities with one hauler assigned to more than 60% of the market share (e.g., Eagan) would see a significant reduction in fuel use by switching to an organized system. A city with many haulers, each having a smaller market share, (for example, St. Paul) would realize

even greater savings. Fewer vehicle miles traveled also results in less air pollutant emissions from heavy duty waste/recycling collection vehicles. Public concern has increased regarding human health and environmental impacts of particulate matter and nitrogen oxides, which are emitted in large amounts from heavy duty vehicles. (Source: The Benefits of Organized Collection, MPCA, February 2012).

Organized MMSW collection programs are also often more cost-effective when compared to subscription programs. Data in Table 4 was derived from the City of Richfield which was the most recent city to organize trash collection. During its process, the city received bills from residents to be able to assess the cost of collection prior to implementation. The monthly cost for residential MMSW collection varies by container size. Although the cost for a 90-gallon cart is similar in both systems, the cost in organized collection systems is lower on average.

Table 4. Monthly cost of residential MMSW service in the Richfield before and after organized collection

Container size	35 gallon	65 gallon	95 gallon
Subscription average	\$16.33	\$17.99	\$18.85
Organized average	\$11.90	\$15.03	\$18.16

Recycling management

Regionally, it is important to apply SMM concepts to prioritize targeted materials that are the most recyclable materials over those with a more energy-intensive recovery process. It is also important to identify and focus efforts on larger generators of recyclables. A regional plan for temporary storage of recyclables will assure diverted materials are not managed at the lowest levels of the hierarchy. Additional space for recyclables as a contingency plan if interruptions in the system occur can avoid those materials potentially being landfilled or incinerated at WTE facilities. Preprocessing at WTE facilities and landfills will increase recycling rates.

Required strategies:

The strategies listed below are required to be incorporated into the CSWMP because they are relatively simple or have significant environmental benefit.

35. **Recruit a minimum of 12 commercial businesses a year to recycle at least three materials from their operations and promote the environmental and resource benefits.** The commercial recycling statute Minn. Stat. § 115A.151 requires businesses in the TCMA that contract for four cubic yards or more per week of solid waste to recycle at least three materials. The commercial recycling law is an opportunity for businesses to decrease their waste, reduce their taxes by increasing recycling, and support Minnesota's recycling industry, which creates approximately 37,000 jobs in the state. There is no tax on recyclables or organics in Minnesota, but there is a 17% state solid waste management tax charged on all commercial trash. Many counties charge additional taxes or fees as high as 53% on trash, but not on recyclables or organics.
36. **Establish mandatory pre-processing of waste at resource recovery facilities and landfills by 2030.** Achievement of the 75% recycling goal will require major system changes. Upfront processing of waste to recover recyclables at transfer stations, resource recovery facilities, and landfills may help achieve that. Steel and aluminum are the easiest to recover from MSW, but other materials should be considered if possible. Processing methods should be evaluated prior to implementation to ensure optimal effectiveness.

37. Provide assistance to multi-family properties to improve recycling (4 or more units with shared walls). Some examples of activities that would achieve this strategy include:

- Education to residents and property managers on how to handle and route materials to their proper bins and how to recycle items not accepted in building provided collection
- Financial and/or technical assistance for infrastructure improvements and implementation of improvements
- Assure property manager plans and provides sufficient space for collecting recycling based on the number of residents
- Collaborate with cities to promote assistance resources, on-site education, and implementation of recycling improvements
- Conduct outreach to multi-family association networks (e.g., Minnesota Multi Housing Association) to promote resources

State-led strategies:

The following strategies are the responsibility of the MPCA to support the efforts of counties.

38. Assist with tracking commercial recycling self-hauling activities. In addition to establishing a baseline, identifying the large volume generators of recyclables is necessary to developing a targeted, effective commercial recycling program. The MPCA should review existing data from other states and the EPA on typical generators of large quantities of recyclables and work with counties to interpret this data for use in program implementation. If appropriate data is unavailable, the MPCA will work with the counties to develop a list of large volume generators, as well as a list of generators of the most impactful materials.

Recycling market development

Traditional recycling markets

Without end markets to use recyclable material, there is no recycling. Recycling market development (RMD) creates and maintains demand for recyclable materials. End markets buy these materials for further processing or to produce products. RMD looks at the highest and best use of post-consumer discards from the waste stream. Recycled material used as a commodity in a manufacturing process generates economic activity.

MRFs and haulers have invested in artificial intelligence technologies and sorting equipment. Domestic end markets have expanded in response to surplus of material. The COVID-19 pandemic and rise of online shopping has shifted the market for OCC and paper. Market demand for other materials has increased in the last 18 months.

Capacity in Minnesota's recycling economy is expanding. MyPlas, capable of processing 90 million pounds of film plastic annually, will soon open in Rogers. Minnesota is home to manufacturing plants in Paynesville, Worthington, and Garfield that produce plastic lumber from post-consumer materials. Plastic lumber is made into furniture in Duluth and Jordan. Minnesota's plastic lumber markets include marine, landscaping, and parks and recreation.

However, there have been worrisome losses of markets since 2018 with capacity also shrinking. WestRock in St. Paul processes 600 tons of mixed paper and cardboard per day, a reduction from the former daily capacity of 1,200 tons after the closure of the corrugated medium manufacturing operations in October 2022. Major closures in the TCMA since 2018 include:

- Gerdau Ameristeel Recycling Plant– recycled 560,000 tons of scrap steel annually
- Ball/Rexam– made 2 billion aluminum cans/year

- Brotex – no longer recycles 6,000 tons/year of carpet from Minnesota
- WestRock– recycled OCC (corrugated cardboard) 200,000 tons/year (portion of their plant) in addition to the reduced mixed paper capacity
- Verso Paper Mill in Duluth –recycled mostly industrial paper trimmings

Capacity is under attack in other ways. Overseas markets have forced MRFs and haulers to make expensive investments in infrastructure. Minnesota has one of the lowest residual rates in the country. Residuals are the fraction left over from processing recyclable materials. Yet with supply high and demand low, buyers can be picky. Cleaner material is of higher value and sells more easily.

Markets are cyclical. We must maintain investment in new technologies for sorting equipment to remain competitive. We need to focus on supporting our local businesses and economies and keeping jobs and tax dollars in Minnesota. We need to invest in new products produced with recycled materials.

Investments in technology at MRFs helps make that possible.

State-led strategies:

The following strategies are the responsibility of the MPCA and will support counties.

39. Support and invest in new facilities and retain processors of recycled material for end markets.

Establish a directory of processors throughout the state. Dedicate staff resources to assisting and connecting local processors that prepare collected material for end markets to manufacturers.

Processors need to maintain and upgrade equipment to be competitive. Investing in new and upgraded facilities is a benefit to the local recycling market and supports the economy.

Organics management

Organic materials account for approximately 25% of the waste thrown away by Minnesotans. Preventing wasted food and rescuing edible food are strategies that offer the greatest environmental benefit for managing organic materials. Based on EPA's WARM calculations, preventing one ton of food waste results in 20 times fewer GHGe than composting one ton of food waste. Policies oriented to enhance those efforts are included in the waste reduction and reuse section of this MPP. However, composting and feeding food to livestock or backyard chickens are also important strategies for situations where prevention and rescue were unsuccessful. Counties are encouraged to collaborate with partners to develop and implement best practices to expand organics collections. Partnerships with organizations like the Minnesota Composting Council (MNCC), Food Rescue non-profits, waste haulers, Minnesota Waste Wise and others could lead to better program development and faster progress towards recovery goals.

Anaerobic digestion is covered in the emerging technology section of this MPP.

Anoka County Rice Creek Compost Site Organics Pilot Project

The Anoka County Rice Creek Compost Site, located in Lino Lakes, serves the eastern half of Anoka County. Accepted materials are yard and tree waste, as well as organics recycling. Visitors reported the site as difficult to navigate due to wet and muddy road conditions. Demand often exceeded capacity.

To address the issues, Anoka County acquired an adjacent property on higher ground in 2015 to make improvements. Site design, building removal, building construction, road construction, and surface improvements were completed in 2021 to improve site access, improve traffic flow and safety, expand capacity for processing of organics in the north metro, and allow for a greater number of visitors. Over the last three years, an average of nearly 7,000 vehicles visited annually.

Early in the planning process, one of the existing buildings on the new property was identified as a possible solution for processing organics collected at the organics transfer station. Anoka County and its site contractor, OTI, Inc. approached the MPCA with the possibility of composting organics within the covered enclosed barn as an adjacent facility to the yard waste facility. The county discussed the operation with the MPCA and then began operating a small-scale composting site. The site is managed in a manner consistent with MPCA rules that govern small compost sites. This resulted in the first-of-its-kind small-scale composting facility adjacent to a yard waste facility.

Organics are collected from the public at the organics drop-off on site, then brought into the barn and combined with tree and leaf waste from the yard waste site to be processed into compost. The pilot has completed, and the site is considered fully operational. The finished compost is available for purchase to residents during spring through mid-fall.



Required strategies:

The strategies listed below are required to be incorporated into the CSWMP because they are relatively simple or have significant environmental benefit.

40. **Make residential curbside organics collection available in cities with a population greater than 5,000 by 2030.** Drop sites collecting organics have been well received in the region. However, they appear to only be reaching the most enthusiastic residents. Like curbside recycling services, programs should be offered to all single-family dwellings, duplexes, and small multifamily properties. Programs that charge all eligible households must comply with Minn. Stat. § 115A.93, subd 3 (c). This means all haulers must charge and offer organics to everyone. If offered as a subscription service, the licensing authority must make sure that haulers are compliant with 115A.93 subd 3(c). Programs that charge all eligible households, comply with the statute, are cheaper per household and reduce barriers to participation. Additionally, programs with the lowest contamination are supported by robust education. Curbside collection requires proper and frequent education to be successful. It ensures programs are accessible and maximizes participation.
41. **Expand backyard composting outreach and resources for residents.** Provide resources needed to set up a simple yard waste compost pile and education to assure implementation is sustained. Establish a webpage with an explanation all available resources. Promote the program at least twice per year to residents. This will be especially important in areas experiencing hauler shortages for yard waste.
42. **Require management of organics from large commercial food generators by 2033.**
Commercial and industrial entities that generate large volumes of organics (e.g., restaurants, grocery stores, and food processors) must have an opportunity to reduce their environmental impacts. They often reduce their disposal costs by first preventing food from going to waste. They also rescue food and recycle food waste. As noted in the SMM section, the most impactful action is to reduce the amount of food waste created. Only then should focus shift to rescue of remaining edible food. Local policies should first require adoption of policies that support the prevention and rescue initiatives at large generators.

After the adoption of prevention and rescue initiatives, large generators must implement organics recycling programs. This serves to capture the remaining organic material they would otherwise discard. Many communities like Hennepin County and Western Lake Superior Sanitary District (WLSSD) have already adopted policies requiring large generators like grocers and restaurants to implement these types of programs. Large volumes of material are being captured and used to create compost or feed livestock.

Optional strategy:

The following strategy is optional and may be incorporated into a county CSWMP. Each strategy has been assigned a point value, which is added to the total amount of points the county must achieve for approval of their CSWMP by the MPCA.

43. **Establish additional organics recycling drop-off sites.**

Point Value: 7

Many counties offer organics drop-off sites, which have been successful at capturing food waste for households without curbside collection. Site selection should be in convenient, well-lit places. This strategy can be paired with multi-family recycling strategies to provide opt-in access to residents without curbside collection of organics recycling.

State-led strategies:

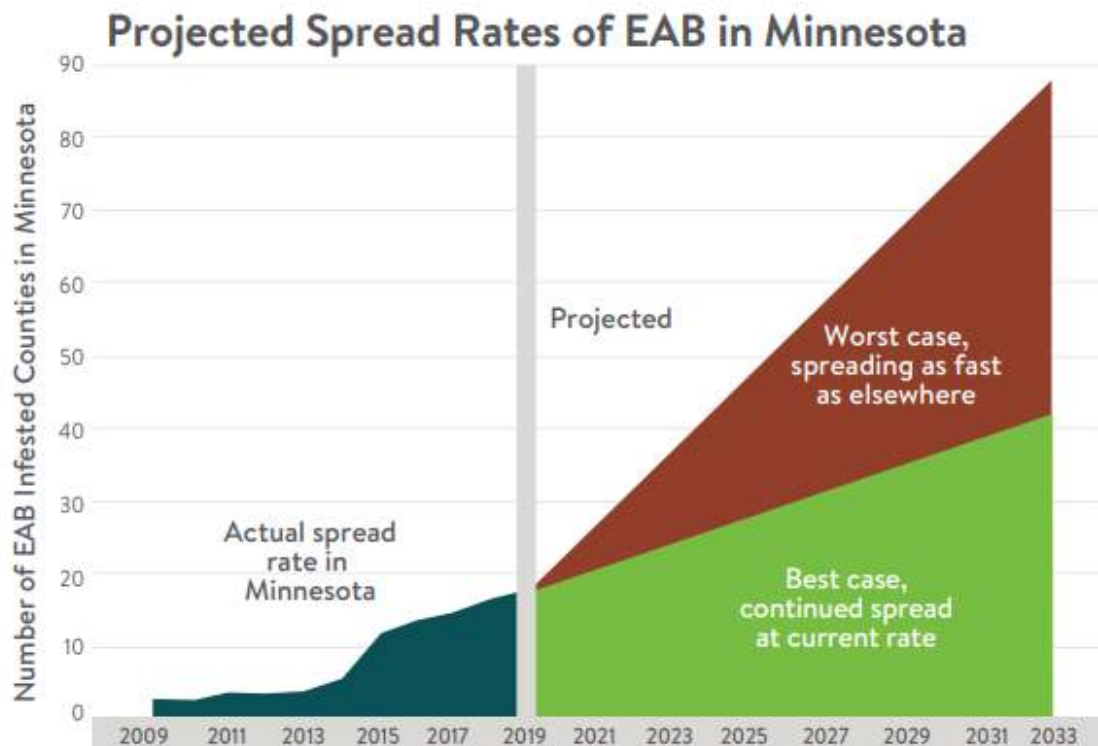
The following strategies are the responsibility of the MPCA to support counties.

44. **Standardize the role of compostable products in organics recycling programs by 2025.** Most of Minnesota’s composting programs have included compostable products as acceptable materials. Some metro cities have adopted ordinances requiring the use of compostable take-out containers. Compostable product advocates suggest they capture more food scraps and increase recycling rates; however, MPCA is not aware of any research that confirms this claim. A study from Oregon using life cycle analysis of compostable products has shown unfavorable results, even when compared to single use disposable items. Standardization of compostable materials will reduce resident confusion and reduce contamination for compost facilities.

Wood waste & EAB

The TCMA is heavily impacted by EAB, with an estimated 20% of community trees being ash. All seven metro counties are included in the Minnesota Department of Agriculture’s (MDA) EAB quarantine area, with infestation observed throughout the area. Additionally, climate change has increased the severity and frequency of storms that knock down trees and branches that must be quickly removed to preserve access to sidewalks and roads and to restore power. These factors have led to large volumes of wood waste. The trajectory of the EAB infestation suggests we are still five to ten years from peak volumes of wood waste in the TCMA (see Figure 9).

Figure 9. Projected county infestation impact in Minnesota due to EAB



Past and projected spread rates of EAB have been slower in Minnesota than the national average. In the worst-case scenario, all 87 counties will have EAB infestations by 2031, as calculated with the national average rate of spread. Under a best-case scenario, with EAB spreading no faster than it has in Minnesota to date, EAB will be present in 39 counties by the same date. Source: MDA

Currently, the St Paul Cogeneration (SPC) District Energy plant in St Paul manages approximately 250,000 tons of wood waste annually. The District Energy facility is a combined heat and power plant fueled by biomass. In recent years, the facility has accepted wood waste at no charge and relied upon the energy fees collected from its district heating customers and revenues from electricity sold to Xcel Energy to finance the plant. The Public Utilities Commission has indicated it no longer supports relying on just energy fees and electricity sale revenues to operate the facility and other revenue sources are needed, such as a tip fee for wood waste delivered to the plant. Other solid waste streams rely on tip fees to operate facilities to process the materials they receive. As such, it is a reasonable and credible path forward for wood waste generators to pay a tip fee to bring wood waste to the facility in order assist with a portion of the facility's expenses. It is also possible that the facility will cease operations if the facility is unable to fill the revenue shortfall.

With the District Energy facility, capacity for managing wood waste is already strained and being used to the maximum that the current contract allows. If the facility ceases operations, capacity to handle wood waste will be drastically reduced, likely triggering a massive increase in open burning piles. Open burning creates a large amount of small particulate matter that can cause problems for people with asthma. Even if District Energy operations continue, it is certain that additional markets are needed to ensure we direct wood waste to its highest and best use and have capacity to manage the anticipated rising tonnage of material.

Hierarchy of ash tree material management:

The MPCA partnered with the Environmental Quality Board (EQB), the Department of Natural Resources (DNR) and the Department of Agriculture (MDA) to release a report on EAB in 2019. [The report](#) details the scope of the problems caused by EAB and suggests strategies for meeting the challenges. The report also includes a hierarchy of ash tree materials management that seeks to prevent wood waste and to utilize wood for its highest and best use. The hierarchy should guide county planning efforts to minimize the environmental impact of managing wood in their communities. Other tree species are facing similar infestations and diseases. Counties are encouraged to address emerging tree diseases and pests with prevention efforts, when possible, to avoid the generation of wood waste.

The following strategies are needed to meet the challenges of managing wood waste throughout the TCMA during the upcoming planning cycle. The strategies will flatten the curve of waste trees generated, support existing markets for wood waste, and develop new markets to help relieve the pressure on current markets to handle the material.

Required strategies:

The strategies listed below are required to be incorporated into the CSWMP because they are relatively simple or have significant environmental benefit.

45. Develop plans to prevent and manage wood waste in each county and throughout the region.

Plans should assume that biomass plants, including SPC's District Energy, will have tip fees to ensure long-term economic viability. Plans should also not assume the Legislature will provide appropriate funds to biomass plants to allow for their continued operations without a tip fee. Plans should be modified to collect data to improve understanding of the wood waste challenges—at a minimum the amount of wood waste being generated and processed at wood yards. This means that plans should include an ordinance requiring wood yards to register with the county and report volumes of wood waste collected, managed, stored, and disposed. Additional data should be collected on tree inventories and on facilities and industries (biomass, compost sites, mulch producers, tree care companies, etc.) that can participate in discussions about wood waste management. Plans should consider setting goals, especially for wood waste management options that offer the greatest

environmental benefits. Plans should include strategies to educate the public about EAB, tree treatment and preservation, and responsible wood waste management.

46. **Promote existing programs that use EAB-affected wood for furniture, home goods, flooring, and other purposes.** While the volume of wood waste managed via these industries in these areas is not enormous, these industries do play an important role in the system by using wood to produce products, thus preventing waste. Additionally, these industries frequently educate the public about EAB, and they provide important economic benefits through the jobs they create and support. Ensure that these organizations are successful and continue to be available. Develop county purchasing requirements to utilize urban wood when available and encourage residents to purchase products made from urban trees. Consider financial support when appropriate.
47. **Composting and mulching operations must continue to be supported.** These industries provide an important outlet for wood waste management. Additionally, they serve as important infrastructure to help manage additional types of organic waste (i.e., yard waste and food scraps). Support that would meet this requirement could include grants or financial assistance to compost facilities, contracts that commit certain volumes of material to sites over a multi-year term, assistance with siting and/or meeting local permitting or land use requirements and promoting the use of the sites to the public and/or alternate strategies that ensure the long-term viability of composting capacity in the region.

Optional strategies:

The following strategies are optional and may be incorporated into a CSWMP. Each strategy has been assigned a point value, which is added to the total amount of points the county must achieve for approval of their CSWMP by the MPCA.

48. **Update ordinances that address wood burning.**

Point Value: 4

Update ordinances defining rules for burning wood, including restrictions on commercial and municipal burning. Establish requirements that minimize the environmental and human health impact. Open burning is the least preferable management method. Expanding other management methods is the best way to avoid open burning.

49. **Develop and distribute EAB tree care education programs for privately owned land.**

Point Value: 8

Education through digital marketing and paper mailers should include an explanation of the risks to ash trees, why a mature tree canopy is important, and focus on the benefits and cost savings of treatment versus removal.

50. **Incentivize tree treatment as a cost-effective strategy to extend the life of ash trees and to reduce the volume of wood waste generated over the next 20 years.**

Point Value: 8

Counties are encouraged to incentivize treatment of private and public trees and to develop financial incentives and/or provide support for treatment and tree preservation. It is much less expensive to treat trees and keep them living than to remove and replace them.

51. **Allow assessments on property taxes to spread the cost of tree care over a multi-year timeframe.**

Point Value: 9

Some communities have used tax assessments to fund tree care services even on private property. This would allow homeowners to defer costs to make tree care services available and affordable.

52. Expand composting and mulching capacity beyond existing markets.

Point Value: 5

Counties and/or cities can contribute to expanded capacity by offering commitments to deliver organics or wood waste at stable tip fees, purchasing compost and mulch, assisting sites in coming online and/or offering other financial, policy or technical support. This could be accomplished by developing the capacity for biochar or other new technologies. Biochar is a carbon-rich soil amendment and agricultural byproduct. It generates energy from biomass in the absence of oxygen. Biochar operations are in early stages in the TCMA but may use wood waste in a beneficial way. The City of Minneapolis collaborated with Hennepin County to begin using biochar for landscaping in 2019. Counties and cities can develop additional capacity by providing financial support and siting assistance and adopting policies that support capacity development.

53. Support development of systems that use wood fuel.

Point Value: 4

Incentivize retrofits through financial or policy initiatives for heating with efficient, low-emissions wood burning appliances. Encourage use of [Environmental Initiative's Project Stove Swap](#). Burning wood in retrofitted stoves is preferable to open burning. This strategy also reduces reliance on fossil fuels for home heating.

State-led strategies:

The following strategies are the responsibility of the MPCA to support counties.

- 54. MPCA will continue state agency coordination to address wood waste.** MPCA works with Minnesota Department of Natural Resources and Minnesota Department of Agriculture on wood waste issues. Some of the topics needing state level coordination include, but are not limited to, open burning permits, grants for tree management to local governments, and developing educational resources for local government and residents.

Organics market development

The MPCA, along with many municipalities in the TCMA, is working to bring organics collections to curbside containers, drop off sites, sports facilities, and commercial businesses. Opportunities to reduce wasted food and rescue food are most impactful. Food waste that cannot first be prevented or donated should be composted, fed to livestock, or rendered. There are well-identified market expansions for compost.

Use of compost in roadside and other construction projects has many benefits. Compost helps amend soils, so they are better equipped to support plant growth, aerate compacted soils, prevent erosion, and infiltrate runoff to prevent pollutants from entering lakes and streams.

Required strategy:

The strategy listed below is required to be incorporated into the CSWMP because it is relatively simple or has significant environmental benefit.

55. Require food-derived compost in county construction and landscaping projects.

Several communities have established practices to incorporate the use of compost into routine operations. Implementing compost specifications into Minnesota's county construction efforts would help expand markets for compost and ensure that those projects are conducted in a way that better protects Minnesota's lakes, rivers, and streams. In revising their specifications for compost, MnDOT updated the 3890 specifications to include compost products that are derived from food scraps in Grade 2 compost. Counties should specify in ordinances the use of a percentage of Grade 2 compost in roadside construction and landscaping projects, in keeping with the MPCA stormwater

manual. Several communities are establishing such requirements. For example, Denver Colorado has a Soil Amendment Program that requires new residential, commercial, industrial, and government properties to use compost. Eagan also has an ordinance requiring organic matter (Grade 2 compost) be used at no less than 5% at sites with greater than 10,000 square feet of land disturbance. Counties should partner with their public works departments to develop an ordinance that makes incorporating food-derived compost a default purchase.

Optional strategy:

The following strategy is optional and may be incorporated into a CSWMP. Each strategy has been assigned a point value, which is added to the total amount of points the county must achieve for approval of their CSWMP by the MPCA.

56. Find new outlets to increase food to animal operations.

Point Value: 7

For food that cannot be prevented or donated, counties may work with the Board of Animal Health (BAH) to promote and expand food-to-animals programs. A county may solicit new partners to receive a garbage feeder permit, which must be obtained from BAH. An existing list of approved food-to-animal garbage feeders can be found on BAH's website:

<https://www.bah.state.mn.us/swine/>. Support for the new outlets will help assure their long-term viability. The CSWMP must include a plan for addressing food to animal opportunities within the county.

Emerging technology

The solid waste system is evolving. Waste materials change and the technology to separate materials continues to improve. These changes improve our ability to divert more material from land disposal. Yet, the environmental impacts of some of these new technologies are not well known, creating challenges because the new technologies do not fit neatly into current rules and the Solid Waste Management hierarchy. As a result, MPCA and others need more time to understand the new technologies to determine what permits they may need and how they may fit into the Solid Waste Management hierarchy. An example is whether new technologies meet the technical requirements for recycling. If they do, this brings the benefit of tax-exemption status for facilities. Processed materials could also count toward county recycling goals. If they do not, waste is being handled lower on the waste hierarchy.

Anaerobic digestion of food has been a focus of several metro counties, to keep food out of landfills. Stakeholders note the need for more clarity surrounding anaerobic digestion. In response, a review of the solid waste management hierarchy and definitions under Chapter 115A was conducted to provide direction as to when anaerobic digestion could count towards county recycling goals. It was determined that organic materials going to an anaerobic digestion facility do not automatically count toward county recycling goals.

The MPCA must consider on a case-by-case basis whether activities at an anaerobic digestion facility meet existing definitions of recycling, for purposes of meeting the recycling goals found in Minn. Stat. § 115A.551 and/or the definition of recycling in Minn. Stat. § 115A.03, subd. 25b. Please note:

- Anaerobic digestion facilities that accept source-separated compostable materials (SSCM) and then compost the digestate can count this material towards a county recycling goal if they

demonstrate the process used aligns with the requirements included in Minn. Stat. § 115A.03 subd. 32a¹³.

- Other types of organic materials may also count towards a county recycling goal if a county can demonstrate that digestate from the anaerobic digestion process is used “in manufacturing processes that do not cause the destruction of recyclable materials in a manner that precludes further use.”²³⁴⁵
- Use of digestate for alternative daily landfill cover is not considered recycling because this application precludes further use and because landfilling is not recycling. The MPCA holds a long-established position that alternative daily landfill cover is not recycling⁴⁶.
- Anaerobic digestion processes that capture biogas but do not produce a useable digestate may be considered resource recovery, but not recycling.

A hypothetical example of an anaerobic digestion facility that would potentially satisfy existing definitions is one that receives source-separated organic materials, uses the anaerobic digestion process to capture biogas to create energy for use, and produces a digestate that is composted and produces a class I or class II compost. In view of the variety of materials and designs for anaerobic digestion facilities, the MPCA looks forward to discussing proposals with stakeholders for purposes of meeting recycling goals and solid waste planning. Stakeholders are encouraged to reach out to agency staff to initiate conversations about specific scenarios for further clarity on classification of materials sent to anaerobic digesters.

Additionally, it is important to note that the EPA’s food hierarchy describes anaerobic digestion as a process that produces both biogas and a soil amendment⁵. The MPCA is continuously engaging with EPA on this topic to ensure consistency and accounting for the best available information. The agency is also pursuing LCA research to provide Minnesota-based environmental analysis for the anaerobic digestion of food waste.

Gasification and plastics-to-oil technology have been proposed and even temporarily in business in the state. The long-term viability of these technologies is unknown as Rational Energies in Plymouth went out of business when it was unable to sell its fuel. The MPCA views them as similar to WTE operations rather than recycling. As such, the MPCA does not allow for these types of facilities to take source separated plastics or other recyclables in their operations.

State-led strategies:

The following strategies are the responsibility of the MPCA to support counties.

57. Develop a process for gathering the information necessary to make timelier and consistent policy decisions. The MPCA should evaluate the various levels of the hierarchy using a life cycle perspective to determine future policy decisions around new technologies. The evaluation should include:

- Use of existing life cycle analysis, such as the Municipal Solid Waste Decision Support Tool

¹ <https://www.revisor.mn.gov/statutes/cite/115A.03#stat.115A.03.32a>

² <https://www.revisor.mn.gov/statutes/cite/115A.551#stat.115A.551.1>

³ <https://www.revisor.mn.gov/statutes/cite/115A.03#stat.115A.03.25a>

⁴ <https://www.pca.state.mn.us/sites/default/files/w-sw-1-31.pdf>

⁵ Per EPA’s Anaerobic Digestion section of their Food Recovery Hierarchy: <https://www.epa.gov/sustainable-management-food/industrial-uses-wasted-food>

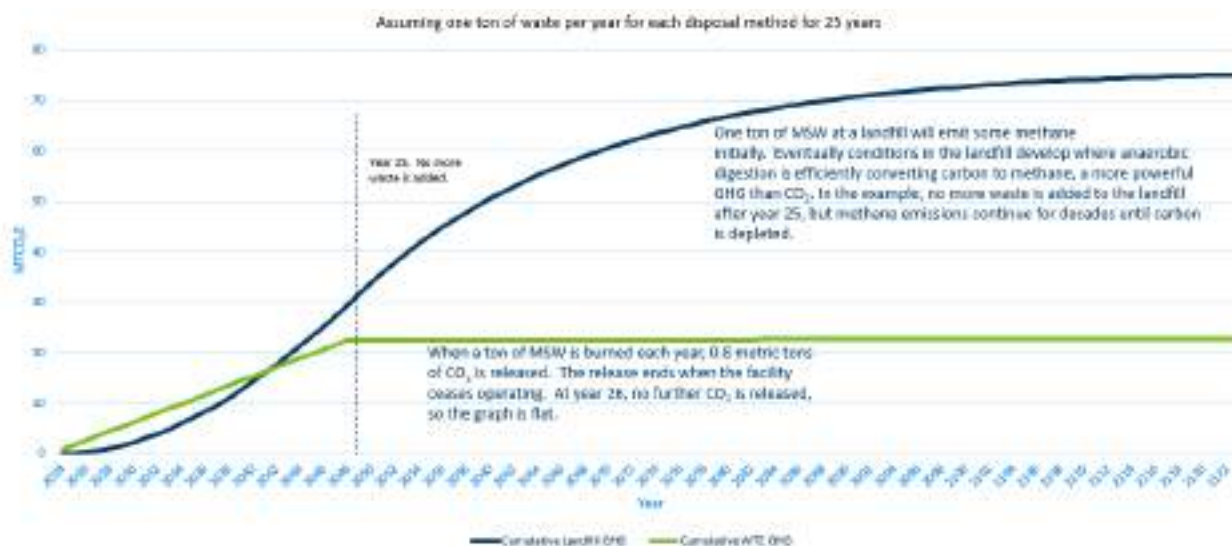
- Research waste management methods including, but not limited to, land disposal, resource recovery, composting, anaerobic digestion, plastics to oil, recycling, and food to livestock
- Identification of gaps in life cycle analysis data and research funds needed to fill those gaps
- Development of solid waste life-cycle policy recommendations
- When needed update state rules for new technology such as anaerobic digestion once sufficient data is in place to inform the process
- Develop a framework for preferred technology

Waste-to-energy

The Waste Management Act identifies a hierarchy that the MPCA is bound by statute to follow, which outlines WTE is preferred over landfills. The following items support this preference for WTE over landfills as a method for waste disposal.

WTE has a significantly smaller climate impact. Landfills produce over three times the amount of GHGe compared to WTE. While operational, the GHGe are similar from WTE and landfills. There is a stark difference at end-of-life. Landfills continue to generate GHGe for decades after closure, while WTE facilities only emit GHGe while operational.

Figure 10. Total GHG generated by landfill and WTE from start of disposal through closure and beyond



After closure, landfills continue to create pollution. Beyond the creation of GHGe, landfills continue to create leachate with contaminants in it. Unless properly managed, leachate can seep into groundwater. Leachate that goes to wastewater treatment plant in part ends up in surface waters due to lack of treatment technologies for many of the contaminants.

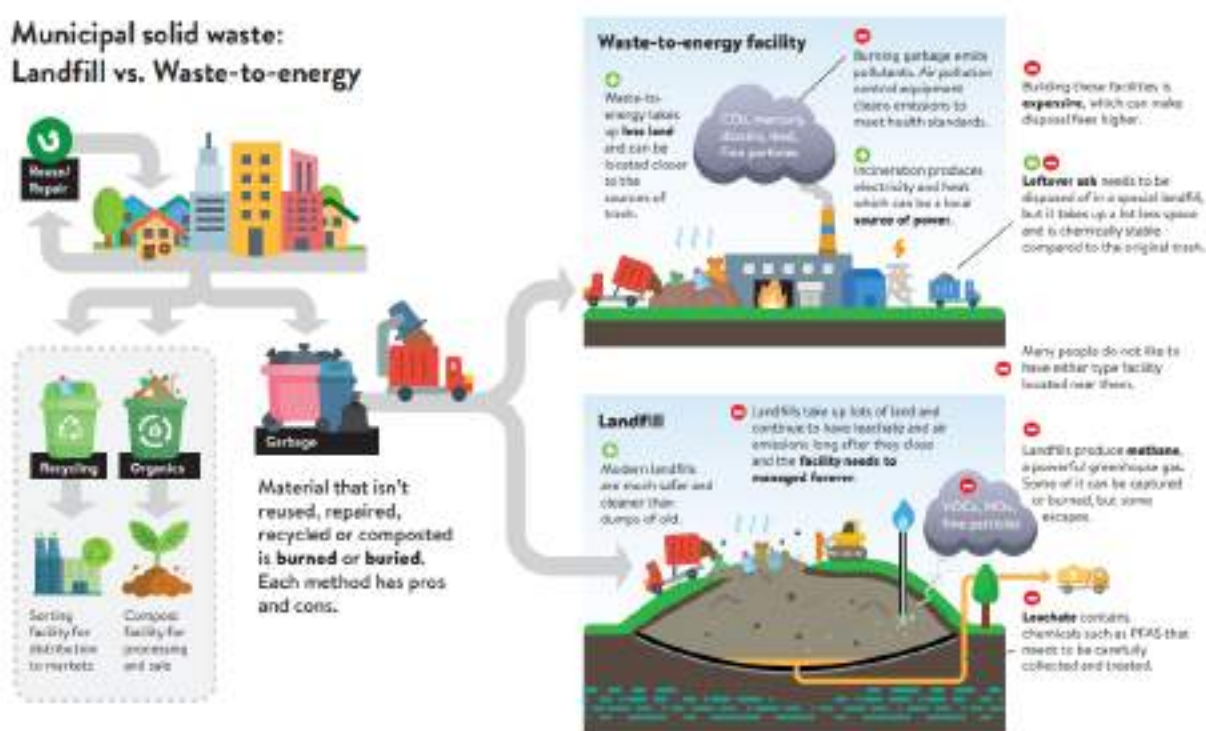
WTE recovers more materials and energy compared to landfills. A portion of the MMSW delivered to resource recovery facilities is diverted to be recycled or recovered for organics management, which is counted as recycled in the objectives in Table 2 and Table 3 (see table footnotes). WTE generates heat and power that contributes to the power grid across the state. Without WTE facilities, additional heat and power must be generated through other methods, which can include burning natural gas or coal to make up the difference.

WTE provides other useful services. WTE facilities are used to destroy pharmaceuticals and drugs for law enforcement departments. Disposal of pharmaceuticals in landfills leads to additional contaminants in leachate, that are not treated.

While WTE has benefits compared to landfiling, the waste hierarchy prioritizes waste reduction, reuse, recycling, and composting over WTE.

Air emissions from WTE and landfills, while meeting state and federal standards, contribute to the overall impacts experienced by neighboring communities. Landfills and WTE facilities located in or near environmental justice areas have a negative impact on communities already overburdened by pollution. WTE facilities in general produce more dioxins, furans, lead, and NOx (nitric oxide), while landfills create more fine particulate matter (PM₁₀ and PM_{2.5}), CO (carbon monoxide), methane, and VOCs (volatile organic compounds).

Figure 11. Municipal Solid Waste: Landfill vs. WTE



The MPCA acknowledges the impacts to residents near WTE facilities and landfills that the past siting of facilities disproportionately impacted disadvantaged communities. Reducing our reliance on WTE facilities and landfills through waste reduction and increased reuse, recycling, and organics recovery is the best way to avoid shifting pollution from one environmental justice area to another. Only then would it be appropriate to set a timeline for taking facilities off-line.

The MPCA supports managing waste as high on the waste hierarchy as possible, as is evident from the strategies in this plan. The solid waste system of the TCMA is not prepared for closing WTE facilities without development of needed infrastructure, programing, and education. The closure of the Elk River WTE facility resulted in increased landfiling, rather than increasing recycling and composting.

On October 24, 2023, the Hennepin County Board passed a board action resolution that instructs county staff to develop a plan for the closure of HERC between 2028 and 2040. Considering the Board's

decision, MPCA expects Hennepin County to develop a contingency plan consistent with the expectations under strategy 12. Ensure there are contingency plans in place if for large facility closures in order to reduce the likelihood of landfill reliance. Changes in management strategies involving large volumes of waste will have regional and potentially statewide impacts. Planning and resource investments are needed to ensure subsequent waste management systems minimize environmental impacts, are cost effective and do not result in increased burdens in communities already experiencing environmental justice concerns.

Table 5. Existing resource recovery facility capacity serving the TCMA

MMSW processing facility	Permitted capacity	Greater Minnesota-forecast tons per year	TCMA- forecast tons per year	Total - forecast tons per year
HERC	365,000	0	365,000	365,000
REC	450,000	0	450,000	450,000
City of Red Wing	36,000	23,000	13,000	36,000

Interested parties in the public and private sector need to work collaboratively to improve processing of collected materials in a way that will capture more recyclables and assess the efficacy of policies.

The MPCA has regulatory authority to ensure implementation of ROD (Minn. Stat. § 473.848) and public entity requirements (Minn. Stat. § 115A.471), both of which require processing of MMSW. Hennepin County and jointly Ramsey and Washington counties have successfully directed waste to their own processing facilities. Designation in Goodhue County has stabilized the base amount that Red Wing receives with tonnage being supplemented with contract waste from two cities in Dakota County. These efforts have allowed the three facilities to operate at full capacity. If there are delivery shortages of waste at the resource recovery facilities listed above, the landfills are obligated to fill the shortage or stop accepting waste. The MPCA expects that operational WTE facilities will continue to run at full capacity going forward.

Required strategy:

The strategy listed below is required to be incorporated into the CSWMP because it is relatively simple or has significant environmental benefit.

- 58. Counties must continue to support the implementation of Minn. Stat. § 473.848 Restriction on Disposal.** Operating resource recovery facilities at full capacity is important. Continue to require delivery of county waste to WTE facilities, if available. Submit timely ROD reports. Continue to actively participate in the quarterly certification process. Facilitate communication between facilities.

Landfilling

The system objectives strive to reduce land disposal to 5% of MMSW generation within the next ten years, recognizing that some MMSW is not processible. Some disposal options will always be necessary. If the MMSW cannot be prevented, reduced, reused, recycled, or composted, it should first go to a resource recovery facility. Only then, if the waste is not processible, should it be landfilled.

Optional strategies:

The following strategies are optional and may be incorporated into a CSWMP. Each strategy has been assigned a point value, which is added to the total amount of points the county must achieve for approval of their CSWMP by the MPCA.

59. Implement additional fees to better account for the externalities of land disposal.

Point Value: 4

Landfilling is the least expensive option at the point of disposal, but the externalities like operating the closed landfill program, groundwater monitoring, and managing vapor intrusion, make it more expensive in the long run. Closed landfills must be monitored and managed in perpetuity to protect the environment and human health. They produce contaminated fluids (leachate) and gases that must be managed properly to avoid polluting groundwater or affecting nearby structures. Finding solutions to minimize land disposal and move waste up the hierarchy will save taxpayers money in the long term. Ramsey County's environmental charge on MMSW is a good example of a possible strategy to better reflect the true costs associated with disposal. Placing a county fee on every ton of MMSW delivered to landfills can provide revenue for preferable waste management programs and can contribute to prices for residents and businesses that reflect actual, long term disposal costs.

Product stewardship

Managing waste in Minnesota is a challenge that requires consistent innovation. One evolving concept pertains to who should be responsible for managing waste. The beverage industry's shift from reusable containers to disposable resulted in an increased amount of waste. In the 1970s, other states began to introduce "bottle bills," also known as container deposit return laws, to address these concerns. This introduced the concept of industry managed product return programs.

Product stewardship was introduced in the 1990s. Product stewardship aims to shift responsibility for negative impacts to the economy, environment, public health, and worker safety to designers, manufacturers, retailers, and users of consumer products. Product stewardship should focus on the impacts of a product and its packaging throughout all lifecycle stages. This includes the material type, toxicity, raw materials, design, and recyclability.

Minnesota was a product stewardship leader in the early 1990s. Lawmakers introduced Minn. Stat. § 325E.125, subd. 3, requiring manufacturers to collect and recycle rechargeable batteries. Since then, more than 30 states have adopted product stewardship laws, including 25 states with e-waste laws. The manufacturer takes responsibility by paying to collect and recycle the products covered under law, with the products covered varying widely from state to state.

Manufacturers have continued to produce without planning for the end-of-life (EOL) management of products and by-products. Updates to the law are needed to address the full scope of the lithium battery issue. When manufacturers are responsible for end-of-life costs, it incentivizes toxicity reduction, consideration of processing costs, and recovery yields. First Solar's take-back program is a great example of EPR. The company recovers materials from retired solar panels to create new panels. The cost of this service is passed on to the owners of the solar panels.

States have been introducing product stewardship laws that focus on materials such as solar panels, carpet, mattresses, and packaging. Studying the development of product stewardship adaptation in other areas of the country provides many benefits. It gives Minnesota an opportunity to avoid pitfalls and focus on proven strategies.

Required strategy:

The strategy listed below is required to be incorporated into the CSWMP because it is relatively simple or has significant environmental benefit.

60. **Participate with the Product Stewardship Committee under the Solid Waste Administrators Association (SWAA).** SWAA provides peer-to-peer networking opportunities, and the Product Stewardship Committee allows for targeted information sharing. Consistency in product stewardship goals between the metro counties is imperative for planning how to handle post-consumer materials. Strong county coordination and support of product stewardship approaches by the counties can help enact legislation and programs at the state level to move the state forward. State policy and actions can help lead to regional and national initiatives.

Household Hazardous Waste (HHW)

HHW facilities play an important role in capturing products or wastes that are not amenable to management at other waste facilities. They reduce the toxicity of the solid waste stream by providing households with an opportunity to bring pesticides, drain cleaners, mercury thermometers, stains, or varnishes, and other such products to drop-off sites. This prevents exposure and operational problems at other solid waste facilities from common HHW.

HHW collection programs are statutorily mandated to remove hazardous materials from the solid waste stream. Each of the metropolitan counties has at least one year-round site for the collection of HHW. A Reciprocal Use Agreement allows residents to use any of the HHW collection sites located in Anoka, Carver, Dakota, Hennepin, Ramsey, and Washington.

Required strategy:

The strategy listed below is required to be incorporated into the CSWMP because it is relatively simple or has significant environmental benefit.

61. **Encourage retailers to increase consumer awareness of responsible end-of-life handling for products containing lithium-ion batteries.** It is illegal to discard rechargeable batteries in the trash. It is important to manage batteries properly to avoid creating serious safety hazards. HHW sites are safely collecting these, but consumers are not always aware that products they purchase contain lithium-ion batteries. This strategy can be accomplished by sending a letter to all licensed tobacco retailers in your county with information such as how to request signage about HHW drop-off locations and the risks associated with improper disposal of lithium-ion batteries.
62. **Continue participation in the reciprocal use agreement for HHW collection sites.** This agreement allows residents of all seven metro counties to use any collection site located in the TCMA. The MPCA values the convenience provided to TCMA residents with the reciprocity agreement. The agreement should continue to be in place into the future to continue providing this service to area residents.
63. **Partner with cities to increase participation in HHW collection.**
Traditional methods of HHW collection capture some of this waste, but there are households that do not participate for a variety of reasons. Private companies providing specialized HHW services, retailers, cities, and other counties should collaborate to increase the number of households effectively diverting their HHW from their trash. Expanding methods of collection could increase the amount of HHW collected.

Optional strategies:

The following strategies are optional and may be incorporated into a CSWMP. Each strategy has been assigned a point value, which is added to the total amount of points the county must achieve for approval of their CSWMP by the MPCA.

64. Host monthly drop-off sites in locations other than a permanent HHW site.

Point Value: 8

The focus can be on a particular type of material, like lawn and garden chemicals in the fall, or a general collection of HHW. Ramsey County has a mobile site for general HHW collection that moves to a new location each month.

Sustainable Building and Deconstruction

Construction, renovation, and demolition of buildings, roads, and bridges produces demolition debris. Traditional demolition is wasteful and destroys usable, valuable materials. Demolition activities usually involve destruction of building materials, which are then mixed and placed in a dumpster. Once materials are mixed, it is difficult to separate them. Mixed materials may be sent for recycling, but at that stage the amount that can be recovered is minimal.

Most of the mixed materials end up going to a landfill. Better handling and preservation of existing materials would reduce unnecessary waste. Materials like concrete, wood, and metals could be diverted for reuse or recycling. In 2021, an estimated 4,842,000 tons of ISW and demolition debris was land disposed. Current ISW designation has resulted in inexpensive land disposal. While it is not the intended use, ISW designation can be used for demolition debris. The result has been growth in non-MMSW (demolition debris and ISW combined) since 2009. By comparison, MMSW experienced modest growth.

Construction and demolition waste landfills in Minnesota are governed by laws promulgated in the late 1980s, which do not require these landfills to be lined. Groundwater monitoring from these landfills found heavy metals at amounts that exceed levels safe for human health. The presence of contaminants of emerging concern were also detected.

Table 6. 2021 disposal in facilities that accept TCMA waste

Waste type	Landfill type	Quantity
Industrial Solid Waste (ISW)	MMSW landfills, ISW Landfills, Class III Demo landfills or to ISW cells at MMSW landfills	3.41 million tons
Construction/Demolition Debris	MMSW landfills, ISW landfills, all types of Demolition Landfills	1.43 million tons
Mixed Municipal Solid Waste (MMSW)	MMSW Landfills	1.10 million tons

Industry has opportunities to improve sustainability in earlier stages of material design and manufacturing. The production of building sector contributes significant GHGe. Building design, maintenance, preservation, and removal also provide opportunities to address sustainability. TCMA counties must consider the broader climate impacts of buildings, beyond end-of-life management.

The greatest environmental benefits are driven by prevention, achieved by reusing existing structures and materials. For example, reuse of buildings with average energy performance provides a greater GHGe reduction when compared to energy efficient new construction. Building preservation and reuse provide the greatest opportunity to avoid GHGe. Furthermore, reused building materials are also diverted from landfills. The TCMA has a low recycling rate for construction and demolition material. While increasing the recycling rate could have benefits, prevention will be the most impactful. Preservation maintains the location and as much of the existing structure as possible. Renovation can provide improved efficiency and usability. Structural moving keeps a functional building in circulation.

Figure 12. Sustainable Building SMM Guidance from most to least preferred management methods



Required strategies:

The strategy listed below is required to be incorporated into the CSWMP because it is relatively simple or has significant environmental benefit.

65. **Implement the use of a Building Material Management Plan.** Also commonly known as Material Conservation and Waste Management Plan, this tool is for buildings going through renovation or deconstruction to document the destination of materials in building/unbuilding projects during and after project completion.

Require that a building material management plan be used for specific non-government projects or for all publicly owned buildings being modified or removed within the jurisdiction. Jurisdictions must document the type and quantity of materials that get reused, recycled, or landfilled/incinerated for all publicly owned buildings being modified or removed. Consider using the MPCA's Building Material Management Plan Template. It is provided as a customizable Microsoft (MS) Excel spreadsheet so cities, counties, and other organizations can gather building material data to support their programs and convey important information regarding construction, renovation, deconstruction, and demolition goals or requirements within their jurisdiction.

Optional strategies:

The following strategies are optional and may be incorporated into a CSWMP. Each strategy has been assigned a point value, which is added to the total amount of points the county must achieve for approval of their CSWMP by the MPCA.

66. **Prior to demolition of county-owned buildings, require that SMM strategies are considered.**

Point Value: 7

For greatest impact, consider implementing these approaches in the order they are listed. Reassign the building for other government purposes. Sell the building to be used as-is or with renovations. If it is not feasible to use the building, deconstruct with all useful materials diverted from the waste stream. Divert a minimum of 75% of materials from disposal and at least 10% of materials reused. Recycle if/when deconstruction is not an option. Consider requiring publicly owned buildings

applying for a demolition permit to provide a feasibility study for deconstruction before a permit is granted.

67. Host a building material collection event or swap.

Point Value: 8

Partner with supporting cities within the county and with resale non-profits to accept used items in good condition for reuse. Promotional opportunities could include postcards, city newsletters, social media, and email. Promotional outreach should include education on the climate and other environmental and human health impacts of the lifecycle of building materials, guidelines, and lists of what is/is not accepted.

68. Provide financial assistance to offset the additional cost of building deconstruction, used building material installation, and/or structural moving.

Point Value: 8

Offer grants for building deconstruction, structural moving, and building material reuse to reduce the amount of wasted building materials and the need to manufacture new items, as well as to effectively divert materials otherwise bound for landfill. Partner with organizations that have strong relationships with lower income communities where single-family homes, multi-family units, businesses, and community centers would benefit from funding and assistance to update (ensuring repairs are done in a way that also support energy efficiency). Consider adding a step in the permitting process where the contractor is introduced to these programs.

For example, Hennepin County began offering deconstruction grants for residents in 2020. Owners of 2–4-unit housing are now offered up to \$5,000 (\$2 per square foot) to use deconstruction techniques. This grant expanded in 2022 for projects that incorporate used building materials. Ramsey County began offering grants for homeowners and developers in 2021, offering the same funding as Hennepin County for residential properties. Commercial properties are eligible for up to \$10,000. Washington County followed suit in 2022.

69. Provide deconstruction training.

Point Value: 8

To support the “unbuilding” of buildings that have reusable materials, contractors will need deconstruction training. Arrange virtual and in-person courses. Aim to develop a workforce ready to provide deconstruction services within your county. Collaborate with other counties to provide trainings, if desired.

70. Annually host or aid with home and building repair and refurbishment trainings.

Point Value: 8

These training should encourage extending the life of products and materials over replacement. Many of these types of classes are already offered through community education or building preservation organizations. Sponsoring these courses to provide free or reduced cost enrollment would fulfill this strategy. This should also be paired with EPA’s Renovator Training to avoid lead exposure.

71. Use purchasing guidelines to require environmental product declaration (EPD) for concrete.

Point Value: 7

Select products with the lowest carbon concrete for all new buildings, sidewalks, and roadways. An EPD is a comprehensive report that includes a life-cycle analysis that provides specific environmental information on a product in a common format. EPDs provide clear information on the environmental benefits of products like energy efficiency. Requiring EPDs for building materials can provide institutions with the information they need to meet specific environmental goals and report on impacts.

State-led strategies:

The following strategies are the responsibility of the MPCA to support counties.

72. **Study waste classification practices.** The MPCA should evaluate the meaning and application of statutory and rule definitions of MMSW, industrial solid waste, and industrial waste. The MPCA will analyze the solid waste system for equity opportunities. Once the evaluation is complete, the MPCA will make recommendations and changes to ensure that all parties within the system understand how to properly classify MMSW, ISW, and demolition debris.
73. **Propose changes to B3 guidelines to strengthen deconstruction requirements.** The sustainable building guideline used by the state is Buildings, Benchmarks & Beyond (B3). B3 studies building performance and develops standards to advance strategies for measuring and increasing performance of buildings receiving state funds. Most buildings participating in the B3 program are state-owned. Yet some buildings developed by local governments, including housing, have participated. The B3 Guidelines (B3-MNBG) are a series of required and recommended performance standards. Among them are energy and waste efficiency standards (SB 2030).
74. **Incentivize deconstruction over landfilling MMSW and demolition debris.** The MPCA has been working with stakeholders connected to sustainable building material management. The goal is to support and incentivize the deconstruction and reuse of demolition debris materials, since the cost of disposal is so low. The MPCA will focus on direct deconstruction incentives.
75. **Lead Sustainable Building Group (SBG) developments.** The MPCA will serve as a technical expert for various built environment conferences, host working groups and meetings, develop legislative proposals to advance waste reduction regulations, and provide guidance for B3 and GreenStep Cities. The stakeholders in this group established a list of final recommendations, which would establish training, grants, ordinance templates, and other incentive programs to encourage reuse in construction and deconstruction.

See [Appendix G](#) for the full strategy table.

Appendix A: Overview of the current Twin Cities Metropolitan Area solid waste management system

We cannot solve on the backend the problems that are created upstream. Consumption directly leads to waste and there is little the solid waste industry can do to mitigate the issues caused by overconsumption. In 2020, the TCMA generated an estimated 3.29 million tons of MMSW. Approximately 8.6 cubic yards of non-MMSW was reported in 2021. This waste includes demolition debris, industrial, and medical waste. Non-MMSW is sent to demolition debris and/or industrial waste landfills. The TCMA solid waste infrastructure is comprised of private and public entities. Materials generated by homes, businesses, and institutions are first collected then transported, recycled, recovered, incinerated, or land disposed.

Description of the system

Minn. Stat. § 115A

The goal of this section is to protect the state's land, air, water, and other natural resources and the public health by improving waste management in the state to serve the following purposes:

1. Reduction in the amount and toxicity of waste generated
2. Separation and recovery of materials and energy from waste
3. Reduction in indiscriminate dependence on disposal of waste
4. Coordination of solid waste management among political subdivisions
5. Orderly and deliberate development and financial security of waste facilities including disposal facilities

Minn. Stat. § 473.803 requires metropolitan counties to plan and manage an integrated solid waste system. A recycling implementation strategy for meeting the goal of 75% by 2030 is mandated. The recycling rate includes both traditional recyclables, yard waste, and source-separated compostable materials. If current trends continue, we cannot expect the recycling rate to exceed an average of 61% by 2030. The MMSW recycling rate as of 2021 is 45.2 %, which has grown by almost 20% over the past 10 years.

Collection

Approximately 200 waste hauling businesses are licensed in the TCMA via a regional joint powers agreement to collect and transport MMSW. State law requires waste haulers to provide volume-based service. TCMA communities have two types of agreements with waste haulers: open collection and organized collection. Open collection allows residents and businesses to choose their waste hauler. Cities that contract with haulers on behalf of communities have systems referred to as organized collection. About 38% of communities in the TCMA have organized trash collection and about 59% have organized recycling collection. Yard waste, organics recycling, and recycling drop-off sites serve many communities.

Toxicity reduction

Waste that is hazardous as defined by federal and state laws and local ordinances poses environmental and public health and safety risks. Toxicity reduction is an effort to manage the risks associated with the hazardous character of waste.

The TCMA addresses the hazardous character or toxicity of waste in two ways. The first, aimed at residents, encourages reduction of wastes with hazardous character, coupled with a network of HHW programs operated by counties. The second, aimed at commercial generators of hazardous waste, includes regulating under the federal Resource Conservation and Recovery Act standards for businesses in the TCMA.

HHW collection programs are imperative for removing toxic materials from the waste stream. Year-round operation of an HHW site is present in each metropolitan county. Efforts to capture HHW also include seasonal, temporary, satellite, or special one-day collections. TCMA residents may use any of the HHW collection sites located in TCMA counties due to an effective reciprocity program among the metro counties.

Chemicals in the environment are a growing concern. Their presence indicates that there are opportunities for reducing exposure to toxic chemicals through pollution prevention. Apart from lead and perhaps mercury, none of these chemicals would have been found in people 70 years ago. Air, water, and soil sampling also document the unintended presence of many toxic chemicals due to human activity.

The MPCA is conducting a PFAS source evaluation and reduction initiative with the goal of supporting operators of PFAS conduits to the environment, such as landfills. Solid waste facilities perform an essential function in society of managing waste while minimizing environmental and human health impacts. Unlike industrial facilities using or producing PFAS products, landfills have limited options for managing PFAS inputs into their facilities, and PFAS levels will reflect a composite of historic and ongoing levels in disposed materials. The MPCA regulates solid and hazardous waste in Minnesota to support an integrated waste management system and to ensure protection of public health and Minnesota's land, air, and water resources.

Recycling

Residential recycling programs consist of curbside collection and drop-off sites. Curbside recycling programs contract with a municipality or operate through subscription service. Most counties provide some funding for municipal programs. There are public drop-off locations for recyclables in five counties. Many businesses have active recycling programs, and commercial recycling accounts for a considerable part of the recycling in the region. The success of the region's recycling program is not only a result of county and city efforts, but also of the significant contribution the private sector has made through the development of markets, provision of drop-off locations, and the many elements needed for the recycling infrastructure.

Recyclables collected are taken directly to a recycling market, a recycling broker, or to an MRF. Materials commonly recovered for recycling include:

- Steel & aluminum cans
- Newspaper and magazines
- Office paper and mail
- Cardboard
- Boxes: food, beverage, toiletries
- Glass jars and bottles

- Plastic bottles, containers, jugs (#1, #2, & #5)
- Cartons

Presently, eight businesses operate MRFs that manage residential recyclable materials generated in the TCMA: Republic in Inver Grove Heights, Republic in Minneapolis, DemCon in Shakopee, Dick's Sanitation (Recycle Minnesota) in Lakeville, Eureka Recycling in Minneapolis, Republic Services in Delano, Tennis Sanitation in Saint Paul Park, and Waste Management in Minneapolis. In 2021, the materials recycled came from these sources: 65.5% from commercial and 34.5% from residential. Historically, 20 to 25% of the residential waste and about 50% of CII waste is recycled.

Lithium-ion batteries should be disposed of via e-waste streams. However, some are disposed of in unsuitable places. Dangerous fires in garbage trucks, at transfer stations, MRFs, and landfills have resulted. Uncontrolled burning of waste is a threat to human health and the environment. Fires cause structural damage that require repairs, increased insurance costs, and require the organizations to spend funds on repairs. Insurers offering coverage to waste facilities may reasonably estimate a high risk of a severe fire breaking out, leading them to pass the financial burden of that danger to their customers. Not only are prices increasing, but also insurers are leaving the market, making it more difficult for MRFs to get insurance. The industry, which had almost 50 insurance options as little as three years ago, now has fewer than 10.

Yard waste

Under state law, yard waste should be separated from MMSW and is banned from land disposal. A few cities offer the collection of yard waste mixed with other organics for composting. Yard waste is managed through county, municipal, and private programs. Yard waste collection sites located throughout TCMA operate year-round or seasonally. They are operated by counties, cities, or private firms. Curbside collection of yard waste occurs in many areas using separate collection vehicles.

Documented yard waste volumes are reported to the MPCA; in 2020, 424,762 tons of yard waste was reported in the TCMA. The capture rate for yard waste in TCMA is 88.8%.

Invasive earthworms known as jumping worms are an emerging issue in Minnesota, with confirmed presence in Hennepin and Ramsey counties dating back to 2007. Tree diseases and invasive insects will continue to be an issue, despite efforts to diversify the tree canopy.

EAB is now identified in 30 Minnesota counties and continues to spread, which leads to the creation of wood waste. District Energy's Saint Paul Cogeneration (SPC) facility is the only outlet at this time to manage the hundreds of thousands of tons of wood waste generated each year via biomass.

The PUC regulates energy production activities at SPC, as the facility is a source of energy production. SPC currently processes about 250 tons of wood waste annually. WTE facilities play a strong role in waste management and SPC is increasingly important in dealing with wood waste. EAB projections suggest this will continue to be a pervasive issue, with greater spread and impact.

SPC provides an important service that is environmentally preferable. If SPC were to discontinue services, it would leave the TCMA without a biomass energy resource and would lead to intentional open burning or spontaneous fires. Uncontrolled burning of wood contributes to air pollution by releasing PM2.5, benzene, formaldehyde, acetaldehyde, acrolein, and polycyclic aromatic hydrocarbons (PAHs). Extensive scientific evidence demonstrates short-term exposure to PM2.5 causes cardiovascular health effects. In 2020, reported emissions at SPC were 77,200 tons of CO₂e and a combined total of 0.34 tons of PM₁₀ and PM_{2.5}, 20.5 tons VOC and 255 tons NO_x. Control equipment at SPC greatly reduces other pollutants like lead, ammonia, and sulfur dioxide.

Organic waste management

Organics recovery programs include food rescue, food-to-livestock, and composting. Each management method can capture different mixtures of feedstock. Waste reduction opportunities to reduce organic materials diverted to trash should take priority. Further reducing or recovering organic materials from the trash can be accomplished through different diversion strategies. The MPCA is assessing the newly released EPA Wasted Food Scale to determine how it applies to operations and activities throughout Minnesota. The Food Scale was developed by EPA's assessment of various common pathways for managing food and prioritizes them based on their environmental impacts and potential contributions to a circular economy.

Figure 13. EPA Wasted Food Scale preferred management methods



Organic materials account for a large portion of the MMSW sent to landfills and resource recovery facilities. The Burnsville Sanitary Landfill conducted a waste characterization study in 2019, which identified organics made up 49.13% of waste sorted. Hennepin Energy Recovery Center conducted a similar study in 2017, which identified organics accounting for 28.8% of total composition of waste. The

nearly 20% difference between facilities could be explained by Hennepin county's early adaption of curbside collection of organics.

Each management method has different requirements regarding what materials are acceptable, but it is clear there is substantial opportunity to reduce or recover organic materials that are currently ending up in the trash.

Access to organics collection has improved and increased in the last six years. Ramsey and Washington will roll out a joint effort for curbside collection to residents by late 2023. These counties are also looking to add anaerobic digestion as an additional method for processing organic waste, as is Hennepin County. Hennepin requires residential collection of organics. Dakota County has passed an ordinance that sets tiered effective dates to require commercial collection for different types of businesses to divert and collect food scraps from their back-of-house operations. Individuals willing to self-haul their organics have access to drop sites in every metro county.

Curbside collection primarily utilizes one of three methods:

1. Collecting organics curbside in a cart – including only food scraps, non-recyclable paper, and compostable plastics, in a compostable bag
2. Co-collecting organics with yard waste
3. Co-collecting organics, in a durable compostable bag, with MMSW (sorting facilities to remove compostable bags are required with this model)

The TCMA is currently served by several food rescue organizations, four food-to-livestock operations with garbage feeder permits (able to accept meat and vegetative food scraps), three large scale composting operations that are permitted to accept SSO, and many yard waste composting facilities. With the introduction of new programs, capacity is now a challenge. Transfer capacity, route density, and access to hauling service also remain a challenge.

In 2020 and 2022, the Legislature increased SCORE funding for the state by \$500,000 and \$700,000 respectively. The Waste Management Act includes language that requires metro counties to spend half of any increase in funding as compared to a base year of 2014 on organics (i.e., food rescue, composting, food-to-livestock, anerobic digestion). The counties' obligations for organics spending are listed in Table 7. Metro counties detail how funding is spent as part of the annual reporting process. Their reports have confirmed compliance with this requirement and frequently show spending on organics far exceeds their obligation.

Table 7. Organics obligation by county for FY2020-2023

Metro county	FY2020 Organics obligation	FY2021 Organics obligation	FY2022 Organics obligation	FY2023 Organics obligation
Anoka	\$104,192.00	\$105,832.50	\$125,626.00	\$126,377.50
Carver	\$38,311.00	\$38,496.00	\$43,430.00	\$45,238.00
Dakota	\$123,311.50	\$123,854.50	\$154,999.50	\$156,174.00
Hennepin	\$375,199.00	\$383,780.50	\$449,543.50	\$448,556.50
Ramsey	\$163,542.50	\$164,105.00	\$183,106.00	\$178,877.50
Scott	\$47,606.50	\$48,828.00	\$59,816.00	\$61,625.50
Washington	\$79,516.50	\$77,492.00	\$97,598.00	\$99,625.50
Metro total	\$931,679.00	\$942,388.50	\$1,114,119.00	\$1,116,503.50

TCMA counties reported collecting a total of 549,135 tons of organics in calendar year 2020. Table 9 provides the total amount of organics recovery reported, by type, in the 2021 SCORE report for the TCMA counties.

Table 8. Organics recovered in 2021 (in tons) (data from the 2021 SCORE report)

Material type	Tons collected	Change from 2020
Food to livestock	107,133	-0.8%
Food to people	23,585	34.7%
Other materials	1,944	198%
Source-separated organic materials	79,891	103.7%
Yard Waste	335,379	-12.6%

The yard waste stream is primarily coming from residential sources. The food-to-livestock and food-to-people figures come from commercial sources. The 2020 data showed disparities among metro counties for organics diversion. The metro average decreased from 2019 to 2020 by nearly 20%, while some counties, like Washington, experienced growth year-on-year of nearly 80%.

It is also worth noting that the items included in the organics calculation now include yard waste composting. That policy change took effect in 2013 and now counties include documented yard waste in their annual reports to the MPCA. This change in reporting process resulted in a significant increase in the combined organics/recycling rate. Further increase in the organics recovery rate will likely be more challenging to achieve in future years.

Resource recovery

Three MMSW resource recovery facilities serve the TCMA. The Elk River Resource Recovery Project (GRE-Elk River) was an RDF processing plant owned by Great River Energy (GRE). The site became a WTE facility in 1989 and closed in 2019. GRE-Elk River's operational capacity was about 250,000 tons per year, all of which is now diverted to landfills.

Table 9. Existing resource recovery facility capacity serving the TCMA

MMSW Processing Facility	Permitted capacity	Greater Minnesota-forecast tons per year	Forecast tons per year - TCMA	Forecast tons per year - Total
HERC	365,000	0	365,000	365,000
REC	450,000	0	450,000	450,000
City of Red Wing	36,000	23,000	13,000	36,000

The HERC facility in Minneapolis uses a mass-burn technology, producing energy for district heating and electricity. The facility also recovers ferrous metal for recycling from the ash. HERC managed 361,502 tons of waste in 2021.

The Ramsey/Washington County Resource Recovery Facility (Recycling and Energy Center) is a refuse-derived fuel (RDF) facility owned by Ramsey and Washington counties. The facility was purchased by the two counties in 2016. Mixed waste is sorted into processible and non-processible waste on the tipping floor, processed, and separated into three waste streams: RDF, recyclable metal, and residue. The RDF is transported for combustion to Xcel Energy power plants in Red Wing and Mankato, where it is burned to generate electricity. The facility recovers ferrous and non-ferrous metals for recycling, and unprocessable waste and residue from processing is delivered to landfills. Recycling and Energy Center's permitted capacity is 450,000 tons per year.

The city of Red Wing (City) operates an RDF processing plant in Red Wing. Mixed waste is sorted into processible and non-processible waste on the tipping floor, processed, and separated into three waste streams: RDF, recyclable metal, and residue. The RDF is transported for combustion to Xcel Energy's power plant in Red Wing. The facility recovers a variety of recyclable materials including paper, plastics, and ferrous and non-ferrous metals for recycling. Unprocessable waste and residue from processing is delivered to a landfill. Red Wing's permitted capacity is 16,000 tons per year for metro and surrounding counties and 20,000 tons for Goodhue County.

The three resource recovery facilities have a combined operating processing capacity of 802,627 tons per year, down from the over 1.15 million tons capacity the metro had before GRE-Elk River closed. In addition, there is available unpermitted, but installed capacity, of 40,000 tons per year at HERC. In 2021, PCA prevailed in court on ROD. Since that time, processing capacity has been fully utilized at the three remaining facilities. There is currently no additional capacity, which has increased use of land disposal.

Landfills

In 2021, 33% of the TCMA MMSW was land disposed. Nine landfills received 1,102,177 tons of TCMA MMSW, with 15% destined for landfills located out of state. Figure A-2 shows total amounts of TCMA MMSW that the landfills received in 2021, with 93% of total waste headed to landfill classified as unprocessed MMSW. Four Minnesota landfills receive the majority of TCMA MMSW, with collective remaining permitted MMSW capacity of approximately 10.2 million cubic yards. If these facilities continue to receive waste at approximately the same rate in the future, the permitted capacity will range from 4.9 to 14 years. Notwithstanding, this does not consider the additional design capacity that could potentially be permitted or practices that move materials up the waste management hierarchy.

Table 10. Landfill locations accepting TCMA waste

State	Landfill name	Owner	Total tons
Minnesota	Elk River Landfill SW-74	Waste Management	255,741
Minnesota	Pine Bend Sanitary Landfill SW-45	Republic Services	474,508
Minnesota	Burnsville Sanitary Landfill SW-56	Waste Management	160,481
Minnesota	Spruce Ridge Resource Management Facility SW-6	Waste Management	44,830
Minnesota	Nobles County Landfill Inc SW-11	Waste Connections	2,038
Minnesota	N/A	N/A	736
Wisconsin	Lake Area Landfill	Republic Services	43,606
Wisconsin	Rice Lake Landfill	Allied Waste Services	1,225
Wisconsin	Seven Mile Creek Landfill	GFL Environmental Inc.	27,859
Iowa	Central Disposal Landfill	Waste Management	91,153
MN Total			938,334
Out of State total			163,843
Grand total			1,102,177

Of note, Seven Mile Creek Landfill was acquired by a Wisconsin-based hauler, and it no longer accepts TCMA waste. If TCMA landfills are not allowed to expand, Twin Cities residents could end up with no facility to send their waste. In January 2021, four landfills applied for additional capacity. The agency has made determinations of how TCMA waste would be allocated to the four applicant facilities that requested additional capacity:

- Burnsville Sanitary Landfill – 1,692,893 tons
- Dem-Con Landfill – 627,244 tons
- Pine Bend Sanitary Landfill – 2,398,746 tons
- Rich Valley Landfill – 893,889 tons

Permitting capacity is in flux because two of these facilities have not submitted permit applications to accept MMSW.

Expanding landfill capacity in TCMA is a direct result of the closure of GRE. Minnesota has four MMSW landfills. The TCMA currently houses two, both located in Dakota County. The Burnsville Sanitary Landfill, located in Burnsville, is owned by Waste Management Inc. (WMI). The Pine Bend Sanitary Landfill, located in Inver Grove Heights, is owned by Republic Waste. Both landfills operate methane gas-to-energy systems that capture methane gas generated by the decaying waste. Two other Minnesota landfills that receive significant amounts of TCMA MMSW are the WMI Spruce Ridge Landfill in McLeod County and the WMI Elk River Landfill in Sherburne County. These also operate methane gas-to-energy systems. For the four Minnesota landfills that receive the majority of TCMA MMSW, while the efficiency of the gas collection systems has not been established, it is estimated that an average of 75% of the methane that is captured is used to produce electricity, and the remaining captured methane is flared.

Two out-of-state landfills received TCMA MMSW in 2021, including the Republic Services Lake Area Landfill in Sarona, Wisconsin, and the Rice Lake Landfill in Rice Lake, Wisconsin.

Non-MMSW management

In 2021, an estimated 4,841,899 tons of non-MMSW waste was land disposed. The TCMA is served by nine landfills that accept industrial wastes and/or demolition debris, or non-MMSW. These landfills have approximately 25 million cubic yards of remaining capacity. Non-MMSW includes nonhazardous industrial waste, demolition debris, materials banned from disposal with MMSW, problem materials, infectious waste, and other waste streams that are not MMSW or otherwise defined or regulated as hazardous waste.

Materials separated for recycling at some demolition debris transfer stations and landfills include concrete, bituminous asphalt, aluminum, copper, steel, brick, mattresses, appliances, and tires. Other materials have the potential to be separated and recycled from the demolition debris. Private businesses own and operate most of the TCMA facilities that manage non-MMSW. There is some public sector activity in managing certain non-MMSW materials in the TCMA, such as tree waste processing and crushing, and concrete or road base material recycling.

Table 11. Non-MMSW landfills accepting TCMA demolition debris

Facility name	Demolition debris tons	Industrial tons
Dawnway Demolition Landfill - SW-303	32,033	0
Dem-Con Landfill Hawick SW-629	14,556	0
Dem-Con Landfill, LLC - SW-290	315,033	141,264
DKV Demolition Landfill - SW-429	762	0
Elk River Landfill - SW-74	2	0
Ladd Demolition Landfill - SW-469	152	0
Pine Bend Landfill - SW-45	761	225,258
Rolling Hills Landfill, Inc - SW-60	0	2,399
Shamrock Landfill -SW-399	51	30
SKB Lansing Landfill - SW-514	316	1,739
SKB Rosemount Industrial Waste Facility – SW-383	885,460	2,775,210
Spruce Ridge Resource Management, Inc. – SW-6	2,924	39,727
Valley Demolition and Recycling, LLC – SW-527	2	0
Vonco II Becker - SW-580	182,708	221,512
Grand total	1,434,760	3,407,139

Appendix B: Environmental justice review

The MPCA defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. This will be achieved when everyone benefits from the same degree of environmental protection and has equal access to the decision-making processes that contribute to a healthy environment. In May 2022, the MPCA released the [Environmental Justice Framework](#) which established the vision, strategies, and implementation actions for integrating environmental justice principles into the MPCA's work. This report includes a commitment to evaluate the environmental justice implications of program policies. The MPCA is developing an environmental justice review tool, which can be used broadly across all the agency's work, as well as detailed tools for specific program areas. The MPCA will share these tools and resources with counties once they are complete.

The following sections constitute the MPCA's environmental justice review of the MPP. Counties are required to complete an environmental justice review when developing their respective CSWMP.

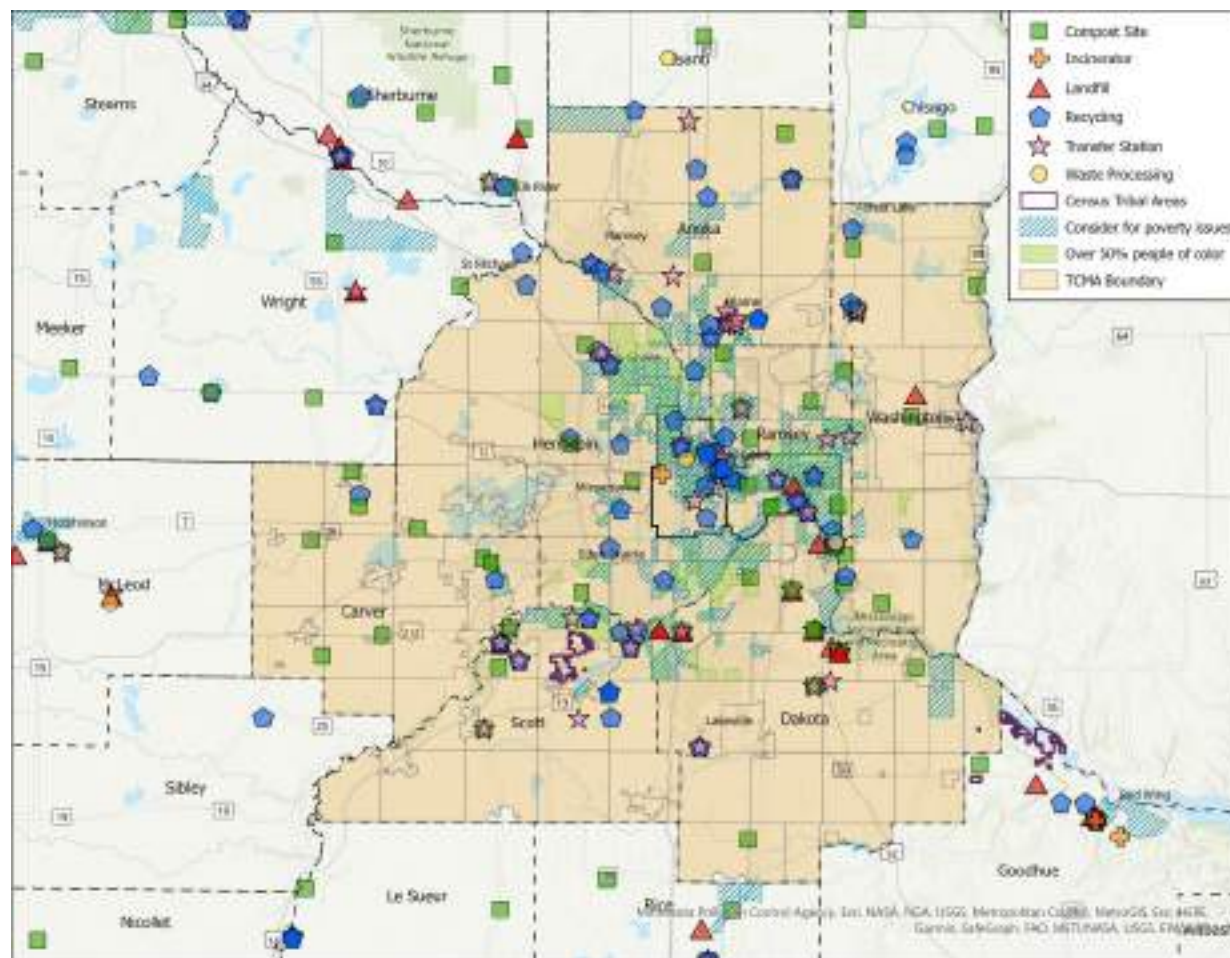
1. Identify potentially affected communities. Identify facilities that are in areas of concern for environmental justice. This is defined by the MPCA as census tracts using data from the U.S. Census and American Community Survey and meet one or both demographic criteria. These two criteria are defined as:
 - Total population of people of color greater than 40%
 - At least 35% of people reported income less than 200% of the federal poverty level
2. Identify who is likely to be affected by the proposed policy. What are the impacts of the proposed policy on communities of concern for environmental justice? Will it create disproportionate impacts or increase existing disproportionate impacts on minority or low-income populations? Examples include impacts on health, quality of life (from noise or visual impacts, etc.), personal finances, etc.
3. Review for impact. What are the opportunities for action? If the proposed policy would result in negative environmental or socio-economic impacts, or would add to cumulative impacts to people of color and low-income populations, what steps could be taken to avoid or mitigate these impacts? Additionally, does the proposed policy present opportunities to address existing disproportionate impacts on people of color, low income, or indigenous populations? Develop a list of likely impacts and actions to ensure that negative impacts are mitigated, and positive impacts are enhanced.
4. Assess engagement. How have you involved community members and stakeholders? What specific measures have been taken to engage community members in areas of concern for environmental justice?
5. CSWMP must include description of how the county has engaged with disadvantaged communities during the development of the CSWMP. Solid waste facilities must also engage with disadvantaged communities in their area when appropriate. Counties and facilities must always consider the impact to residents, particularly the disadvantaged communities that are more difficult to hear from, when making decisions about solid waste management.

Our models show low-income communities and areas of higher concentrations of people of color are at a greater risk from air pollution. Residents in 46% of lower income areas and 91% of communities of color experience air pollution risk above health guidelines (compared to only 32% of communities statewide). For this reason, the MPCA uses these criteria, as well as tribal boundaries, as a preliminary screening to identify areas where additional review or action is needed or desired. Additional information on variables such as language, education, and housing are considered and factored into

decisions and actions for areas where the preliminary screening has indicated a need to take a closer look.

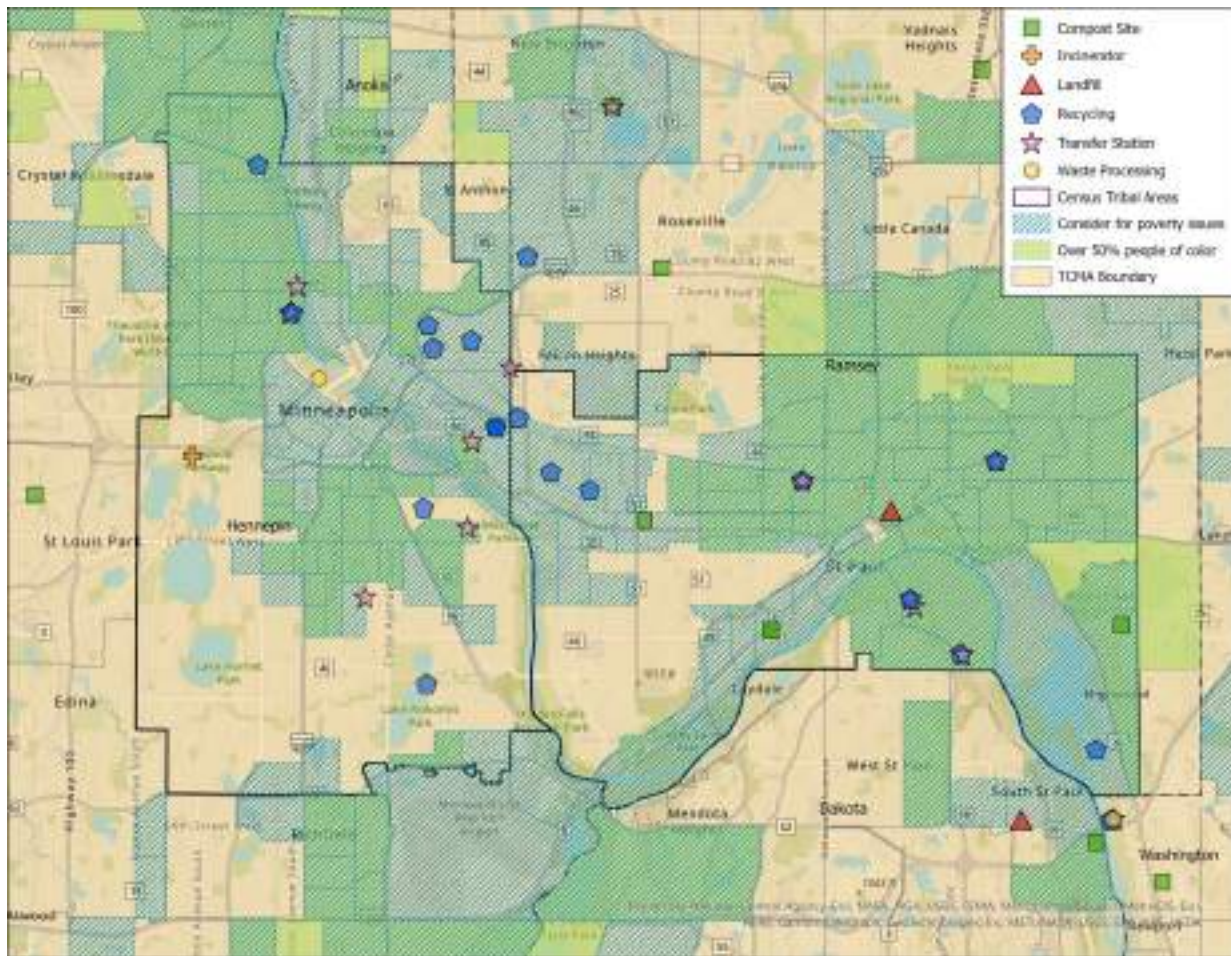
Figures 10 and 11 show solid waste facility locations and census tracts that are considered areas of concern for environmental justice. Areas marked with purple lines are census tracts with more than 40% of the population earning income less than 185% of the federal poverty level. As of 2022, this is an annual income of \$51,338 for a family of four.

Figure 14. Map of solid waste facilities and EJ boundaries located within the TCMA



Areas shaded in green are census tracts with greater than 50% people of color.

Figure 15. Map of solid waste facilities and EJ boundaries located within Minneapolis and Saint Paul



The first priority of the MPP is to ensure the proper management of waste to protect human health and the environment. The MPP also supports reducing waste and increasing recycling. The policies and strategies proposed in the MPP are intended to reduce the environmental impacts associated with waste, because reduction in environmental impacts is beneficial to all Minnesotans.

The TCMA is home to several waste management facilities – out of 125 facilities, 42 of these are in areas of concern for environmental justice. Reducing waste generation would mean less material would need to be managed by these facilities. Meeting the landfill diversion goals established in the MPP would likely divert material from landfills to regional recycling, organics recovery, and resource recovery facilities, including the facilities located within areas of concern for environmental justice. The potential impacts include increases in traffic and noise, as well as potential impacts to air quality due to increased vehicular traffic and facility emissions.

If the objectives in the MPP are attained, the region may need more recycling and organics recovery facilities. These facilities would be subject to the standard process for new facility development, outlined in Appendix D. In addition, as described in the MPCA’s environmental justice framework when considering permit applications for new facilities and during renewal of existing permits for facilities located in areas of concern for environmental justice, the MPCA will:

- Identify facility and permit types that warrant additional actions based on the potential for adverse effects.

- Identify and evaluate additional measures, beyond meeting established permit limits, to avoid and diminish impacts.
- Increase civic engagement, public participation, and outreach for community groups and residents.
- Foster increased community involvement and actions on the part of the entities that we regulate.
- Consider ways to prioritize work to enhance benefits to areas of concern for environmental justice.

A large role of the MPCA is ensuring that facilities are properly permitted to minimize human health and environmental harm. During permitting for facilities in areas of concern for environmental justice, the MPCA can identify and evaluate additional measures, beyond meeting established permit limits, to avoid and diminish impacts. This could include changing processes or procedures, installing additional pollution control equipment, or otherwise achieving a lower level of pollutant release than required by state or federal requirements. The MPCA can also work with the permittee to incorporate these measures into the permit or supplemental documents as possible.

Compliance and enforcement are other tools the MPCA can use to mitigate potential impacts. The MPCA could determine that more frequent inspections at facilities in areas of concern for environmental justice is needed to ensure the facilities are meeting applicable regulations and permit conditions.

Consistent with the WMA hierarchy, this MPP prefers resource recovery to landfilling. Communities of concern for environmental justice have indicated their concern about air emissions from resource recovery facilities located within their boundaries. To reduce reliance on resource recovery facilities and landfills, this MPP promotes best practices designed to reduce waste and increase recycling and organics recovery. While the MPCA recognizes that waste will continue to be processed at resource recovery facilities and disposed at landfills, the aggressive objectives established in this MPP encourage the TCMA to significantly reduce reliance on these less preferable management methods.

Certain strategies proposed in this MPP would directly benefit communities in areas of concern for environmental justice. For example, the MPP recommends implementing organized collection for MMSW. Organized collection is a more efficient method of managing trash and can lead to reductions in illegal dumping, a common concern in lower income communities. Lower mobile source emissions and reduced truck traffic are additional benefits of organized collection. The MPP also includes an environmental justice review in the permitting process – for new and existing facilities – to ensure that environmental justice concerns are addressed.

Appendix C: Predrafting notice

Statement of subjects expected to be covered by revisions to the Metropolitan Area Solid Waste Policy Plan

Introduction

The Minnesota Pollution Control Agency (MPCA) has started the process to prepare revisions to the TCMA Solid Waste Management Policy Plan (MPP). The current MPP can be viewed [online](#) or it can be provided by request. The current MPP was adopted by the MPCA on April 6, 2017. The new revised MPP will be adopted by the MPCA Commissioner by December 31, 2022.

Revisions to the MPP will be prepared in accordance with Minn. Stat. § 473.149. The MPP contains goals and policies for solid waste (i.e., all waste, except wastewater and other liquid wastes) management, including recycling and household hazardous waste management. The statute requires that the MPP contain objectives to decrease the landfilling of MMSW, what most of us consider garbage, and specific components of the solid waste stream, including residuals and ash. The MPP must be followed by entities who play a role in TCMA solid waste management.

The MPCA is required to prepare this pre-draft notice to solicit public comments on the anticipated revisions to the MPP. MPCA welcomes public comments. They will be carefully reviewed and taken into consideration when MPCA makes decisions regarding updates to the MPP. Public comments must be received within 45 days from the date of the publication in the State Register. Questions about the document or the process may be directed to Peder Sandhei at 651-757-2688 or 1-800-657-3864 (toll-free in Minnesota). Public meetings are currently scheduled for May 26, 2021, for MPCA staff to answer questions, and hear comments.

Written comments on the pre-draft notice should be sent to: peder.sandhei@state.mn.us

Comments must be received by the MPCA by 4:30 p.m., C.S.T., July 12, 2021. [Written correspondence may be sent to the following address: Peder Sandhei, Minnesota Pollution Control Agency, 520 Lafayette Rd. N., 2nd Floor, St. Paul, Minnesota 55155-4100]

If you wish to stay informed on the development of the MPP, please submit a comment on the pre-draft notice by the deadline indicated above. All comments will be published on the Agency's MPP website page and commenters will be added to a stakeholder list and be notified of any future MPP developments. If you do not submit a comment on the pre-draft notice but would like to be included on future MPP related distributions, please contact Mr. Sandhei.

Overall approach and philosophy

The MPP revisions will focus on:

- Reduction in the amount of waste generated
- Reduction in the toxicity of waste generated
- Recycling and composting
- Recovery of energy from waste
- Reduction in land disposal (landfilling)
- Coordination of solid waste management among cities, counties, townships, etc.
- Broadening participation and accountability for all parties involved in solid waste management

- Protection of public health and state's air, land, water, and other natural resources
- Additional emphasis on SMM principles and environmental benefits that consider life cycle analysis, such as GHG impacts, rather than tons diverted from land disposal
- Environmental Justice

The MPP will continue to support: SMM principles, treating waste as a resource; minimizing the use of landfills; waste and toxicity reduction; the management of all solid waste; recycling and organics goals; region-wide waste processing; regional coordination; and minimizing environmental impacts. The MPP will continue to support policies aimed at preventing, reducing, and managing all wastes such as household solid waste, construction and demolition waste, industrial solid waste, and ash.

The MPP revisions will be developed consistent with the State policies and purposes expressed in Minn. Stat. § 115A.02 of the Minnesota Waste Management Act (WMA). The MPP will support the WMA hierarchy of preferred waste management methods.

The MPCA will consult with the seven metro counties, the public and private sector, and other interested stakeholders in the revision of the MPP.

Description of how the existing solid waste system serves the Twin Cities Metropolitan Area

The TCMA's current solid waste infrastructure has developed extensively since the passage of the 1980 WMA. In 2019, 47% was recycled or composted, and additional 21.5% was processed for energy recovery, and 31% was landfilled.

The MPP will describe how the existing solid waste system benefits the TCMA, including the environmental benefits, and how the new MPP proposes to increase those benefits. The MPP will also identify the amount of waste and types of materials managed by the different solid waste management methods.

The MPP will show how a comprehensive waste prevention, reuse, recycling, composting, processing, and disposal system to manage solid waste (integrated solid waste system), consistent with the waste management hierarchy, protects public health, supports a vibrant economy, reduces emissions of air pollutants such as GHGs, conserves energy and resources, and produces energy. It will also discuss how the solid waste system can be improved through more effective governance, a more efficient collection system, broadened accountability, and additional landfill reduction.

Addressing obstacles in the metro solid waste system

The MPP will discuss some challenges that face the TCMA solid waste system, including, but not limited to:

- Local government responsibility over solid waste management
- Accountability throughout the system
- Collection of SMM accurate and meaningful data
- Expansion of SMM principles
- A need for effective recycling
- Recycling market development
- Opportunities to advance productive use and disposal of materials

Solid waste management facilities and programs

The MPP will include goals and policies for solid waste management, including recycling consistent with Minn. Stat. § 115A.551, and household hazardous waste management consistent with Minn. Stat. § 115A.96, subdivision 6, in the TCMA.

The MPP will include specific and quantifiable regional objectives for minimizing waste generation and reducing reliance on the practice of landfilling of MMSW and other components of the solid waste stream. The objectives will be stated for a period of at least 20 years. The MPP will also include objectives for waste reduction, reuse, and minimization of solid waste through recycling, organic waste composting, and resource recovery, for a period of at least 20 years.

The MPP will identify:

- Environmental and resource management benefits of waste processing (WTE)
- Quantities and geographic origin of waste requiring processing
- Available WTE facility capacity, and the inter-county regional opportunities for the development of future processing capacity and opportunities for inter-county sharing of waste

The MPP will evaluate the existing state and regional administration structure and make appropriate recommendations that best fulfill the needs of integrated solid waste management. The MPP also will explore issues beyond the TCMA jurisdiction that affect the regional solid waste system.

MPP implementation tools

The MPP will include procedures, standards, and criteria regarding the MPCA review of: CSWMP; annual waste certification reports; waste facility permits; certificates of need; waste designation, and solid waste supply contracts and processing agreements. The usefulness of these reviews will also be examined to determine if some of them should be eliminated, changed or if others are needed.

Finally, the MPP will include standards and criteria for the MPCA review of solid waste facility permits regarding the following matters: general location; capacity; waste supply; operation; processing techniques; environmental impact; effect on existing, planned, or proposed collection services and waste facilities; and economic viability.

Appendix D: Procedures, standards, and criteria

Minn. Stat. § 115A, 116 and 473 authorize the MPCA to formulate and set out procedures, standards, and criteria to implement the Metropolitan Solid Waste Management Policy Plan (MPP) 2023 to 2043 and facilitate the MPCA's review of:

- Solid waste facility permit applications
- Solid waste supply and processing contracts
- Waste district proposals
- Waste designation proposals
- Landfill certificates of need proposals
- County annual and waste certification reports
- County solid waste management plans (CSWMP)

The MPCA will implement the MPP when conducting these reviews. Public and private entities subject to review are encouraged to contact the MPCA before preparing and submitting approval requests. The MPCA will coordinate its review with other applicable state and local procedures.

Solid waste facility terms and definitions

The MPCA will administer the MPP using terms and definitions used in chapters 115A, 116, and 473 and related rules.

Solid waste facility permit applications

The MPCA review of solid waste facilities is governed primarily by Minn. Stat. § 473.823. Minn. Stat. § 473.823, subd. 3(b) provides that a permit may not be issued for the operation of a solid waste facility in the TCMA that is not “in accordance with the Metropolitan Policy Plan.” The statute also provides that in making this determination, *“the commissioner shall consider the areawide need and benefit of the applicant facility and the effectiveness of proposed buffer areas to adequately protect surrounding land uses in accordance with the Metropolitan Policy Plan, and may consider, without limitation, the effect of the applicant facility on existing and planned solid waste facilities.”* In this section of the MPP, the MPCA establishes the procedures that shall be applied for review of new and existing solid waste facility permit applications, including the information to be submitted in particular applications, when those applications will be requested, and how the MPCA will approve, disapprove, or conditionally approve such facilities.

Minn. Stat. § 473.823 is reproduced below

473.823 RULES AND PERMITS.

Subd. 3. Solid waste facilities; review procedures. (a) The agency shall request applicants for solid waste facility permits to submit all information deemed relevant by the commissioner for review, including without limitation information relating to the geographic areas and population served, the need, the effect on existing facilities and services, the effectiveness of proposed buffer areas to ensure, at a minimum, protection of surrounding land uses from adverse or incompatible impacts due to landfill operation and related activities, the anticipated public cost and benefit, the anticipated rates and charges, the manner of financing, the effect on metropolitan plans and development programs, the supply of waste,

anticipated markets for any product, and alternative means of disposal or energy production.

(b) A permit may not be issued for the operation of a solid waste facility in the metropolitan area which is not in accordance with the metropolitan policy plan. The commissioner shall determine whether a permit is in accordance with the policy plan. In making this determination, the commissioner shall consider the areawide need and benefit of the applicant facility and the effectiveness of proposed buffer areas to adequately protect surrounding land uses in accordance with the policy plan, and may consider, without limitation, the effect of the applicant facility on existing and planned solid waste facilities.

(c) If the commissioner determines that a permit is in accordance with the policy plan, the commissioner shall approve the permit. If the commissioner determines that a permit is not in accordance with the policy plan, the commissioner shall disapprove the permit. Approval of permits may be subject to conditions the commissioner determines are necessary to satisfy criteria and standards in the policy plan, including conditions respecting the type, character, and quantities of waste to be processed at a solid waste facility used primarily for resource recovery and the geographic territory from which a resource recovery facility or transfer station serving such a facility may draw its waste.

(d) A permit may not be issued in the metropolitan area for a solid waste facility used primarily for resource recovery or a transfer station serving the facility, if the facility or station is owned or operated by a public agency or if the acquisition or betterment of the facility or station is secured by public funds or obligations issued by a public agency, unless the commissioner finds and determines that adequate markets exist for the products recovered and that establishment of the facility is consistent with the criteria and standards in the metropolitan and county plans respecting the protection of existing resource recovery facilities and transfer stations serving such facilities.

Procedures for obtaining MPCA approval of solid waste facility permits

Coordination of MPCA review. For existing facilities, the MPCA will request information related to the solid waste facility and information required in the MPP before the MPCA completes review and reissues the permit. The MPCA may request additional information from solid waste facility permit applicants after the adoption of the MPP. The application will need to contain information related to the proposed solid waste facility and information required in the MPP.

Basic information required. To obtain MPCA approval solid waste facility permit applicants must include:

- Information relating to the geographic areas and population served, including highlighting areas of concern for environmental justice
- The need for the facility, including information that shows that new or expanded resource recovery and disposal facilities are consistent with MPCA most recent forecast of waste generation and waste management objectives
- The effect of the facility on existing facilities and services
- For public facilities: The effect of public facilities on existing comparable public and private facilities
- The effectiveness of proposed buffer areas to ensure, at a minimum, protection of surrounding land uses from adverse or incompatible impacts due to landfill operation and related activities
- The anticipated public costs and benefits of the facility
- The anticipated rates and charges
- The manner of financing

- The effect on metropolitan CSWMPs and development programs
- The supply of waste
- Solid waste supply contracts subject to Minn. Stat. § 473.813
- Anticipated markets for any product
- Alternative means of disposal or energy production
- Additional information required by the commissioner, including but not limited to, environmental justice review criteria (see Appendix B for more information)
 - All solid waste facilities located in environmental justice zones must:
 - Do an annual impact review. Identify how the facility is impacting the neighborhood in which it resides. Develop a list of impacts and benefits to the community. Examples of impacts could include air emissions such as particulate matter, traffic concerns due to trucks, odors, or others.
 - Develop a plan for mitigating the negative impacts and enhancing the benefits to the community including the process for community engagement.
 - Engage with the local community on an annual basis to make sure their concerns are addressed in the plan.
- The owner or operator of any landfill or waste combustor shall conduct a waste composition study. Waste composition analysis must include the following:
 - Sampling protocol must follow the most recent ASTM International Test Standard D 5231-92 or an alternative as approved by the MPCA.
 - Material waste type categories must be consistent with the most recent Statewide Waste Characterization or otherwise approved by MPCA prior to the sort occurring

Standards/criteria for approval of solid waste facility permits as consistent and in accordance with the MPP

Following receipt of a complete application, the commissioner shall determine whether a permit is consistent and in accordance with the MPP within 90 days. In making this determination, the commissioner shall consider:

- The area wide need and benefit of the applicant facility.
- The effectiveness of proposed buffer areas to adequately protect surrounding land uses in accordance with the MPP.
- The effect of the applicant facility on existing and planned solid waste facilities.
- The requirements of Restriction on Disposal in Minn. Stat. § 473.848.
- For a solid waste facility used primarily for resource recovery or a transfer station serving the facility and owned or operated by a public agency or if the acquisition or betterment of the facility or station is secured by public funds or obligations issued by a public agency (public facility), the owner must demonstrate that:
 - Adequate markets exist for the products recovered.
 - The public facility does not displace comparable private and public facilities already existing in the area unless the displacement is required in order to achieve the waste management objectives identified in the MPP.
 - The public facility is consistent with the applicable CSWMP.
 - The public facility is necessary to achieve the waste management objectives identified in the CSWMP.

- The public facility is consistent with state policy and purposes outlined in Minn. Stat. § 115A.02 and Minn. Stat. §§ 473.842 to 473.849.

Minn. Stat. § 473.149 provides that *“For solid waste facilities owned or operated by public agencies or supported primarily by public funds or obligations issued by a public agency, the plan shall include additional criteria and standards to protect comparable private and public facilities already existing in the area from displacement unless the displacement is required in order to achieve the waste management objectives identified in the plan.”* For solid waste facilities owned or operated by public agencies or supported primarily by public funds or obligations issued by a public agency (public facility), the owner must demonstrate that the public facility:

- Does not displace comparable private and public facilities already existing in the area unless the displacement is required in order to achieve the waste management objectives identified in the CSWMP.
- Is consistent with the applicable CSWMP.
- Is necessary to achieve the waste management objectives identified in the CSWMP.
- Additional information required by the commissioner, including but not limited to, environmental justice review criteria (see Appendix B for more information)
- All solid waste facilities located in environmental justice zones must:
 - Do an annual impact review. Identify how the facility is impacting the neighborhood in which it resides. Develop a list of impacts and benefits to the community. Examples of impacts could include air emissions such as particulate matter, traffic concerns due to trucks, odors, or others.
 - Develop a plan for mitigating the negative impacts and enhancing the benefits to the community including the process for community engagement.
 - Engage with the local community on an annual basis to make sure their concerns are addressed in the CSWMP.
- The owner or operator of any landfill or waste combustor shall conduct a waste composition study every five years. Waste composition analysis must include the following:
 - Sampling protocol for waste composition studies must follow the most recent ASTM International Test Standard D 5231-92 or an alternative as approved by the MPCA.
 - Material waste type categories must be consistent with the 2013 Statewide Waste Characterization or otherwise approved by MPCA prior to the sort occurring
- Is consistent with state policy and purposes outlined in Minn. Stat. § 115A.02 and Minn. Stat. §§ 473.842 to 473.849.

If the commissioner determines that a permit is in accordance with the MPP, the commissioner shall approve the permit. If the commissioner determines that a permit is not in accordance with the MPP, the commissioner shall disapprove the permit.

Solid waste supply and processing contracts

Cities, counties, and towns in the TCMA can enter contracts for the delivery of solid waste to waste facilities and can enter into contracts for the processing of solid waste (Minn. Stat. § 473.813, subd. 1). Before a local unit of government enters into a waste management contract for a period of longer than five years in duration, they must get MPCA approval (Minn. Stat. § 473.813, subd. 2). The success of waste facilities often depends on long-term commitments for waste supplies and processing. It is anticipated that long-term supply and processing contracts may continue to be used as new or existing

contracts are renewed or renegotiated. Existing MPCA contract approvals will remain in effect unless (1) the contract term is extended; or (2) the contract is amended or revised during its term.

Minn. Stat. § 473.813 is reproduced below

473.813 CITIES, COUNTIES, TOWNS; SOLID WASTE CONTRACTS.

Subdivision 1. For up to 30 years. Notwithstanding any contrary provision of law or charter, and in addition to the powers or authority granted by any other law or charter, a city, county, or town in the metropolitan area may directly negotiate and enter into contracts, for a term not to exceed 30 years, for the delivery of solid waste to a waste facility and the processing of solid waste. Contracts made by direct negotiations shall be approved by resolution adopted by the governing body of the city, county, or town.

Subd. 2. Review by commissioner. Before a city, county, or town enters into any contract pursuant to subdivision 1 for a period of more than five years, the city, county, or town shall submit the proposed contract and a description of the proposed activities under the contract to the commissioner for review and approval. The commissioner shall approve the proposed contract if the commissioner determines that the contract is consistent with the metropolitan policy plan, permits issued under section 473.823, and county reports or approved master plans. The commissioner may consolidate the review of contracts submitted under this section with the review of related permit applications submitted under section 473.823 and for this purpose may delay the review required by this section.

Procedures for review of solid waste supply and processing contracts

- **Procedure:** Any city, county, or town entering into a contract for the delivery of solid waste to a waste facility and the processing of solid waste for a term longer than five years, shall submit that contract to the MPCA for review at least 90 days prior to the anticipated effective date of the contract. Contracts subject to this review include waste delivery agreements, organized collection contracts, host community fee agreements in lieu of fees authorized under Minn. Stat. §§ 115A.919 and 115A.921 if they include a waste delivery provision, and other agreements including waste delivery provisions.
- **Application of standards to contracts:** MPCA will approve contracts if the proposed contract is consistent with the MPP, permits issued under Minn. Stat. § 473.823, and county annual reports and approved CSWMP. A contract to deliver waste to a facility that is not specified in the applicable CSWMP will not be approved. To be approved, a contract to deliver waste must have a provision that terminates the contract in less than 30 years.
- **Timely MPCA contract review:** All contracts submitted to the MPCA for review will be reviewed and approved or not approved within 60 days. The MPCA will notify the city, county, or town of its decision, and if the contract is disapproved MPCA will notify the city, county, or town of the reasons for disapproval.
- **Consolidation of contract review with permit review:** MPCA may consolidate the review of contracts submitted under this section with the review of related permit applications submitted under Minn. Stat. § 473.823 and, for this purpose, may delay the review required by this section.
- **Contracts that are inconsistent with the MPP:** If MPCA determines that a contract is not consistent with the MPP, then MPCA may require that the parties to the contract revise its terms and re-submit the revised contract for MPCA approval.

Waste management districts

The procedure, standards, and review criteria for waste management districts is set out in Minn. Stat. §§ 115A.62 to 115A.72. Minnesota counties, including metropolitan counties, can form waste management districts. This authority enables counties to implement waste management practices they may not be able to conduct independently, or which can be more effectively performed jointly. The establishment of a waste management district must be approved by the MPCA. Specific conditions may be incorporated as part of the MPCA's approval. Minn. Stat. § 115A.63, subd. 3 provides that a waste management district formed by metropolitan counties must have the same procedural and substantive responsibilities and duties as a metropolitan county, including requirements for preparing a comprehensive solid waste management plan. The requirements for county solid waste planning are contained in Minn. Stat. § 473.803 and in the MPP.

Waste designation proposals

The Waste Management Act, Minn. Stat. §§ 115A.80 to 115A.893, allows county or waste district to designate a facility where all MMSW generated within its boundaries, or a service area thereof, is required to be delivered. Using designation to direct the waste to a particular destination is referred to as waste designation or waste assurance. The MPCA approval of waste designations is required for designation to take effect. Designation is authorized by the Minnesota Legislature to further state policies and purposes, as articulated in Minn. Stat. § 115A.02, and to advance the public purposes served by effective solid waste management. See Minn. Stat. § 115A.80.

The procedures, standards, and criteria for approval of waste designation are contained in Minn. Stat. §§ 115A.80 to 115A.893.

Landfill Certificate of Need

The Metropolitan Landfill Abatement Act, Minn. Stat. § 473.823, subd. 6, states that no new land disposal capacity for MMSW shall be permitted in the TCMA without a CON issued by the MPCA indicating that the additional disposal capacity is needed. The MPCA must certify need only to the extent that there are no feasible and prudent alternatives to land disposal. Alternatives that are speculative or conjectural cannot be deemed to be feasible and prudent. Economic considerations alone cannot justify the CON or the rejection of alternatives. Minn. Stat. § 473.823, subd. 6 requires the MPCA to include in the MPP the standards and procedures for certifying need. The standards and procedures must be based on the metropolitan disposal abatement plan and the solid waste disposal facilities development schedule, both included in the Metropolitan System Plan (Part 3), and with approved CSWMPs that are consistent with the abatement plan and development schedule.

Minn. Stat. § 473.823, subd. 6 is reproduced below

Certification of need. No new mixed municipal solid waste disposal facility or capacity shall be permitted in the metropolitan area without a certificate of need issued by the commissioner indicating a determination that the additional disposal capacity planned for the facility is needed in the metropolitan area. The commissioner shall amend the policy plan, adopted pursuant to section 473.149, to include standards and procedures for certifying need that conform to the certification standards stated in this subdivision. The standards and procedures shall be based on the metropolitan disposal abatement plan adopted pursuant to section 473.149, subdivision 2d, the solid waste disposal facilities development schedule adopted under section 473.149, subdivision 2e, and the provisions of any master plans of counties that have been approved under section 473.803, subdivision 2, and that are consistent with the abatement plan and development schedule. The

commissioner shall certify need only to the extent that there are no feasible and prudent alternatives to the disposal facility, including waste reduction, source separation and resource recovery which would minimize adverse impact upon natural resources. Alternatives that are speculative or conjectural shall not be deemed to be feasible and prudent. Economic considerations alone shall not justify the certification of need or the rejection of alternatives.

Procedures for obtaining MPCA CON for landfills in the Metropolitan Area

Scope: MPCA will apply these standards to applications for additional MMSW capacity for MMSW landfills located in the Metropolitan Area.

Timing of CON application: MPCA will notify landfills located in the Metropolitan Area and will issue a public communication of MPCA's intent to accept CON applications for additional MMSW land disposal capacity after the adoption of the MPP and after MPCA approval of all county solid waste management plans (CSWMP). If the facility does not currently have an approved permit to accept MMSW, the CON application must come in first, however, the CON determination cannot be finalized until environmental review and other permitting requirements are completed.

Process order:

1. MPCA issues notice of intent to accept CON applications
2. The facility must submit the documents within a 180-day application period following the notice of intent.
3. MPCA reviews applications for completeness after the closure of the 180-day application period. (90-day review period)
4. MPCA issues preliminary CON determinations
5. Must issue public notice to get comment on the preliminary determinations.
6. Facilities must submit a complete permit application within 18 months of receiving a preliminary determination if they do not currently have an MSW permit. If the 18-month deadline is not met, the preliminary capacity will be revoked and either, held until a future notice of intent to accept CON applications is issued, allocated to other Metro facilities that applied or will be held aside for Greater Minnesota facilities to apply for. How that capacity will be treated will be driven by county letters and existing waste flows. The applicant facility will have to wait until the next MPCA intent to accept CON to reapply. If existing preliminary determinations do not have facility permit applications submitted, the 18 months starts at the issuance date of this Plan.
7. Notify the facilities and the public of the preliminary determinations for facilities that need to complete environmental review
8. Final determinations are approved as each facility completes environmental review. The final approvals are not issued at the same time, but rather as each individual facility completes their respective permit processes.
9. The facility cannot use the additional CON until their permit is finalized or a minor modification is completed.

Submittal of CON applications: CON applications from MMSW landfills located in the Metropolitan Area must be submitted within a period of 180 days after MPCA's CON notification is published. A CON application must include the following:

- Annual solid waste estimates. The CON application shall include estimates of the amount (in tons) and type of solid waste to be managed annually at the facility during its design life.

- **Origin of waste.** The CON application shall include identification of the origin of the solid waste including estimates of the amount of solid waste to be received annually from each county or district of origin. Information about quantities of solid waste from counties or districts outside the metropolitan area shall be based on information in approved CSWMP. Information about quantities of solid waste from counties or districts within the metropolitan area shall be based on information in the MPP and approved CSWMP.
 - If an approved CSWMP does not state that solid waste from a county or district will be managed at the proposed facility, the application shall include a letter from the county or district board of the county or district generating the solid waste indicating that in the county's or district's best estimate the amount of solid waste in question is available for management at the proposed facility. The letter must be consistent with the approved greater Minnesota solid waste management plan (SWMP), the CSWMP, and any applicable CSWMP amendments. Counties shall provide the letter to the facility with projected annual amounts expected to go to the applicant facility. County letters must be specific to the facility or facilities considered in the metro application. New letters must be provided for separate CON requests that occur outside of the metro process. The letter must be signed by the county board or by an employee with documented board approved delegation.
- **Alternatives.** The CON application shall include an analysis of alternatives to the new or expanded disposal capacity if the new capacity has not been included in the approved Greater Minnesota county solid waste management, the MPP, or CSWMP.
- **Estimate errors.** If the amount of new capacity needed is greater than the amount identified in the approved CSWMP, SWMP, or the MPP due to assumptions concerning the amount of solid waste generated, the application must document the basis for calculating the amount of capacity.

Public informational meeting on CON application: The MPCA may hold a public informational meeting on its preliminary determination to approve or deny the application for a CON if the commissioner determines that a public informational meeting would help to clarify and resolve issues regarding the CON application.

Standard: No new MMSW disposal facility or capacity shall be permitted in the Metropolitan Area without a CON issued by the commissioner indicating a determination that the additional disposal capacity planned for the facility is needed in the Metropolitan Area. The MPCA will approve CON applications only if MPCA determines that no feasible and prudent available alternative MMSW management facilities, including existing permitted land disposal capacity, can substitute for the proposed capacity.

The MPCA will apply the following criteria to determine whether CON can be granted:

- **Restriction on disposal:** MPCA will not accept or review any application for additional land disposal capacity for a landfill located in the Metropolitan Area unless MMSW resource recovery facilities serving the TCMA are functioning at full capacity and waste has been certified as unprocessable by metro counties.
- **Orderly and deliberate development of facilities:** Pursuant to Minn. Stat. § 115A.02, the MPCA must ensure the orderly and deliberate development of facilities, including landfills. To avoid a situation where the TCMA is dependent on the services of a single disposal facility, MPCA will not grant all CON to one landfill.
- **Tonnage as basis of CON:** MPCA will grant CON in tons to a landfill instead of cubic yards or other volume units.

- **Alternatives:** MPCA will consider existing permitted capacity in the service area of the facility seeking the CON. The fact that a permit for a facility may expire during the expected service life of the facility seeking CON shall not be deemed to extinguish permitted capacity assuming that the existing permitted facility is likely to be re-permitted.
- **Plan consistency:** MPCA will not grant a CON unless the new landfill capacity is consistent with the MPP, with applicable CSWMP, applicable greater Minnesota comprehensive solid waste management plans, and applicable information from other solid waste management jurisdictions outside of the state of Minnesota.
- **Forecasting tons:** If the amount of new capacity needed is greater than the amount identified in the MPP, approved CSWMP or SWMP due to errors in forecasting MMSW generated, the application must document the basis for calculating the amount of capacity needed and provide an analysis of alternatives, including landfill abatement programs.
- **Least cost alternative:** MPCA will not approve a CON application based solely on a determination that it is the least-cost alternative.
- The agency shall revoke or revoke and reissue the certificate of need if the commissioner determines that the information contained in the certificate of need is no longer accurate or that the owner or operator of the disposal facility has not fulfilled all applicable state and federal requirements.

County annual report and waste certification reports

The TCMA counties are required to submit annual solid waste reports and certification reports to the MPCA for approval under Minn. Stat. §§ 473.803, subd. 3 and 473.848, subd. 2. The MPCA will review these reports for consistency with the MPP and for consistency with the requirements of Minn. Stat. § 473.848, which states that no person shall dispose of unprocessable MMSW generated in the TCMA at a land disposal facility unless it is certified as unprocessable. Minn. Stat. § 473.848, subd. 4 states that the MPCA may adopt standards for determining when waste is unprocessable and procedures for expediting certification and reporting of unprocessed waste. The MPCA will use the information contained in the reports to enforce Minn. Stat. § 473.848 with respect to permitted waste facilities and public entities. MPCA permitted waste facilities, including MMSW resource recovery facilities and MMSW landfills, are required by state law to comply with Minn. Stat. § 473.848. The restriction on disposal in Minn. Stat. § 473.848, subd. 1 applies only to solid waste management and landfilling within Minnesota. Public entities that manage solid waste or contract for the management of solid waste are required by Minn. Stat. § 115A.46, subd. 5(b) to manage the waste consistent with the CSWMP.

The TCMA counties shall submit certification reports to the MPCA as a separate report before the deadline of April 1, of each year and include the certification report in the annual solid waste report. The TCMA counties may submit more frequent reports, such as quarterly certification reports, during each year to the MPCA to assist MPCA obtain compliance with Minn. Stat. § 473.848.

Minn. Stat. § 473.848 subd. 2 is reproduced below

Subdivision 1. Restriction. (a) For the purposes of implementing the waste management policies in section 115A.02 and metropolitan area goals related to landfill abatement established under this chapter, a person may not dispose of unprocessed mixed municipal solid waste generated in the metropolitan area at a waste disposal facility unless the waste disposal facility meets the standards in section 473.849 and:

- (1) the waste has been certified as unprocessable by a county under subdivision 2; or*
- (2)(i) the waste has been transferred to the disposal facility from a resource recovery facility;*

(ii) no other resource recovery facility serving the metropolitan area is capable of processing the waste; and

(iii) the waste has been certified as unprocessable by the operator of the resource recovery facility under subdivision 3.

(b) For purposes of this section, mixed municipal solid waste does not include street sweepings, construction debris, mining waste, foundry sand, and other materials, if they are not capable of being processed by resource recovery as determined by the council.

Subd. 2. County certification; office approval. (a) By April 1 of each year, each county shall submit an annual certification report to the office detailing:

(1) the quantity of waste generated in the county that was not processed prior to transfer to a disposal facility during the year preceding the report;

(2) the reasons the waste was not processed;

(3) a strategy for development of techniques to ensure processing of waste including a specific timeline for implementation of those techniques; and

(4) any progress made by the county in reducing the amount of unprocessed waste.

The report shall be included in the county report required by section 473.803, subdivision 3.

(b) The Pollution Control Agency shall approve a county's certification report if it determines that the county is reducing and will continue to reduce the amount of unprocessed waste, based on the report and the county's progress in development and implementation of techniques to reduce the amount of unprocessed waste transferred to disposal facilities. If the Pollution Control Agency does not approve a county's report, it shall negotiate with the county to develop and implement specific techniques to reduce unprocessed waste. If the Pollution Control Agency does not approve two or more consecutive reports from any one county, the Pollution Control Agency shall develop specific reduction techniques that are designed for the particular needs of the county. The county shall implement those techniques by specific dates to be determined by the Pollution Control Agency.

Standard for approval of county certification: The MPCA will approve a county's reports if it determines that the county is reducing and will continue to reduce the amount of unprocessed waste based on the report and the county's progress in development and implementation of techniques to reduce the amount of unprocessed waste transferred to disposal facilities.

Procedures

- **Required report:** MPCA will notify the TCMA counties that annual reports and certification reports are required to be submitted to the MPCA on or before April 1 each year. Additional quarterly certification reports, including the information required in Minn. Stat. § 473.848, subd. 2, paragraph (a), clauses 1, 2, 3, and 4, may be submitted on or before April 30, July 31, October 31, and January 31.
- **Content and Form:** MPCA will provide forms and instructions to the TCMA counties that outline the information and data required in the annual reports/certification reports.
- **MPCA review and approval:** MPCA will review and approve or disapprove a certification report if it determines that the county's certification shows the county is reducing and will continue to reduce the amount of unprocessed waste.

The MPCA will apply the following criteria to approval of county certification reports

- **Unprocessable waste:** The MPCA will not approve a county certification if it certifies waste as unprocessable when there is reasonably available capacity in the TCMA system that could be used to process solid waste generated in the county. In determining reasonably available capacity, the MPCA will give consideration to the specific geographic area that typically supports each of the processing facilities that serves the TCMA. The TCMA processing system is described in Appendix A, but this system could change periodically. The MPCA will annually provide a list

of processing facilities that serve the TCMA to the counties prior to the date the certification report is due. To be fully utilized, the processing facility must be operating at 100% of its operating capacity, taking into account outages for maintenance and repair.

- **Facility Provided ROD Reports:** The landfills and resource recovery facilities must fill out quarterly reports for submittal to the MPCA. These reports must include the following information:
 - Monthly data provided quarterly
 - County of origin of the waste (Transfer stations must provide to landfills)
 - Projected shortages and days affected
 - Date of notice and date of expected shortage
 - Amount sent to resource recovery on behalf of landfill to cover shortage
 - Other information as needed to determine compliance.
- As stated in the signed settlement agreement, “Landfill shall be entitled to rely on a presumption that each resource recovery facility is operating at full capacity except for any particular time period for which Landfill is notified at the specified email address by a particular resource recovery facility of an Anticipated Shortage 14 days in advance. If the Landfill takes the steps outlined in this Schedule of Compliance, MPCA will not bring an enforcement action and will advise the TCMA counties that the MMSW disposed of at the Landfill for that year will be considered and should be certified as unprocessable.”
- If there is a market change in the number of landfills serving the TCMA, then the landfills must agree to revise their compliance plans. The MPCA may facilitate the obligation discussion between facilities if needed. Once new obligations amounts are determined, the facilities must notify MPCA.
- Approval/disapproval
 - Annual reports must enumerate the actions the county is taking and the actions taken on behalf of the county to implement the goals and objectives of the MPP.
 - Annual reports must contain sufficient detail of programs so that the MPCA can determine if programs are effective and embody best practices for the management of waste.
 - Annual reports must show that the county is taking effective actions to ensure that no unprocessable MMSW goes to land disposal facilities in accordance with the requirement of Minn. Stat. § 473.848.
 - MPCA will approve annual reports if the reports describe and report on the specific barriers to implement the objectives and goals of the MPP, contain a description of the county programs that will be implemented to overcome the barriers, and contain recommendations to MPCA to assist in overcoming the barriers.

Regional and County Solid Waste Management Plans (CSWMP)

The Metropolitan counties are required by Minn. Stat. § 473.803 to prepare and submit CSWMP to the MPCA for approval. The MPCA will review the CSWMP in accordance with the requirements of Minn. Stat. §§ 473.149, 473.803, and 473.848. In accordance with Minn. Stat. § 473.803, subd. 2, the MPCA will review the CSWMP for consistency with the MPP. The general content requirements for CSWMP are contained in Minn. Stat. § 473.803. If the MPCA disapproves a CSWMP, the county must within 90 days submit a CSWMP to the MPCA for approval.

Minn. Stat. § 473.803 is reproduced below

473.803 METROPOLITAN COUNTY PLANNING.

Subdivision 1. County master plans; general requirements. Each metropolitan county, following adoption or revision of the metropolitan policy plan and in accordance with the dates specified therein, and after consultation with all affected local government units, shall prepare and submit to the commissioner for approval, a county solid waste master plan to implement the policy plan. The master plan shall be revised and resubmitted at such times as the metropolitan policy plan may require. The master plan shall describe county solid waste activities, functions, and facilities; the existing system of solid waste generation, collection, and processing, and disposal within the county; proposed mechanisms for complying with the recycling requirements of section 115A.551, and the household hazardous waste management requirements of section 115A.96, subdivision 6; existing and proposed county and municipal ordinances and license and permit requirements relating to solid waste facilities and solid waste generation, collection, and processing, and disposal; existing or proposed municipal, county, or private solid waste facilities and collection services within the county together with schedules of existing rates and charges to users and statements as to the extent to which such facilities and services will or may be used to implement the policy plan; and any solid waste facility which the county owns or plans to acquire, construct, or improve together with statements as to the planned method, estimated cost and time of acquisition, proposed procedures for operation and maintenance of each facility; an estimate of the annual cost of operation and maintenance of each facility; an estimate of the annual gross revenues which will be received from the operation of each facility; and a proposal for the use of each facility after it is no longer needed or usable as a waste facility. The master plan shall, to the extent practicable and consistent with the achievement of other public policies and purposes, encourage ownership and operation of solid waste facilities by private industry. For solid waste facilities owned or operated by public agencies or supported primarily by public funds or obligations issued by a public agency, the master plan shall contain criteria and standards to protect comparable private and public facilities already existing in the area from displacement unless the displacement is required in order to achieve the waste management objectives identified in the plan.

Subd. 1a. [Repealed, 1991 c 337 s 90]

Subd. 1b. [Repealed, 1995 c 247 art 1 s 67]

Subd. 1c. County abatement plan. Each county shall revise its master plan to include a land disposal abatement element to implement the metropolitan land disposal abatement plan adopted under section 473.149, subdivision 2d, and shall submit the revised master plan to the commissioner for review under subdivision 2 within nine months after the adoption of the metropolitan abatement plan. The county plan must implement the local abatement objectives for the county and cities within the county as stated in the metropolitan abatement plan. The county abatement plan must include specific and quantifiable county objectives, based on the objectives in the metropolitan abatement plan, for abating to the greatest feasible and prudent extent the need for and practice of land disposal of mixed municipal solid waste and of specific components of the solid waste stream generated in the county, stated in six-year increments for a period of at least 20 years from the date of metropolitan policy plan revisions. The plan must include measurable performance standards for local abatement of solid waste through resource recovery and waste reduction and separation programs and activities for the county as a whole and for statutory or home rule charter cities of the first, second, and third class, respectively, in the county, stated in six-year increments for a period of at least 20 years from the date of metropolitan policy plan revisions. The performance standards must implement the metropolitan and county

abatement objectives. The plan must include standards and procedures to be used by the county in determining annually under subdivision 3 whether a city within the county has implemented the plan and has satisfied the performance standards for local abatement. The master plan revision required by this subdivision must be prepared in consultation with the advisory committee established pursuant to subdivision 4.

Subd. 1d. Plans for required use of resource recovery facilities. Plans proposing designation of resource recovery facilities pursuant to section 473.811, subdivision 10, shall evaluate the benefits of the proposal, including the public purposes achieved by the conservation and recovery of resources, the furtherance of local, district, or regional waste management plans and policies, and the furtherance of the state policies and purposes expressed in section 115A.02, and also the costs of the proposal, including not only the direct capital and operating costs of the facility but also any indirect costs and adverse long-term effects of the designation. In particular the plan shall evaluate:

(a) whether the required use will result in the recovery of resources or energy from materials which would otherwise be wasted;

(b) whether the required use will lessen the demand for and use of land disposal;

(c) whether the required use is necessary for the financial support of the facility;

(d) whether less restrictive methods for ensuring an adequate solid waste supply are available;

(e) all other feasible and prudent waste processing alternatives for accomplishing the purposes of the proposed designation, the direct and indirect costs of the alternatives, including capital and operating costs, and the effects of the alternatives on the cost to generators.

Subd. 1e. [Repealed, 1995 c 247 art 1 s 67]

Subd. 2. Commissioner review. The commissioner shall review each master plan or revision thereof to determine whether it is consistent with the metropolitan policy plan. If it is not consistent, the commissioner shall disapprove and return the plan with its comments to the county for revision and resubmittal. The county shall have 90 days to revise and resubmit the plan for the commissioner's approval. Any county solid waste plan or report approved by the council prior to July 1, 1994, shall remain in effect until a new master plan is submitted to and approved by the commissioner in accordance with this section.

The commissioner shall review the household hazardous waste management portion of each county's plan.

Subd. 2a. Waste abatement. The commissioner may require any county that fails to meet the waste abatement objectives contained in the metropolitan policy plan to amend its master plan to address methods to achieve the objectives. The master plan amendment is subject to review and approval as provided in subdivision 2 and must consider at least:

(1) minimum recycling service levels for solid waste generators;

(2) mandatory generator participation in recycling programs including separation of recyclable material from mixed municipal solid waste;

(3) use of organized solid waste collection under section 115A.94; and

(4) waste abatement participation incentives including provision of storage bins, weekly collection of recyclable material, expansion of the types of recyclable material for collection, collection of recyclable material on the same day as collection of solid waste, and financial incentives such as basing charges to generators for waste collection services on the volume of waste generated and discounting collection charges for generators who separate recyclable material for collection separate from their solid waste.

Subd. 3. Annual report. By April 1 of each year, each metropolitan county shall prepare and submit to the commissioner for approval a report containing information, as prescribed in the metropolitan policy plan, concerning solid waste generation and management within the

county. The report shall include a statement of progress in achieving the land disposal abatement objectives for the county and classes of cities in the county as stated in the metropolitan policy plan and county master plan. The report must list cities that have not satisfied the county performance standards for local abatement required by subdivision 1c. The report must include a schedule of rates and charges in effect or proposed for the use of any solid waste facility owned or operated by or on its behalf, together with a statement of the basis for such charges.

The report shall contain the recycling development grant report required by section 473.8441 and the annual certification report required by section 473.848.

Subd. 4. Advisory committee. Each county shall establish a solid waste management advisory committee to aid in the preparation of the county master plan, any revisions thereof, and such additional matters as the county deems appropriate. The committee must consist of resident representatives, representatives from towns and cities within the county, and representatives from private waste management firms. The committee must include residents of towns or cities within the county containing solid waste disposal facilities. The commissioner or the commissioner's appointee is a nonvoting ex officio member of the committee.

Subd. 5. Role of private sector; county oversight. A county may include in its solid waste management master plan and in its plan for county land disposal abatement a determination that the private sector will achieve, either in part or in whole, the goals and requirements of sections 473.149 and 473.803, as long as the county:

- (1) retains active oversight over the efforts of the private sector and monitors performance to ensure compliance with the law and the goals and standards in the metropolitan policy plan and the county master plan;*
- (2) continues to meet its responsibilities under the law for ensuring proper waste management, including, at a minimum, enforcing waste management law, providing waste education, promoting waste reduction, and providing its residents the opportunity to recycle waste materials; and*
- (3) continues to provide all required reports on the county's progress in meeting the waste management goals and standards of this chapter and chapter 115A.*

CSWMP standards and procedures

The MPP hereby sets out the following specific procedures, standards and review criteria for the administration of Metropolitan CSWMP:

Procedures

- **Scope:** MPCA will review CSWMP submitted to MPCA for approval under Minn. Stat. § 473.803.
- **Timeline for CSWMP:** MPCA requires counties to formulate, submit and obtain MPCA approval of a new CSWMP within 12 months of the MPCA's adoption of the MPP. If a county fails to formulate and obtain MPCA approval of a new CSWMP within 24 months after the MPCA's adopts the MPP, then MPCA may withhold the disbursement of SCORE block grants under Minn. Stat. § 115A.557.
- **Requirements for the contents of CSWMP:** See statute above and additional standards outlined below.
- **MPCA review of CSWMP:** MPCA will review CSWMP and submit comments if there are any deficiencies in the CSWMP in accordance with the standards and criteria outlined below.

Standard. To be approved by the MPCA, the CSWMP must contain the information contained in Minn. Stat. § 473.803 and implement the CSWMP, including the goals and objectives of the MPP. The MPCA will review the CSWMP to determine:

- Whether the CSWMP implements the local abatement objectives for the county and cities within the county as stated in the Metropolitan System Plan (Part 3).
- Whether the CSWMP includes specific and quantifiable county landfill abatement objectives, based on the objectives in the metropolitan landfill abatement plan, for abating to the greatest feasible and prudent extent the need for and practice of land disposal of mixed municipal solid waste and of specific components of the solid waste stream generated in the county, stated in six-year increments for a period of at least 20 years from the date of the MPP revisions.
- Whether the CSWMP includes measurable performance standards for local abatement of solid waste through resource recovery and waste reduction and separation programs and activities for the county as a whole and for statutory or home rule charter cities of the first, second, and third class, respectively, in the county, stated in six-year increments for a period of at least 20 years from the date of the MPP revisions.
- Whether the performance standards implement the metropolitan and county abatement objectives.
- Whether the CSWMP includes standards and procedures to be used by the county in determining annually under Minn. Stat. § 473.803, subd. 3 whether a city within the county has implemented the CSWMP and has satisfied the performance standards for local abatement.
- Whether the CSWMP outlines specific and measurable actions to be taken by entities delegated by the county to implement the MPP.
- Whether the CSWMP outlines specific measures to maintain oversight over entities delegated by the county to implement the MPP.
- Whether the CSWMP outlines accountability measures for solid waste programs delegated to the private sector.
- Whether the CSWMP includes criteria and standards to protect comparable private and public facilities already existing in the area from displacement unless the displacement is required to achieve the waste management objectives identified in the CSWMP. Specifically, the CSWMP must require that for all solid waste facilities owned or operated by public agencies or supported primarily by public funds or obligations issued by a public agency (public facility), the owner must demonstrate that the public facility:
 - Does not displace comparable private and public facilities already existing in the area unless the displacement is required in order to achieve the waste management objectives identified in the CSWMP
 - Is consistent with the applicable CSWMP
 - Is necessary to achieve the waste management objectives identified in the CSWMP
 - Is consistent with state policy and purposes outlined in Minn. Stat. § 115A.02 and Minn. Stat. §§ 473.842 to 473.849

Role of private sector; county oversight. Pursuant to Minn. Stat. § 473.803, subd. 5, a county may include in its CSWMP and in its CSWMP for county land disposal abatement a determination that the private sector will achieve, either in part or in whole, the goals and requirements of sections 473.149 and 473.803, as long as the county:

6. Retains active oversight over the efforts of the private sector and monitors performance to ensure compliance with the law and the goals and standards in the MPP and the CSWMP.

7. Continues to meet its responsibilities under the law for ensuring proper waste management, including, at a minimum, enforcing waste management law, providing waste education, promoting waste reduction, and providing its residents the opportunity to recycle waste materials.
8. Continues to provide all required reports on the county's progress in meeting the waste management goals and standards of Minn. Stat. §. 473 and 115A.

To approve a CSWMP that includes this element, the CSWMP must include:

9. Specific quantifiable plans and strategies formulated and provided to the county by the private sector that shows how the private sector will implement applicable portions of the MPP and CSWMP.
10. Specific quantifiable methods and strategies that the county will implement to hold the private sector accountable for achieving waste management objectives. These strategies must include a description of applicable fees, subsidies, agreements, regulations, licenses, reporting requirements, and/or other institutional arrangement that are manifest in the arrangement that the county has with the private sector that will assure the private sector will implement applicable parts of the CSWMP and the MPP.
11. Specific measures that counties will implement to maintain oversight and measurement of outcomes of the programs delegated to the private sector. The CSWMP must also specify what fees, subsidies, agreements, regulations, licenses, reporting requirements, sanctions and/or other institutional arrangements that will be used to correct actions taken by the private sector if, in measuring the actions of the private sector, the county finds that the private entity is not managing waste as specified in the MPP and the CSWMP.

CSWMP approval. While a county is developing a new CSWMP for submittal to the MPCA, the existing CSWMP remains in effect until the MPCA approves or disapproves the new CSWMP. If the MPCA disapproves a county CSWMP, the county shall resubmit the CSWMP with changes that reflect the MPCA's comments within 90 days. If the CSWMP is not approvable after revision, the MPCA will disapprove the CSWMP and will terminate the eligibility of the county for grants pursuant to Minn. Stat. § 115A.557subd. 3(b)(1).

Appendix E: Glossary

Terms used in this MPP are intended to have meanings consistent with state statutes. Any words not defined in this appendix should be understood to have a meaning consistent with state law.

Collection

The aggregation of waste from the place at which it is generated and includes all activities up to the time the waste is delivered to a waste facility. (Minn. Stat. § 115A.03, subd. 5)

Composting

The controlled microbial degradation of organic waste to yield a humus-like product. (Minn. R. 7035.0300, subp. 20)

Construction debris

Waste building materials, packaging and rubble resulting from construction, remodeling, repair and demolition of buildings and roads. (Minn. Stat. § 115A.03, subd. 7). Also referred to in the MPP as construction and demolition waste.

Disposal facility

A waste facility permitted by the MPCA that is designed or operated for the purpose of disposing of waste on or in the land, together with any appurtenant facilities needed to process waste for disposal or transfer to another waste facility. (Minn. Stat. 115a.03, subd. 10)

Governance

Governance is the process by which materials are managed for the public good with an emphasis on highest and best use of materials and overall system sustainability. Governance includes the goals and activities of government entities, businesses, nonprofits, communities, and individual residents.

Hazardous waste

Any refuse, sludge, or other waste material or combinations of refuse, sludge or other waste materials in solid, semisolid, liquid, or contained gaseous form, which because of its quantity, concentration, or chemical, physical, or infectious characteristics may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or b) poses a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. Categories of hazardous waste materials include but are not limited to explosives, flammables, oxidizers, poisons, irritants, and corrosives. Hazardous waste does not include source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended. (Minn. Stat. § 116.06, subd. 11)

Household hazardous waste

Waste generated from household activity that exhibits the characteristics of or that is listed as hazardous waste under MPCA rules but does not include waste from commercial activities that is generated, stored, or present in a household. (Minn. Stat. § 115A.96, subd. 1b)

Industrial waste

Solid waste resulting from an industrial, manufacturing, service, or commercial activity that is managed as a separate waste stream. (Minn. Stat. § 115A.03, subd. 13a)

Industrial solid waste

All solid waste generated from an industrial or manufacturing process and solid waste generated from nonmanufacturing activities such as service and commercial establishments. Industrial solid waste does not include office materials, restaurant and food preparation waste, discarded machinery, demolition debris, municipal solid waste combustor ash, or household refuse. (Minn. R. 7035.0300, subp. 45)

Land disposal

Depositing of materials in a land disposal facility.

Land disposal facility

Any tract or parcel of land, including any constructed facility, at which solid waste is disposed of in or on the land. (Minn. R. 7035.0300, subp. 52)

Leachate

Liquid that has percolated through solid waste and has extracted, dissolved, or suspended materials from it. (Minn. R. 7035.0300, subp. 56)

Local governmental unit

Cities, towns, and counties. (Minn. Stat. § 115A.03, subd. 17)

Long-term care

Actions to prevent or minimize the threat to public health and the environment posed by a mixed municipal solid waste disposal facility that has stopped accepting waste by controlling the sources of releases or threatened releases at the facility (Minn. Stat. § 115B.39, subd. 2.(c)).

Major appliances

Defined by statute as clothes washers and dryers, dishwashers, hot water heaters, heat pumps, furnaces, garbage disposals, trash compactors, conventional and microwave ovens, ranges and stoves, air conditioners, dehumidifiers, refrigerators, and freezers. (Minn. Stat. § 115A.03, subd. 17a)

Materials recovery facility (MRF)

Facility designed for centralized sorting, processing, and/or grading of collected recyclable materials for marketing.

Twin Cities Metropolitan Area (TCMA)

Means the area over which the Metropolitan Council has jurisdiction, including only the counties of Anoka; Carver; Dakota excluding the city of Northfield; Hennepin excluding the cities of Hanover and Rockford; Ramsey; Scott excluding the city of New Prague; and Washington. (Minn. Stat. § 473.121, subd. 2)

Municipal Solid Waste (MSW)

Means mixed municipal solid waste (MMSW), materials banned from MMSW such as yard waste and specific problem materials, recyclable materials, and other solid waste that is solid waste that is generated by residential, commercial, industrial, and community activities.

Mixed municipal solid waste (MMSW)

(a) Garbage, refuse and other solid waste from residential, commercial, industrial and community activities that the generator of the waste aggregates for collection, except as provided in paragraph (b), (b) mixed MSW does not include auto hulks, street sweepings, ash, construction debris, mining waste, sludges, tree and agricultural wastes, tires, lead acid batteries, motor and vehicle fluids and filters, and other materials collected, processed and disposed of as separate waste streams, but does include source-separated compostable materials. (Minn. Stat. § 115A.03, subd. 21)

Non-municipal solid waste (non-MMSW)

Solid waste resulting from construction, demolition, or industrial activities which is not mixed municipal solid waste.

Organic material

Organic waste typically includes food waste, non-recyclable paper products, yard waste, and other materials that readily degrade. According to EPA, “Organic matter in landfills breaks down and releases methane, a potent GHG, and contributes to landfill leachate that can pollute waterways.”

Organized collection

A system for collecting solid waste in which a specified collector, or a member of an organization of collectors, is authorized to collect from a defined geographic service area or areas some or all the solid waste that is released by generators for collection. (Minn. Stat. § 115A.94, subd. 1)

Postconsumer material

A finished material that would normally be discarded as a solid waste having completed its life cycle as a consumer item. (Minn. Stat. § 115A.03, subd. 24b)

Problem material

Material that, when it is processed or disposed of with mixed municipal solid waste, contributes to one of the following results: 1) the release of a hazardous substance, or pollutant or contaminant; 2) pollution of water; 3) air pollution; or 4) a significant threat to the safe or efficient operation of a solid waste facility. The four conditions are further defined in Minn. Stat. § 115A.03, subd. 24a.

Processing

Describes the treatment of waste after collection and before disposal. Processing includes, but is not limited to, reduction, storage, separation, exchange, resource recovery, physical, chemical, or biological modification and transfer from one waste facility to another (Minn. Stat. § 115A.03, subd. 25 and 473.848, subd. 5).

Recycling

The process of collecting and preparing recyclable materials and reusing the materials in their original form or using them in manufacturing processes that do not cause the destruction of recyclable materials in a manner that precludes further use. (Minn. Stat. § 115A.03, subd. 25b)

Recycling facility

A facility at which materials are prepared for reuse in their original form or for use in manufacturing processes that do not cause the destruction of the materials in a manner that precludes further use. (Minn. Stat. § 115A.03, subd. 25c)

Recyclable materials

Materials that are separated from mixed municipal solid waste for the purpose of recycling or composting, including paper, glass, plastics, metals, automobile oil, batteries, source-separated compostable materials, and sole source food waste streams that are managed through biodegradative processes. Refuse-derived fuel or other material that is destroyed by incineration is not a recyclable material. (Minn. Stat. § 115A.03, subd. 25a)

Refuse-derived fuel

A product resulting from the processing of MMSW in a manner that reduces the quantity of noncombustible material present in the waste, reduces the size of waste components through shredding or other mechanical means, and produces a fuel suitable for combustion in existing or new solid fuel-fired boilers. (Minn. Stat. § 115A.03, subd. 25d)

Residuals

Waste materials left after recovery of recyclables and/or the physical, chemical, or biological processing of wastes.

Resource recovery

The reclamation for sale, use, or reuse of materials, substances, energy, or other products contained within or derived from waste. (Minn. Stat. § 115A.03, subd. 27)

Resource recovery facility

A waste facility established and used primarily for resource recovery, including related and appurtenant facilities such as transmission facilities and transfer stations primarily serving the resource recovery facility. (Minn. Stat. § 115A.03, subd. 28)

Reusable

Most items can be reused even if the original design was intended for single use, making a reuse definition more difficult. However, this also makes it more important for programming to clarify number of reuses necessary (e.g., grant programs for swapping single-use items for reusables or ordinance requiring reusables for all dine-in food service). Recently, reusable programming and policy has been focusing on food service ware, food packaging, and personal product packaging. These are three main elements defining “reusable” for these types of scenarios:

- **Durable design** – as previously noted, most items can be reused regardless of the original intent. Programs and policies must indicate how durable (i.e., number of reuses to break even with the life cycle impacts of a single-use alternative) an item needs to be considered “reusable”
- **Actual reuse (returns and/or refills)** – more resources go into manufacturing a more durable, reusable item, so actual reuse is needed to offset those impacts. This typically means ensuring a system is in place for individuals to personally refill the item or return it to be refilled or used again. Programs and policies must specify an expectation for how this system will be designed, funded, serviced, and operated long-term.
- **Non-toxic materials** – while there are clear benefits of reusable items and systems, it is critical to test, monitor, and restrict harmful chemicals to limit human and environmental exposures. Often programs and policies emphasize reuse to reduce waste generation or climate impacts from manufacturing and overlook toxicity considerations.

Reuse

The continued use, repair, or repurposing of items or materials which extends the life of resources and decreases the demand for new production. Continued use can include resale (e.g., thrift stores), sharing (e.g., clothing swaps without a financial exchange), or rental (e.g., formal wear rental). When repurposing an item or material, it is in the current form of the product without drastic modifications – this is the main difference between reuse and recycling.

Secondary materials

The marketable or usable products derived from solid or hazardous waste through processing or separation.

Solid waste

Garbage, refuse, or sludge from a water supply treatment plant or air contaminants treatment facilities, and other discarded waste materials and sludges, in solid, semisolid, liquid, or contained gaseous form, resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include hazardous waste; animal waste used as fertilizer; earthen fill, boulders, rock; sewage sludge; solid or dissolved materials in domestic sewage or other common pollutants in water sources, such as silt, dissolved or suspended solids in industrial wastewater effluents or discharges which are point sources subject to permits under section 402 of the federal Water Pollution Control Act; as amended, dissolved materials in irrigation return flows; or source, special nuclear, or by-product materials as defined by The Atomic Energy Act of 1954, as amended. (Minn. Stat. § 116.06, subd. 22)

Solid waste management

The systematic administration of activities that provide for the collection, separation, storage, transportation, transfer, processing, treatment, and disposal of solid waste.

Source separation

Separation of recyclable or compostable materials by the waste generator prior to collection.

Source reduction (see also waste reduction)

An activity that prevents generation of waste or the inclusion of toxic materials in waste, including: (1) reusing a product in its original form; (2) increasing the life span of a product; (2) reducing material used in production or packaging, or changing procurement, consumption, or waste generation habits to result in smaller quantities or lower toxicity of waste generated. (Minn. Stat. § 115A.03, subd. 36b)

Storage

Containment of solid or hazardous waste, in an approved manner, after generation and before collection, for ultimate recovery or disposal.

Sustainable materials management

Describes an approach to serving human needs by using/reusing resources most productively and sustainably throughout their life cycles, generally minimizing the amount of materials involved and all the associated environmental impacts (Source: EPA). SMM focuses on the best use and management of materials based on how they impact the environment throughout their life cycle. SMM considers the impacts of extracting raw materials, scarcity of materials, product design, product use, and reuse.

Transfer station

An intermediate waste facility in which waste collected from any source is temporarily deposited to await transportation to another waste facility. (Minn. Stat. § 115A.03, subd. 33)

Unprocessed mixed municipal solid waste (Unprocessed MMSW)

For the purpose of Minn. Stat. § 473.848, waste is "unprocessed" if it has not, after collection and before disposal, undergone separation of materials for resource recovery through recycling, incineration for energy production, production and use of refuse-derived fuel, composting, or any combination of these processes so that the weight of the waste remaining that must be disposed of in a mixed municipal solid waste disposal facility is not more than 35% of the weight before processing, on an annual average.

Waste flow designation

A requirement by a waste management district or county that all or any portion of the mixed municipal solid waste that is generated within its boundaries or any service area thereof be delivered to a processing or disposal facility identified by the district or county. (Minn. Stat. § 115A.81, subd. 2)

Waste facility

All property real or personal, including negative and positive easements and water and air rights, which is or may be needed or useful for the processing or disposal of waste, except property used for the collection of the waste and property used primarily for the manufacture of scrap metal or paper. Waste facility includes, but is not limited to, transfer stations, processing facilities, and disposal sites and facilities. (Minn. Stat. § 115A.03, subd. 35)

Waste management

Activities that are intended to affect or control the generation of waste and activities which provide for or control the collection, processing, and disposal of wastes. (Minn. Stat. § 115A.03, subd. 36)

Waste reduction (see also source reduction)

An activity that prevents generation of waste or the inclusion of toxic materials in waste, including:

(1) reusing a product in its original form; (2) increasing the life span of a product; (2) reducing material used in production or packaging, or changing procurement, consumption, or waste generation habits to result in smaller quantities or lower toxicity of waste generated. (Minn. Stat. § 115A.03, subd. 36b)

Yard waste

Garden wastes, leaves, lawn cuttings, weeds, shrub, and tree waste, and prunings. (Minn. Stat. § 115A.03, subd. 38)

Appendix F: Metro Policy Plan MMSW forecast

Forecasted MMSW using per capita MMSW generation using a combination of ARIMA and baseline forecasting methods.

Data sources

Mixed Municipal Solid Waste (MMSW) Tonnage

All forecasts use tonnage information provided by the counties from their MMSW Certification reports and SCORE reports. Additional work has been done by the MPCA and the counties to ensure these sources are aligned.

Population

Population estimates and forecasts come from the Minnesota State Demographic Center at the Department of Administration. Additional interpolation has been performed on the forecasts to achieve annual values versus 5-year values. If there is no Population estimate available for a given year, the forecast value is used instead.

2020 Population values are sourced from the U.S. Census.

Alternative forecast assumptions

Assumptions for the alternative forecast regarding the amount of diversion of Recycling and Organics from MMSW were sourced from the counties and compiled by the MPCA into a consistent format and applied to the MPCA's forecasted MMSW generation rate.

Methodology

Forecast assumptions

Below is the summary of assumptions used for the MPP forecast:

- Ramsey and Washington counties are combined into one entity due to difficulty in splitting out their WTE and their joint powers agreement
- Metro counties will achieve the 75% recycling rate as laid out in Minn. Stat. § 115A.551 by 2030
 - Using the baseline rate for traditional recyclables and organics, increased recycling and organics diversion will be assumed at a constant rate until the 75% recycling rate is achieved in 2030.
- Total compliance with Restriction on Disposal (ROD) is assumed
 - Capacities for the WTE facilities serving the TCMA provided in Table 12.
 - If there is additional capacity at a given WTE facility, that capacity will be used by all available MMSW in the TCMA regardless of originating county
- Landfilling is assumed to be a minimum of 5% given the need to manage non-processibles, bulky items at WTE facilities and residuals and rejects from recycling and composting facilities.
- Baseline is the last year of observable data since the latest year of data represent the best data available to the counties and their current education and diversion practices.
- The continued operation of HERC is assumed. While the Hennepin County board has instructed staff to develop a plan with HERC closing sometime in the 2028-2040 timeframe, it is currently not clear if that timeline will be met or when within that timeframe the facility would come

offline. If HERC closes during the planning period, the MMSW would be managed via landfilling. The Metro Policy Plan (MPP) is updated every 6 years and a new forecast is developed with each iteration. MPCA will have a better understanding of the future of HERC during the development of the next MPP.

Forecast models

Each county was modeled separately using an Auto-regressive Integrated Moving Average (ARIMA) model on population corrected MMSW tonnage (per capita generation) from 2010 to 2020.

Recycling and Organics was forecasted using a baseline per capita generation (2020) – the tons of traditional recyclables generated per person and the tons of organics generated per person. As the population increases, new residents will have access to the same infrastructure, education, and benefits that current residents do thus increased population will not increase the current per capita generation but will increase total tonnage.

WTE capacity

Hennepin County is the sole provider of MMSW to the HERC facility while Ramsey and Washington split the capacity of the Ramsey-Washington Energy Center. Each of these facilities is assumed to be at capacity due to ROD compliance.

Dakota County will continue to send MMSW to the Red Wing processing facility, estimating 10,000 tons in 2020 and 13,000 tons in all subsequent years.

Table 12. Annual capacity (in tons) for the WTE facilities servicing the TCMA.

Facility	Annual Capacity (in Tons)
HERC	365,000
Ramsey-Washington Energy Center	450,000
City of Red Wing	13,000

Total landfill tonnage

The amount of material estimated to go to landfills is determined by the MMSW forecast created by the MPCA and is the amount remaining after additional diversion is removed from the MMSW and the amount dedicated to WTE is subtracted, as shown in Equation 1.

Equation 1. Calculation for landfill tonnage using MMSW forecast, additional diversion assumptions, and WTE capacity

$$\text{Landfill} = \text{MMSW} - (\text{Additional Diversion} + \text{WTE})$$

Results

The per capita generation point estimate was multiplied by the forecasted population change for each county and management method to provide the total MMSW.

Figure 16. Reported and forecasted TCMA MMSW collection methods amounts in tons

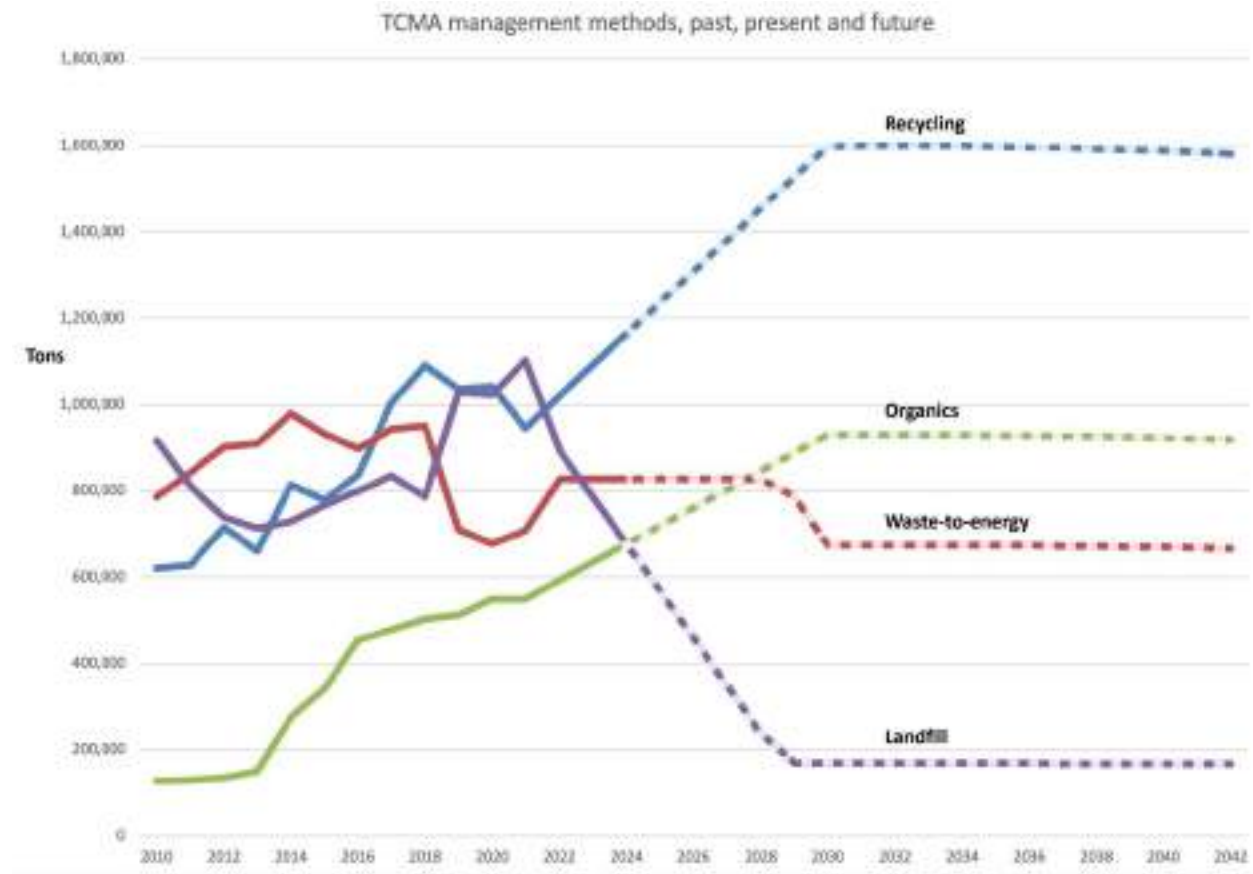


Table 13. Total TCMA MMSW forecast by management method

Year	Landfill	WTE	Recycling	Organics	Total MSW	Total MMSW	Recycling Rate
2010	917,472	785,506	620,069	127,879	2,450,926	1,702,979	31%
2011	810,443	842,273	627,884	130,010	2,410,610	1,652,716	31%
2012	739,152	901,721	715,089	134,292	2,490,254	1,640,873	34%
2013	713,741	908,636	660,166	150,980	2,433,523	1,622,377	33%
2014	728,970	978,326	813,580	275,574	2,796,450	1,707,296	39%
2015	767,491	931,415	778,092	341,745	2,818,743	1,698,906	40%
2016	799,435	897,494	836,135	452,956	2,986,020	1,696,929	43%
2017	834,315	942,536	1,004,251	479,283	3,260,385	1,776,852	46%
2018	785,118	951,181	1,091,967	502,906	3,331,173	1,736,299	48%
2019	1,028,517	710,286	1,036,330	511,934	3,287,068	1,738,803	47%
2020	1,023,749	678,239	1,041,423	549,135	3,292,546	1,701,987	48%
2021	825,124	821,000	1,118,619	590,477	3,355,219	1,809,433	51%
2022	750,682	821,000	1,188,683	627,698	3,388,064	1,720,145	54%
2023	674,392	821,000	1,259,825	665,492	3,420,710	1,612,238	56%
2024	596,250	821,000	1,332,017	703,843	3,453,110	1,503,892	59%
2025	516,260	821,000	1,405,232	742,737	3,485,229	1,395,014	62%

Year	Landfill	WTE	Recycling	Organics	Total MSW	Total MMSW	Recycling Rate
2026	434,457	821,000	1,479,466	782,172	3,517,095	1,285,592	64%
2027	350,828	821,000	1,554,665	822,118	3,548,611	1,175,605	67%
2028	265,388	821,000	1,630,789	862,556	3,579,733	1,065,079	70%
2029	180,521	818,633	1,707,795	903,462	3,610,411	954,059	72%
2030	182,030	728,122	1,785,643	944,814	3,640,609	842,609	75%
2031	183,515	734,060	1,800,245	952,479	3,670,298	842,970	75%
2032	184,973	739,892	1,814,588	960,006	3,699,459	843,113	75%
2033	186,404	745,615	1,828,665	967,391	3,728,075	843,036	75%
2034	187,807	751,230	1,842,477	974,635	3,756,150	842,739	75%
2035	189,184	756,737	1,856,024	981,738	3,783,683	842,225	75%
2036	190,534	762,137	1,869,311	988,703	3,810,684	841,497	75%
2037	191,858	767,433	1,882,342	995,531	3,837,165	840,562	75%
2038	193,157	772,628	1,895,128	1,002,229	3,863,142	839,423	75%
2039	194,432	777,726	1,907,674	1,008,799	3,888,632	838,089	75%
2040	195,683	782,731	1,919,992	1,015,248	3,913,653	836,565	75%
2041	196,911	787,646	1,932,092	1,021,580	3,938,229	834,858	75%
2042	198,120	792,479	1,943,990	1,027,805	3,962,393	832,977	75%

Appendix G: Strategy table

Table 14. Strategy table with point values and interested parties

Code Number	Strategy	Type	Optional Point Value	Interested Parties
1	Increase compliance with Hauler reporting per Minn. Stat. § 115A.93.	Required		haulers, industry, county staff
2	Provide required county reporting.	Required		county staff
3	Require waste composition study at least once every 5 years at all landfills that are located within your county.	Required		landfill operators
4	Improve recycling data collection at businesses within the county.	Optional	7	county staff, businesses
5	Require waste composition study at all landfills.	State-led		MPCA
6	Develop appropriate and consistent waste reporting systems to measure all waste.	State-led		MPCA
7	Continue to explore options for growing the agency's LCA data, modeling, and resources to better support counties in measuring and tracking environmental and human health impacts.	State-led		MPCA
8	Continue to engage with counties in the development of an environmental target that better accounts for and incentivizes programming and actions higher on the hierarchy.	State-led		MPCA
9	Participate in an annual joint commissioner/staff meeting on solid waste.	Required		county staff and board
10	Commit to standardized outreach and education.	Required		county staff, MRFs, residents
11	Engage in efficient and value-added infrastructure planning.	Required		county staff, SW facility operators
12	Develop contingency plans for large facility closures to reduce landfill reliance	Required		county staff, SW facility operators
13	Provide grants for or access to software that can track food waste.	Required		county staff, restaurants, cafeterias
14	Establish partnerships between food rescue organizations and restaurants/stores to increase food rescue.	Required		county staff, food rescue orgs, restaurants, grocery stores
15	Launch bi-annual sustainable consumption challenges for residents.	Required		county staff, residents
16	Implement a formal county sustainable purchasing policy using MPCA guidance.	Required		county staff, vendors
17	Participate in Responsible Public Purchasing Council meetings.	Required		county staff, MPCA

Code Number	Strategy	Type	Optional Point Value	Interested Parties
18	Work with health inspectors to educate restaurants and other establishments that have excess prepared food to donate.	Optional	7	county staff, health dept, restaurants and other food producers/surveyors
19	Offer grants or rebates for organizations to transition to reusable food and beverage service ware.	Required		county staff, restaurants , organizations serving food
20	Offer grants for source reduction, reuse, and repair.	Required		county staff, repair and reuse businesses
21	Implement a green meeting policy.	Required		county staff
22	Implement a county policy encouraging all county and city-led events and food providers use reusable food and beverage service ware.	Optional	6	county staff
23	Adopt an ordinance with a mandatory consumer charge or ban for single-use items.	Optional	9	county staff, restaurants
24	Join and/or actively participate in a reuse network, like Reuse Minnesota, to provide county and city staff with learning opportunities to broaden their reuse expertise.	Optional	6	county staff
25	Establish a Repair Ambassador program, like the Recycler/Composters (RCAs) Ambassador programs.	Optional	7	county staff, residents
26	Establish a reuse location for residential drop-off and pick-up.	Optional	7	county staff, residents
27	Establish a curbside set-out day to allow residents to set out used items for reuse.	Optional	7	county staff, residents, reuse businesses
28	Develop standardized guidance and methodology for tracking source reduction and reuse activities and their resulting benefits.	State-led		MPCA
29	Research and pursue financial strategies to best incentivize source reduction and reuse, such as grants and loans.	State-led		MPCA
30	Collect recyclables, organics, and trash on the same day.	Required		county staff, residents, haulers
31	Collect recycling weekly by 2030.	Optional	7	county staff, residents, haulers
32	Pair the option of bi-weekly trash collection with weekly recycling and organics collection.	Optional	7	county staff, residents, haulers
33	Contract for residential recycling and organics by 2030.	Optional	7	county staff, residents, haulers
34	Contract for residential MMSW collection by 2030.	Optional	7	county staff, residents, haulers
35	Recruit a minimum of 12 commercial businesses a year to recycle at least three materials from their operations and promote the environmental and resource benefits.	Required		county staff, businesses

Code Number	Strategy	Type	Optional Point Value	Interested Parties
36	Establish mandatory pre-processing of waste at resource recovery facilities and landfills by 2030.	Required		haulers, landfill operators, transfer station operators
37	Provide assistance to multi-family properties to improve recycling (4 or more units with shared walls)	Required		county staff, property managers
38	Assist with tracking commercial recycling self-hauling activities.	State-led		MPCA
39	Support and invest in new facilities and retain processors of recycled material for end markets.	State-led		MPCA
40	Make residential curbside organics collection available in cities with a population greater than 5,000 by 2030.	Required		county staff, residents, haulers
41	Expand backyard composting outreach and resources for residents.	Required		county staff, residents
42	Require management of organics from large commercial food generators by 2033.	Required		county staff, commercial food generators
43	Establish additional organics recycling drop-off sites.	Optional	7	county staff, residents
44	Standardize the role of compostable products in organics recycling programs by 2025.	State-led		MPCA
45	Develop plans to prevent and manage wood waste in each county and throughout the region.	Required		county staff, yard waste processors, tree care and landscaping operators
46	Promote existing programs that use EAB-affected wood for furniture, home goods, flooring, and other purposes.	Required		county staff, local artisans and producers of wood products
47	Composting and mulching operations must continue to be supported.	Required		county staff, composting and mulching operators
48	Update ordinances that address wood burning.	Optional	4	county staff, county board
49	Develop and distribute EAB tree care education programs for privately owned land.	Optional	8	county staff, residents
50	Incentivize tree treatment as a cost-effective strategy to extend the life of ash trees and to reduce the volume of wood waste generated over the next 20 years.	Optional	8	county staff, residents, arborists
51	Allow assessments on property taxes to spread the cost of tree care over a multi-year timeframe.	Optional	9	county staff, residents, arborists
52	Expand composting and mulching capacity beyond existing markets.	Optional	5	county staff, industry
53	Support development of systems that use wood fuel.	Optional	4	county staff, industry
54	MPCA will continue state agency coordination to address wood waste.	State-led		MPCA, DNR, MDA

Code Number	Strategy	Type	Optional Point Value	Interested Parties
55	Require food-derived compost in county construction and landscaping projects.	Required		county staff, industry
56	Find new outlets to increase food to animal operations.	Optional	7	county staff, farmers, restaurants
57	Develop a process for gathering the information necessary to make timelier and consistent policy decisions.	State-led		MPCA
58	Counties must continue to support the implementation of Minn. Stat. § 473.848 Restriction on Disposal.	Required		county staff, industry, facility operators
59	Implement additional fees to better account for the externalities of land disposal.	Optional	4	county staff, industry
60	Participate with the Product Stewardship Committee under the Solid Waste Administrators Association (SWAA).	Required		county staff
61	Encourage retailers to increase consumer awareness of responsible end-of-life handling for products containing lithium-ion batteries.	Required		county staff, retail store operators
62	Continue participation in the reciprocal use agreement for HHW collection sites.	Required		county staff, HHW sites
63	Partner with cities to increase participation in HHW collection.	Required		county staff, HHW sites
64	Host monthly drop-off sites in locations other than a permanent HHW site.	Optional	8	county staff, HHW sites
65	Implement the use of a Building Material Management Plan.	Required		county staff, builders and contractors
66	Prior to demolition of county-owned buildings, require that SMM strategies are considered.	Optional	7	county staff
67	Host a building material collection event or swap.	Optional	8	county staff, residents
68	Provide financial assistance to offset the additional cost of building deconstruction, used building material installation, and/or structural moving.	Optional	8	county staff, residents, builders and contractors
69	Provide deconstruction training.	Optional	8	county staff, builders and contractors
70	Annually host or aid with home and building repair and refurbishment trainings.	Optional	8	county staff, builders and contractors, residents
71	Use purchasing guidelines to require environmental product declaration (EPD) for concrete.	Optional	7	county staff
72	Study waste classification practices.	State-led		MPCA
73	Propose changes to B3 guidelines to strengthen deconstruction requirements.	State-led		MPCA
74	Incentivize deconstruction over landfilling MMSW and demolition debris.	State-led		MPCA
75	Lead Sustainable Building Group (SBG) developments.	State-led		MPCA

Appendix H: Air Toxic and Cumulative Impact Rules

Proposed changes to certain rules will be applicable to HERC. These rules apply only to air quality permits in certain geographic areas of Minnesota. Option B registration permits are exempt from these rules.

Minn. Stat. § 116.065 requires MPCA to adopt rules to implement and govern cumulative impacts analysis in Environmental Justice areas in 7 county metro and cities of Duluth and Rochester. The Notice of Intent to Adopt (NOIA) must be published in the State Register by May 2026. The Cumulative Impacts Analysis Rule will be applicable to facilities with air permits located in or within one mile of an environmental justice area in the TCMA and cities of Duluth and Rochester. HERC will be subjected to Cumulative Impacts Analysis rule once adopted due to its location in an EJ area within Hennepin County and its Part 70 permit. The MPCA may require a Cumulative Impacts assessment, if a petition requesting that a cumulative analysis be conducted by at least 100 individuals who reside or own property in the environmental justice area impacted by the facility and is supported by material evidence that demonstrates a potential adverse cumulative impact. More detail can be found on the MPCA website.

[Cumulative impacts | Minnesota Pollution Control Agency \(state.mn.us\)](https://state.mn.us/cumulative-impacts)

The Air Toxics Regulations Rule will be applicable to facilities with air permits located in the TCMA. Three years after adopting rules, the MPCA is required amend existing air quality permits to conform to the rules. This applies even if the case there is no pending permit action. HERC will be subjected to this rule once adopted due to its location within Hennepin County and its Part 70 permit. The MPCA must establish testing, monitoring, reporting, record-keeping, and inspection requirements for facilities that reflect:

1. The different risks to human health and the environment posed by the specific air toxics and amounts emitted by a facility, such that facilities posing greater risks are required to provide more frequent evidence of permit compliance, including but not limited to performance tests, agency inspections, and reporting;
2. The facility's record of compliance with air toxics emission limits and other permit conditions; and
3. Any exposure of residents of an environmental justice area to the facility's air toxics emissions.

More information can be found on the MPCA website. [Air toxics emissions reporting | Minnesota Pollution Control Agency \(state.mn.us\)](https://state.mn.us/air-toxics-emissions-reporting)

Appendix I: Public Comments and Responses

Name	Affiliation	Comment	Response
Ally Sutherland	City of Inver Grove Heights	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/mv0yil3_document.pdf	Source separation is the best way to recover materials and to ensure the highest value of those materials. However, despite our best efforts, human behavior is unpredictable. Preprocessing is the process of pulling recyclables out of mixed waste and it can recover additional recyclables, especially metals. The cost of collection is the primary driver of cost to residents, but historically tip fees have not been the driver for cost. The plan has been modified to extend the timeline to allow facilities time to visit the best preprocessing system. The Minnesota Legislature passed a sweeping bill to address and prohibit PFAS in consumer products. The Minnesota Attorney General reached an \$850 million settlement with 3M. For more information about this, visit https://3msettlement.state.mn.us/ . All past and present research can be found on this page. This language will reduce the amount of PFAS entering landfills. To address landfill leachate, the MPCA is addressing PFAS through our solid waste and wastewater programs. MPCA is also reviewing newly published research on landfill leachate. The plan prioritizes waste reduction, reuse, and recycling as the most important things we can do. These all minimize the amount of waste going to disposal. These activities are funded by the solid waste management tax and landfill fees. A clear and consistent process for MPCA's issuance of CON to landfills statewide is now reflected in the plan.
Aaron Rosenblum	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/k00uivg_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Akira Yano	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/wj0oi5v_document.pdf	The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the Minnesota Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. Thank you for your feedback.
Albert (Shane) McCaffrey	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/au0hqs_document.pdf	Metro counties will develop solid waste plans of their own based on this plan. This plan includes strategies to address organics recycling, multi-family, and education.
Alex Burns	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/wq0ri3v_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the Minnesota Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. Thank you for your feedback.
Alice Brandt	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/om04t8_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Amanda Koehler	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/xw0lii3_document.pdf	Compostable single-use is a better option than conventional single-use. However, reuse is the best option. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers. Chickens are not officially considered a solid waste management method, but the additional avenue for food waste management for residents is intriguing.
Amy Sheldon	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/ir03aj_document.pdf	Curbside collection of textiles has been discontinued by municipal programs due to the exposure to weather. Textiles must be dry and clean for both reuse and recycling. The Secondary Materials and Recycled Textiles (SMART) Association estimates that about half of new clothing end up donated. Of the clothing that is donated, about 20% are sold in reuse outlets, 25% are shipped overseas, 50% are used as absorbents/rags/stuffing, and about 5% head to landfills or WTE facilities. That means that over half of all textiles end up in the garbage. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse nor recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact. Minnesota Statute 115A.151 applies to most commercial buildings. Those that contract waste service for 4 cubic yards or more per week are required to recycle at least three materials types. Resident education is addressed in this plan with a strategy that calls for a commitment to standardized outreach and education. We agree that the messaging reaching residents should be easy to understand. Piecemeal efforts by counties, cities, haulers, and other organizations are rarely collaboratively developed and therefore can lead to confusion over what materials can be recycled or composted. Assuring a consistent message from those within the solid waste system would help bring clarity to the users of the system. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers. The plan requires counties to standardized outreach and education. This will address the concern that different terms are used throughout the metro and will help to address confusion. Waste reduction in construction and remodeling projects will require many solutions. The state doesn't currently have requirements for construction and remodeling material management. However, there are several waste reduction initiatives and an increase in reuse activities. Removing barriers to buying, selling and donation of surplus materials benefits us all.
Andrea Siegel	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/o502i9s_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Counties are required to complete an environmental justice review when developing their solid waste plans. The requirements are laid out in Appendix B. With the addition of multi-family strategies in the plan, we believe this supports a solid waste system that strives for fair treatment and meaningful involvement of all people. The plan has been amended to allow for counties to propose optional strategies. We encourage all our metro counties to propose strategies that would directly address environmental justice. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the Minnesota Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. Thank you for your feedback.

Name	Affiliation	Comment	Response
Amy Sklar	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/gy0wioh_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Andrea Sit	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ct07iaa_document.pdf	This plan requires residential curbside organics collection to be region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers. The plan includes education requirements that should help create more informed residents. Minnesota has some of the best recycling rates in the nation. There are many systems and requirements in place that assure the materials in resident bins are routed to their intended place. MN statute 115A.95 does not allow for haulers to deliver source-separated recyclable materials to a disposal facility unless the MPCA determines that no other recycling options are available. Except for litter in waterways, it's highly unlikely that any plastic waste from Minnesota ends up in the ocean. County environmental centers and household hazardous waste drop sites are wonderful resources for managing materials safely and to their highest use. The plan has been revised to require counties to promote these sites to residents.
Andrea Tauer	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ad0fiect_document.pdf	Curbside collection of textiles has been discontinued by municipal programs due to the exposure to weather. Textiles must be dry and clean for both reuse and recycling. The Secondary Materials and Recycled Textiles (SMART) Association estimates that about half of new clothing end up donated. Of the clothing that is donated, about 20% are sold in reuse outlets, 25% are shipped overseas, 50% are used as absorbents/rags/stuffing, and about 5% head to landfills or WTE facilities. That means that over half of all textiles end up in the garbage. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse nor recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact.
Andrew Coyne	City of Stillwater	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/i60hi6j_document.pdf	MPCA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. Wood waste is expected to increase and will require collaboration to find upstream solutions. Planning will be required to avoid open burning.
Andy Healy	ARCA Recycling, Inc.	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/uk0xi04_document.pdf	Appliances at the end of their useful life contain many valuable materials—like steel—that can be recycled. There are also many concerning components, like refrigerants, that need to be managed properly to avoid harm to human health and the environment. MPCA will continue to value appliance recycling and recovery as playing a very important role in solid waste management. MPCA received funding in the last Legislative session for various grants that will be utilized to make address waste issues and climate change reduction.
Ann Hanson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/t20qi10_document.pdf	Due to difficulty with sorting at recycling centers, black plastic has nearly no market value for recycling. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse nor recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact. Removing barriers for participation was our original intent and we received great feedback on changes to further our progress. Legislative action will be needed to create accountability for those producing waste through product design.
Beverly Mears	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/d308i9pb_document.pdf	All of the 7-county metro environmental centers and household hazardous waste (HHW) drop-off sites are open to residents of any metro county. Many materials are collected for free, but some require a collection fee. The plan also includes a strategy to expand mobile collection of HHW, which would provide residents with more convenient access.
Bill Keegan	Dem-Con Companies	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/hl0xi5b_document.pdf ; https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/fa0fio3_document.pdf	Minnesota has an existing rechargeable battery law. MPCA's Solid Waste Policy Report to the Minnesota Legislature recommends updates to address the full scope of the lithium battery issue. The MPCA is working with partners on legislative proposals to improve the collection and recycling of batteries. A strategy has been added to the plan to implement education programs on proper battery management. Creating safe storage spaces that minimize fire risks at waste facilities is challenging. Thank you for the feedback on Appendix D. You provided many valid points, which were considered when revising the plan. A clear and consistent process for MPCA's issuance of CON to landfills statewide is now reflected in the plan. Source separation is the best way to recover materials and to ensure the highest value of those materials. However, despite our best efforts, human behavior is unpredictable. Preprocessing can recover additional recyclables, especially metals. The cost of collection is the primary driver of cost to residents and historically tip fees have not been the driver for cost. The strategy's timeline has been extended.
Blaine McKeever	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/9r04i6c_document.pdf	Retail drop off is far from ideal, but is currently the best option for plastic film recycling. We can encourage retailers to monitor their collection bins more closely to optimize collection efforts.
Bobby Stewart	Highland Sanitation	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/5l0ji1u_document.pdf	Tax breaks and credits are outside of the scope and authority of the plan. The authority of this plan extends to counties in the metro area. Strategies are included to encourage the development of reuse markets and programs. The Recycling Association of MN has a Recycling Education Toolkit available on their website that has signage and messaging available for use. https://recycleminnesota.org/rec-toolbox/ The strategy for single-use containers has been revised in response to multiple comments. Yard waste and SSO mixed together is undesirable for most compost facilities. Effective composting requires the proper ratio of carbon and nitrogen sources. Co-collection of these materials make it difficult to achieve a consistent ratio. However, if compost facilities and haulers can work together to ensure co-collection works effectively, it would be worth exploring as an option.

Name	Affiliation	Comment	Response
Bonnie Matter	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/cd0wig_0_document.pdf	This plan does not have authority to make changes like eliminating plastic bags. However, there is an optional strategy for counties to adopt an ordinance with a consumer charge or ban on disposable single-use items, which is open for a county to interpret as including plastic shopping bags. Convenience is a critical component of success. The plan includes a strategy that would expand curbside collection of organics recycling to all cities with a population of 5,000 or greater. Restaurants cannot place orders directly in customers own containers, but you may bring your containers to restaurants for leftovers. The plan also includes a requirement for counties to provide financial assistance to organizations for transitioning to reusable foodware options. This plan seeks to address and divert unnecessary food waste through strategies that provide access to tracking software, partnering with health inspectors to identify diversion and prevention, and establishing partnerships between food rescue organizations and the businesses that create it. Some manufacturers produce packaging-free products. The strategies in this plan can encourage a shift toward that direction, but we will need more manufacturers to reduce packaging and residents to support these changes. Reducing waste at the source provides the greatest environmental benefit. Legislative action will be necessary to require manufacturers to participate. This plan does not have authority to standardize packaging, but does call for standardized outreach and education on recycling.
Brad Hanzel	Carver County	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/og09l6p_document.pdf	The composting rule changes adopted in 2015 prioritized environmental protection and sought to allow flexibility in compost operations. To expand organics capacity in the region, composters have advocated for the agency to prioritize market development for compost. Additionally, pushing for the expansion of collection programs signals to existing and future operators that there will be material for them to manage. Focusing on these two strategies will support market conditions that can help meet the regions capacity needs. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers. MPCA will continue to enforce MN Stat. 473.848, which requires WTE energy facilities to operate at full capacity. It is understood that some counties will supply more waste to those facilities than others. It is also understood that some counties will not be able to meet the total percentage laid out in the Metro Policy Plan. However, it should be noted that MPCA expects counties to support the existing infrastructure when possible as well as continue to implement strategies to avoid land disposal as much as possible. MPCA will defer to the expertise of counties to propose variations to strategies that will work for their residents and haulers. The plan has been amended to allow counties to provide alternative strategies. For required strategies, proposals must achieve comparable objectives. For optional strategies, counties should work with their PCA solid waste planner to determine the point value of the alternative strategy. MPCA acknowledges that data submittal prior to a license renewal may be challenging. This appears in the plan as a best practice to ensure hauler compliance. Carver County may follow the other best practices, which can be effective too. We appreciate that the county understands the value of quality hauler data. Interested parties have raised many concerns about the undue burden weekly recycling would have on their operations. Accordingly, this now appears in the plan as an optional strategy. This strategy can make collection frequency more convenient for residents but is cost prohibitive and would further exacerbate the driver shortage. Providing additional bins at no cost could achieve the same objective as weekly collection without the added emissions from extra truck routes. The strategy to pair trash and recycling collection has been made optional to address similar hauler concerns. MPCA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. MPCA has requested and received funding to work on wood waste projects which will also include developing markets. Implementing the strategy for county-owned buildings was the original intent of this strategy. The plan has been edited for clarity. Thank you for your valuable feedback.
Bridget Diep	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/ea0hinx_document.pdf	Enforcement of 115A.93 Subd 3(c) assures that haulers do not imposing a greater charge on residents who recycle than on residents who do not recycle, which includes organics recycling. Minn. Stat. § 115A.151 requires businesses to collect a minimum of three materials for recycling. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
Caleb Werth	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/4j0figl_document.pdf	Compostable single-use is a better option than conventional single-use that cannot be recycled, but reuse is the best option. MPCA will look to counties to interpret or adjust this strategy to achieve the best outcome given their resources and residents. The strategy has been edited to incorporate the successful and vetted aspects of the Minneapolis ordinance. Many county environmental centers have incorporated reuse areas or plan to in the future. We encourage every metro county to provide this service. Resident education is addressed in this plan with a strategy that calls for a commitment to standardized outreach and education. We agree that the messaging reaching residents should be easy to understand. Piecemeal efforts by counties, cities, haulers, and other organizations are rarely collaboratively developed and therefore can lead to confusion over what materials can be recycled or composted. Assuring a consistent message from those within the solid waste system would help bring clarity to the users of the system. The plan includes a required strategy to offer grants for waste reduction, reuse, and repair. Reuse businesses may be eligible for this funding.
Calla Martin	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/t30ei62_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The optional strategies for sustainable building and deconstruction have high point values, which should incentivize counties to incorporate them in their plans. Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. This is the overarching plan for the metro area. Counties have flexibility to choose optional strategies that they can effectively implement. In order for Minnesota to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question.
Carmela Giardina	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/cl0i07_document.pdf	Recycling refund legislation is very successful at increasing the collection of beverage containers. States with recycling refund often have capture rates greater than 80% for those materials that are covered by the redemption fee. MPCA does not have the authority to require this type of legislation through this plan, because it would take action by the Minnesota Legislature to enact that requirement on beverage manufacturers. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers. The types of materials collected in curbside collection programs are determined by the recycling market. If there is an end-use for an additional material that could be collected in a quantity great enough to support an economically viable market, the industry will implement it.
Carolyn Majkrzak	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/tU0oi3v_document.pdf	Thank you for the feedback.
Cassie Lefebvre	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/oc0w76_document.pdf	Due to the varied resources of metro counties, we believe requiring these strategies would place an undue burden on county staff at this time. Impactful optional strategies carry a high point value, which should provide a strong incentive for counties with the appropriate resources to successfully implement. The plan includes a reuse section with several strategies to address barriers and expand reuse access. Drop-off events hosted by the counties are popular with residents, but these events have been shown to be very expensive and time intensive for county staff to plan and execute. Advertising a special collection day at the existing permanent sites could have a similar impact to raise community awareness, perhaps outside of regular hours. Convenience is a critical component of success for organics recycling. The plan includes a strategy that would expand curbside collection of organics recycling to all cities with a population of 5,000 or greater. The plan includes a strategy for the management of organics recycling from large commercial food generators by 2030. It was optional in the draft and has been changed to required. MPCA has been working with the Departments of Agriculture and Health to create content for inspectors to educate licensed facilities about financial assistance, donation, and opportunities to reduce wasted food. The plan has been revised to include the MPCA's commitment to continue work with partner agencies on improved food rescue and prevention efforts. A strategy encouraging county engagement with health inspectors in individual county plans will remain in the plan to help accelerate adoption of the practice but will not be required.

Name	Affiliation	Comment	Response
Chris Kostik	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/750fijm_document.pdf	Interested parties have raised many concerns about the undue burden weekly recycling would have on their operations. Accordingly, this now appears in the plan as an optional strategy with an alternative option to provide extra bins at no cost. The single-use container fee is an optional strategy that counties may choose to add to their plans. We will look to the counties to select an approach that will best serve the needs of their residents. Counties will be required to offer grants or rebates for organizations to transition to reusable food and beverage service ware. Restrictions like a bag ban should be determined through county and/or city ordinances. The most effective way to reduce waste is to not create it in the first place. Compostable single-use products are a better option than conventional single-use products that cannot be recycled, but reuse is the best option. Extended producer responsibility (EPR) laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. Packaging: The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting.
Chris Long	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ik06ipj_document.pdf	The plan prioritizes reuse strategies. Reducing the amount of material being managed in the solid waste system provides the greatest environmental benefit.
Chris McConn	Minnesota Resource Recovery Association	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/5x0isigp_document.pdf	MPCA supports the waste hierarchy and values the role of waste-to-energy in the system. We appreciate MRRA's alignment with the agency's stance. Due to the unfolding events in Hennepin County and many comments of concern about the continued operation of the Hennepin Energy Recovery Center, we have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Extended producer responsibility (EPR) laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting. Thank you for your support and valuable feedback.
Christine Popowski	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/110si2r_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Chris Roloff	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/5f02iba_document.pdf	The reciprocal use agreement among the metro counties allows residents of any metro county to use any of the 7-metro county environmental centers and HHW sites. The single-use container fee is an optional strategy that counties may choose to add to their plans. We will look to the counties to select an approach that will best serve the needs of their residents.
cj stone	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/fm0uik1_document.pdf	Carbon capture and storage (CCS) is a theoretical idea that has not been tested in real world applications. Additional research is needed to confirm that it can be implemented at a scalable level. MPCA would potentially support demonstration research projects to investigate CCS. Landfills and compost facilities are open for use over many years. During this time any collected organic material would be exposed to precipitation and the atmosphere allowing for the generation of decomposition gases. Introducing large quantities of salt into a landfill would increase the risk of groundwater contamination. Composting and anaerobic digestion provide benefits beyond the disposal of waste such as creating mulch for reuse or electricity generation. CCS would only be used as a disposal method and therefore would be lower on the solid waste hierarchy. The referenced articles discuss agro-sequestration using various crops specifically chosen for the carbon capture potential. The heterogeneous nature of human generated organics used in composting may impact the feasibility of using CCS.
Claire Graupmann	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/3b0ic0_document.pdf	Resident education is addressed in that plan with a strategy that calls for a commitment to standardized outreach and education. We agree that the messaging reaching residents should be easy to understand. Piecemeal efforts by counties, cities, haulers, and other organizations are rarely collaboratively developed and can lead to confusion over what materials can be recycled or composted. Assuring a consistent message from those within the solid waste system would help bring clarity to the users of the system. The plan includes many waste reduction strategies. The plan requires counties to standardized outreach and education. Using consistent terms throughout the metro should help to reduce confusion.

Name	Affiliation	Comment	Response
Commissioner Liz Workman, Board Chair	Dakota County	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ow0filbx_document.pdf	Appendix G now includes a column identifying interested parties expected to be impacted by each strategy in the Metro Policy Plan. Based on comments received, it's clear that the MPCA needs to play a role in creating regional consistency. As the leading state agency, MPCA is committed to coordinating and facilitating regional meetings to discuss solid waste issues. The plan has been modified to clarify the role that MPCA will play. If a county and the MPCA have conflicting compliance rates, that demonstrates a need to collaborate and identify the source of this anomaly. If the MPCA has an outdated license list from the county, this could be the source of the discrepancy. Implementing this strategy for county owned buildings was the intent of this strategy. The plan has been edited for clarity. Interested parties have raised many concerns about the undue burden weekly recycling would have on their operations. Accordingly, this now appears in the plan as an optional strategy. MPCA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. Wood waste is expected to increase and will require collaboration to find upstream solutions. Planning will be required to avoid open burning. The plan has been revised to include a state-led strategy aimed at inter-agency coordination. MPCA promotes the use of compost to MNDOT and enterprise wide. Food-derived compost requirements in some metro counties and cities has bolstered markets. The region's food waste can have a beneficial use in metro construction projects. MPCA must promote robust markets for compost. One avenue is through partnerships with other state agencies. However, the MNDOT specification may not be the right tool for a statewide market development strategy for food-derived compost. In much of Greater Minnesota, food-derived compost is not established. Facilities and compost sites may be remote. Current MNDOT specifications do allow for use of food-derived compost. However, requiring only food-derived compost statewide is not currently feasible. The volume of compost used under MNDOT specifications exceeds the supply of food-derived compost. Additionally, some projects are located far from sources of food-derived compost. These statewide specifications must be achievable through a variety of feedstocks. MPCA will continue to enforce MN Stat. 473.848, which requires WTE energy facilities to operate at full capacity. It is understood that some counties will supply more waste to those facilities than others. It is also understood that some counties will not be able to meet the total percentage laid out in the Metro Policy Plan. However, it should be noted that MPCA expects counties to support the existing infrastructure when possible. The MPCA also has many strategies that expect counties to move materials up the hierarchy via reuse, recycling, and composting whether they have access to WTE or not. Source separation is the best way to recover materials and to ensure the highest value of those materials. However, despite our best efforts, human behavior is unpredictable. Preprocessing can recover additional recyclables, especially metals. The cost of collection is the primary driver of cost to residents, but historically tip fees have not been the driver for cost. The plan has been modified to extend the timeline in order to allow facilities more time to plan. The metro forecast was developed as described in the methodology included within Appendix F. Organics and recycling tonnages were calculated based on needed benchmarks to achieve the 75% recycling goal by 2030. Capacity has historically expanded as programs have come online and as needed. Organics processors (i.e., compost sites and anaerobic digestion facilities) are only likely to make the necessary investments in expanding their capacity if/when they have assurances that materials will be available to be managed. New capacity could come from a variety of sources, including already announced expansions, the initiation of operations at already permitted sites, management of organics at facilities outside the metro region and/or the development of new sites. The forecast is a more useful planning tool in its current format than it would be if it were to reflect an estimate of new capacity that may not accurately reflect real capacity in 2025. The MPCA is generally supportive of adequately funding programs at a state, county, and city-level. Legislative changes are outside the scope of the plan. The plan provides a waste forecast of anticipated generation. Waste reduction is determined by comparing forecasted population growth with documented solid waste generation data. Ideally, the strategies proposed throughout the plan result in future reported generation rates as less than forecasted. The vast number of strategies creates a wide range of possible systems/programs. It wouldn't be possible to estimate costs for all outcomes. It is expected that metro counties consider costs of implementation as they select strategies for their County Solid Waste Plans. MPCA will allow counties to recommend alternative strategies that will be approved by MPCA on a case-by-case basis. The standardized education strategy has been edited to address your concern.
Connor Stratton	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/8o0bihe_document.pdf	MPCA is committed to addressing the GHG contributions the solid waste system produces. This plan seeks to hold counties accountable for assuring meaningful effort is being put forth into the greatest impact reduction activities, like source reduction. MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Cora Preston	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/1s03iqu_document.pdf	Ramsey County will soon roll out curbside pick-up for food scraps: https://www.ramseycounty.us/residents/recycling-waste/collection-sites/food-scraps . Making this an easier option for residents should increase participation and divert more food waste from landfills. An optional strategy that counties may choose to add to their plans would require a fee on takeout containers. We will look to the counties to plan for an approach that will best serve the needs of their residents. There is flexibility in how counties fulfill this strategy and also to better align with the waste hierarchy, which values recycling over composting. Interested parties have raised many concerns about the undue burden weekly recycling would have on their operations. Accordingly, this now appears in the plan as an optional strategy. Piecemeal efforts by counties, cities, haulers, and other organizations are rarely collaboratively developed and therefore can lead to confusion over what materials can be recycled or composted. Assuring a consistent message from those within the solid waste system would help bring clarity to the users of the system.
Corissa Nohrenberg	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/s60biqf_document.pdf	A required strategy calls for expanded backyard composting outreach and resources for residents. Those resources would provide guidance and materials for residents to set up their own backyard compost. Encouraging a reduction in paper marketing materials is a great source reduction idea. Recycling is exempt from the solid waste management tax, so a tax break is already in place. The State and counties could do a better job of making this clear to residents. The cost of curbside collection is outside of the scope of this plan. Haulers establish the costs for service. The Minnesota Department of Corrections (DOC) work release program is something materials recovery facilities (MRFs) have historically used. However, this practice was interrupted during the COVID-19 pandemic due to both safety concerns as well as limited availability of incarcerated workers at MRFs.
Curt Wynkoop	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/pz0nihtv_document.pdf	An analysis of existing data shows that higher participation rates are realized with single-sort recycling than historical rates with multiple streams. Switching from one bin to 5-6 different types in bags or containers would be very difficult. Additionally, workers now use hydraulic systems to empty rolling carts. Under the old system, workers had to physically empty 5-6 different bags or containers into different compartments in the truck. This resulted in injuries that are now avoidable through the simplified single-stream system.
D B	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/720pict_document.pdf	The MPCA has a responsibility to assure the solid waste system is equitable and does not create an undue burden on any community in the Twin Cities Metro Area.
Dagny Heimisdottir	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/oe0vi52_document.pdf	The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.

Name	Affiliation	Comment	Response
Dale Lutz	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/840pi2a_document.pdf ; https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/sx07lea_document.pdf	Thank you for sharing the information about CCC for WTE facilities. MPCA is aware of carbon capture technology and the Minnesota Resource Recovery Association is exploring partnerships with carbon capture technology for WTE facilities located in MN. Carbon captured in MN could be deep well injected into bedrock as close as North Dakota, but there are some technical hurdles to cross prior to that, most notably the pipeline infrastructure to get the CO2 transported efficiently. Solving climate change will require a wide range of creative solutions and CCC could be one of the tools.
Daniel Rosenblum	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/w60blm_s_document.pdf	Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting. MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. This plan seeks to manage waste to its highest and best use.
Deb Leibel	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/c90qbttr_document.pdf	Organized collection systems provide many overall benefits to residents, if implemented properly. Establishment of an organized collection system is a local decision and therefore, this strategy will remain optional. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
Delaney Welle	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/oa0ai9g_document.pdf	Convenience is a critical component of success. A required strategy in the plan expands curbside collection of organics recycling to all cities with a population greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers. Counties are able to pursue the implementation of an ordinance to tax single-use items. Restrictions like a bag ban should be determined through county and/or city ordinances. Education must be a priority to improve our system. In addition, different types of education are important to reach different people. The plan calls for robust education in all seven metro counties.
denise dawson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/d20yicn_document.pdf	Minnesota Statute 115A.93 Subd. 3 prohibits haulers from imposing a greater charge on residents who recycle than on residents who do not recycle. The initial draft of this plan explored the feasibility of weekly recycling collection, which was determined to cause an undue burden on the haulers without evidence of an increase in collection of recyclable materials.
Diane Ballentine	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ah03i9n_document.pdf	Compostable single-use products are a better option than conventional single-use products, but reuse is the best option.
Diane Edson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/wv0u8b_document.pdf	Contamination is a serious issue plaguing the recycling stream. Penalizing violators would be difficult to enforce. The plan focuses on education strategies to mitigate the issue. Interested parties have raised many concerns about the undue burden weekly recycling would have on their operations. Accordingly, this now appears in the plan as an optional strategy. Recycling refund legislation is very successful at increasing the collection of beverage containers. States with recycling refund often have capture rates greater than 80% for materials covered by the redemption fee. MPCA does not have the authority to require this type of legislation through this plan. This would require action by the Minnesota Legislature to enact a requirement on beverage manufacturers. The plan includes a strategy for the management of organics recycling from large commercial food generators by 2030. It was optional in the draft and has been changed to required, based on public comments.
Dick Evans	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/l6067a_document.pdf	The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
don nelson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/0905i8v_document.pdf	Compostable single-use products are a better option than conventional single-use products that cannot be recycled, but reuse is the best option. The plan requires expansion of curbside organics collection to a greater number of households. Terracycle can fill the gaps in collection of materials that cannot be diverted/processed at a traditional recycling facility. Reducing or eliminating these materials is best. For unavoidable waste, it's a great option to assure these materials stay out of landfills and WTE facilities.

Name	Affiliation	Comment	Response
Donna Lindberg	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/wb0aibv_document.pdf	Educational requirements appear throughout the plan. School districts are required to collect and recycle at least three types of recyclables in their schools, although contamination of the recyclables can be a challenge. Curbside collection of organics recycling is a requirement in the plan.
Doug Gurian-Sherman	MN EJ Table and MCEA	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/310qibv_document.pdf	MPCA used up-to-date peer-reviewed science as a basis for the recommendations in this report. The strategies of this plan have merit for reducing waste generation and disposal. We acknowledge that some are more effective and impactful than others. State statute backs the waste hierarchy, and the plan has a strong emphasis on the top of the hierarchy to reduce waste to the extent possible. MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The objectives of the plan show that we are attempting to increase traditional recycling by 20%, organics by 11% and to reduce overall waste generation by 5%. If the Metro area can successfully achieve these objectives, the solid waste system will generate far fewer greenhouse gases.
Doug Heuer	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/7r0vihm_document.pdf	Reducing waste is a keystone theme in this plan. Replacing single-use containers with reusable containers is an effective way to reduce waste. We encourage counties to address solutions to reduce reliance on single-use waste through several optional strategies.
Douglas Carnival	McGrann Shea Carnival Straughn & Lamb, Chartered	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/w104i70_document.pdf ; https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/w104i70_document.pdf	Interested parties have raised many concerns about the undue burden weekly recycling would have on their operations. Accordingly, this now appears in the plan as an optional strategy. The MPCA is tasked with enforcing state law as written. MPCA continues to support the 75% recycling goal. We have and will continue to support a greater emphasis on waste prevention and reuse because of their increased benefits. MPCA continually reviews goals and requirements for ways they can be improved or revised and recommend revisions as appropriate. Source separation is the best way to recover materials and to ensure the highest value of those materials. However, despite our best efforts, human behavior is unpredictable. Preprocessing can recover additional recyclables, especially metals. The cost of collection is the primary driver of cost to residents, but historically tip fees have not been the driver for cost. The plan has been modified to extend the timeline. MPCA acknowledges that an additional cost may not change human behavior, but these added costs could provide resources to fund programs that can focus on alternatives to disposal. It is the intention of the MPCA that the tax/fee would be utilized by the county to reinvest in education and alternatives to disposal. The vast number of strategies creates a wide range of possible systems/programs. It wouldn't be possible to estimate costs for all outcomes. It is expected that metro counties consider costs of implementation as they select strategies for their County Solid Waste Plans. Minnesota has a rechargeable battery law. Updates to the law are needed to address the full scope of the lithium battery issue. The MPCA is working with partners on legislative proposals to improve the collection and recycling of batteries. A strategy has been added to the plan to implement education programs on proper battery management. Creating safe storage spaces that minimize fire risks at waste facilities is challenging. Minnesota Statute 473.149 Subd 3 (b) states that revisions to the plan are exempt from rulemaking. The statute also puts in a robust public comment and engagement process that guides the MPCA in development of the Metro Policy Plan. The plan states that required strategies must be included in county plans in order for approval by MPCA pursuant to MN Stat 473.803. Only those criteria and standards as laid out in Appendix D are required of facilities. Required strategies in the body of the plan are requirements that counties must include in their solid waste plans. County plans set policies and goals. Counties are expected to implement their plans, which may require the introduction of ordinances.
Drew Hatzembihler	Morrison County	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/hp0bill_document.pdf	Greater Minnesota CON is currently identified in rule. Issuance of CON is not done for a set number of years, but rather for the volume of waste anticipated for a set amount of time. Time-based CON is challenging, because it requires long-term forecasts that must account for uncertainty. When landfill capacity is constrained, MPCA and the affected facilities must coordinate to ensure that there is no disruption to the system that results in illegal dumping of waste.
Elia Rubio	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/5x0micx_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Elizabeth Aseltine	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/010lirl_document.pdf	Recycling refund legislation is very successful at increasing the collection of beverage containers. States with recycling refund often have capture rates greater than 80% for those materials that are covered by the redemption fee. MPCA does not have the authority to require this type of legislation through this plan, because it would take action by the Minnesota Legislature to enact that requirement on beverage manufacturers.
Elizabeth Kittelson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/3n0n2dd_document.pdf	Universally-sized collection bins are the best option for hauler safety. If other accommodations could ease your burden, that may be feedback you can share with your city officials.
Elizabeth Shvedenko	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ip0ui7n_document.pdf	Curbside organics recycling pickup programs play an important role in solid waste diversion.
Elke Zimmermann	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/fe0yis6_document.pdf	Contract for residential recycling and organics by 2030 is an optional strategy in the plan. Organized collection has numerous benefits and can lower costs for all types of service (i.e., MSW, recycling, organics) to residents of a community. Resident education is addressed in this plan with a strategy that calls for a commitment to standardized outreach and education. We agree that the messaging reaching residents should be easy to understand. Piecemeal efforts by counties, cities, haulers, and other organizations are rarely collaboratively developed and therefore can lead to confusion over what materials can be recycled or composted. Assuring a consistent message from those within the solid waste system would help bring clarity to the users of the system. The draft plan did not include strategies for multi-family housing. Strategies for multi-family recycling, organics recycling, and reduction have been added to the final plan. The plan includes a strategy to establish a curbside set-out day to allow residents to set out used items for reuse. This should lead counties to eliminate prohibitive ordinances and policies.

Name	Affiliation	Comment	Response
Emily Barker	Minnesota Reusables Coalition	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/y909l8d_.document.pdf	A strategy requiring counties to establish their own green meeting policy now appears in the plan. In response to comments received from cities and counties, the strategy for reusables at county events will remain optional. Compostable single-use products are a better option than conventional single-use products that cannot be recycled, but reuse is the best option. MPCA will look to counties to interpret or adjust this strategy to achieve the best outcome given their resources and residents. The strategy has been edited to incorporate the successful and vetted aspects of the Minneapolis ordinance. MPCA received funding in the last legislative session for grants that will address waste issues and climate change reduction. Quality tracking of materials is the key to successful solid waste management. Measuring our successes and failures allows us to advance the system in a meaningful, data-based way. The plan has been amended to allow counties to provide alternative strategies. For required strategies, proposals must achieve comparable objectives. For optional strategies, counties should work with their PCA solid waste planner to determine the point value of the alternative strategy. This state-led strategy is a brief description of the complex work PCA staff will continue to focus on.
Emily Beltt	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/5j0aifi_.document.pdf	Ramsey County will soon roll out curbside pick-up for food scraps: https://www.ramseycounty.us/residents/recycling-waste/collection-sites/food-scraps . Making this an easier option for residents should increase participation and divert more food waste from landfills.
Emma Marlar	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/v30ci5l_.document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Eric Brace	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/8a0zi2o_.document.pdf	Convenience is a critical component of success. The plan includes a strategy that would expand curbside collection of organics recycling to all cities with a population of 5,000 or greater. The most effective way to reduce waste is to not create it in the first place. Compostable single-use products are a better option than conventional single-use products that cannot be recycled, but reuse is the best option. The plan requires expansion of curbside organics collection to a greater number of households. Making a new product emits greenhouse gases that contribute to climate change and requires a lot of materials and energy - raw materials must be extracted from the earth, and the product must be fabricated then transported to wherever it will be sold. As a result, reduction and reuse are the most effective ways you can save natural resources, protect the environment and save money.
Erin Oakley	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/kd0zi6_.document.pdf	The most effective way to reduce waste is to not create it in the first place. Making a new product emits greenhouse gases that contribute to climate change and requires a lot of materials and energy—raw materials must be extracted from the earth, and the product must be fabricated then transported to wherever it will be sold. As a result, reduction and reuse are the most effective ways you can save natural resources, protect the environment, and save money. The plan includes many strategies targeted at improving diversion of businesses.
Evan Mulholland	MN EJ Table and MCEA	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/vk0siden_.document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Decentralized waste management is an interesting concept. In many ways, this plan is pushing for strategies that do just that. By prioritizing waste reduction, reuse, recycling, and composting over disposal methods, the idea of moving material into decentralized management is in this plan. The plan contains strategies to diversify our end markets for recycling, compost, and wood waste. When it comes to diversifying trash outlets, MPCA would be receptive to discussing what those options could be that also are protective of the environment. The Metro Policy Plan will not be including a HERC shut down by 2025 scenario. At the time of publication, Hennepin County is in the process of developing a plan to close HERC between 2028 and 2040. CON for land disposal facilities is not contingent on the Metro Plan having that scenario published. CON needs are evaluated as need arises, and landfills can expand without a forecast that states that it's needed if conditions in the region are substantially different than the time that the forecast was developed. Forecasts for non-MSW were inadvertently omitted from the draft plan. Non-MSW forecasts, including ash estimates, have been added. Waste-to-energy facilities reduce waste volume by about 75%, greatly reducing the amount of space needed for land disposal. Additionally, ash is homogeneous and chemically-stable, which reduces some of the risks of land disposal. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the Minnesota Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The draft plan did not include strategies for multi-family housing. Strategies for multi-family recycling, organics recycling, and reduction have been added to the final plan.
Frank Hornstein	Minnesota Legislature	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/ov0ki2k_.document.pdf	Forecasts for non-MSW were inadvertently omitted from the draft plan. Non-MSW forecasts, including ash estimates, have been added. Waste-to-energy facilities reduce waste volume by about 75%, greatly reducing the amount of space needed for land disposal. Additionally, ash is homogeneous and chemically-stable, which reduces some of the risks of land disposal. MPCA uses the Metro Policy Plan cycle to increase the expectations for county plans by requiring additional items for them to include. In addition, in previous cycles, MPCA has met with underperforming counties to work with them to see better results. MPCA intends to await the response of the counties in their solid waste plans. We have the authority to approve or deny plans and will work to enforce this statute within our authority in order to continue to push the region toward the 75% goal. MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. MPCA is supportive of significantly reducing the burning of fossil fuels by 2040. The challenge for the waste management sector is that data indicates that landfills generate greater amounts of greenhouse gases than WTE facilities do because of the methane generated. Well intended policy can create unintended consequences. MPCA agrees that we need to consider the best ways to reduce emissions from combusting certain materials. For example, the ban on mercury in batteries had a huge impact on reducing mercury emissions from WTE facilities. The Hennepin County Board passed a resolution requiring that county staff develop a plan to close HERC between 2028 and 2040. It is clear to MPCA that Hennepin County is taking the intent from the Minnesota Legislature seriously and MPCA does not feel the need to interject into their on-going process.
G R	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/2k0tiqk_.document.pdf	Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting.

Name	Affiliation	Comment	Response
Gael Zembal	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/r10cch2_document.pdf	Interested parties have raised many concerns about the undue burden weekly recycling would have on their operations. Accordingly, this now appears in the plan as an optional strategy. One strategy in the plan encourages donation of excess food from restaurants and grocery stores with the help of health inspectors. Resident education is addressed in that plan with a strategy that calls for a commitment to standardized outreach and education. We agree that the messaging reaching residents should be easy to understand. Piecemeal efforts by counties, cities, haulers, and other organizations are rarely collaboratively developed and therefore can lead to confusion over what materials can be recycled or composted. Assuring a consistent message from those within the solid waste system would help bring clarity to the users of the system. The Minnesota State Legislature has enacted rules to maintain the integrity of the recycling system. MN Statute 115A.95 was written to ensure that once material is collected for recycling, it must be taken to a recycling processing facility or end market. This law prohibits material that is collected as recycling from being taken to a landfill and ensures that material collected for recycling is indeed being recycled. In addition, Minnesota imposes a solid waste tax on every ton of solid waste disposed. Counties also impose a separate solid waste tax if material is disposed of in their county. Minnesota does not tax material that is taken to a recycling processing facility. This makes recycling cheaper than disposal. In the 1990's private companies and the public sector made investments in the recycling system to make recycling more desirable. When overseas markets closed their borders to recyclable materials in 2017, Minnesota companies made even more investments to make sure material was clean and ready for end markets. Cleaner material and fewer contaminants in bales of recyclable material mean companies will buy Minnesota's recyclable material over others and at a better price. Minnesota has good, stable end markets for recyclable materials because of the investments made over the last 30+ years. Recycling is important to Minnesota's local economy. Overall, recycling helps support nearly 78,000 jobs in Minnesota. Over 330 manufacturers in Minnesota use recycled material in their products. There is a strategy in the plan for counties to expand backyard composting outreach and resources. Placing a backyard compost pile at least 20 feet away from habitable buildings is widely accepted as a measure to mitigate the associated risks. This is an optional strategy that counties may choose to add to their plans. The strategy requires the adoption of an ordinance with a mandatory consumer charge for take out containers.
Gerald Stiff	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/j00oliq_document.pdf	Education is addressed throughout the plan and plays a very important role in the success of a functional solid waste system. Your county, city, and hauler are all great resources for learning how to best dispose or find a new use for a waste or material.
H McCrillis	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/xg0rih6_document.pdf	Black plastics are not recyclable due to limitations of the sorting equipment at recycling facilities. The optical sorter cannot read the resin type. Elimination of black plastic in packaging would be more beneficial than recycling it.
Hannibal Hayes	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/o00dlq3_document.pdf	MPCA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. Wood waste is expected to increase and will require collaboration to find upstream solutions. Planning will be required to avoid open burning.
Heidi Blum	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/910niq3_document.pdf	The draft plan did not include strategies for multi-family housing. Strategies for multi-family recycling, organics recycling, and reduction have been added to the final plan based on comments like yours.
Helen M Carrillo	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/et0xi7n_document.pdf	Preventing contamination through education is less costly and more effective than establishing a penalty system with compliance officers.
Ivy Booth	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/fn0bib5_document.pdf	The plan includes a strategy for the management of organics recycling from large commercial food generators by 2030. The point value of this strategy has been raised to reflect the impactfulness of the strategy and recognize the amount of work required of county staff to accomplish it. Thanks for your support of this impactful strategy.
J Forman	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/m10zih4_document.pdf	Compostable single-use products are a better option than conventional single-use products, but reuse is the best option. Replacing single-use containers with reusable containers is an effective way to reduce waste. We encourage counties to address solutions to reduce reliance on single-use waste through several optional strategies.
Jacquelyn Chlebeck	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/pw04i37_document.pdf	Thank you for the feedback. The plan includes education strategies that the counties will execute. A visit to a solid waste facility can be exceptionally enlightening.
Jake Heidelberger	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/i409ifm_document.pdf	Ramsey County will soon roll out curbside pick-up for food scraps: https://www.ramseycounty.us/residents/recycling-waste/collection-sites/food-scraps . Making this an easier option for residents should increase participation and divert more food waste from landfills.

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Jane Dow	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/77c034d6_document.pdf	Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting. MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The plan includes many strategies to address food waste. MPCA advocates for diversion of food waste to the extent of the plan's authority. Food waste rescue activities beyond what is included in the plan would require legislative action and/or county/city ordinance passage. Recycling refund legislation is very successful at increasing the collection of beverage containers. States with recycling refund often have capture rates greater than 80% for those materials that are covered by the redemption fee. MPCA advises the MN Legislature in the Solid Waste Policy Report to implement a statewide deposit refund program.
Janet Court	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/sc0hia1_document.pdf	The most effective way to reduce waste is to not create it in the first place. Making a new product emits greenhouse gases that contribute to climate change and requires a lot of materials and energy—raw materials must be extracted from the earth, and the product must be fabricated then transported to wherever it will be sold. As a result, reduction and reuse are the most effective ways you can save natural resources, protect the environment, and save money.
Jay Krafthefer	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/p00mi6e_document.pdf	Recycling refund legislation is very successful at increasing the collection of beverage containers. States with recycling refund often have capture rates greater than 80% for those materials that are covered by the redemption fee. MPCA advises the Minnesota Legislature in the Solid Waste Policy Report to implement a statewide deposite refund program.
Jayson Smart	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/dd06i88_document.pdf	The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers. The plan includes a required strategy to offer grants for waste reduction, reuse, and repair. Reuse businesses may be eligible for this funding.
Jeanne Nordland	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/vv0ii04_document.pdf	Thank you for the feedback. The plan now includes a suggestion to include worm composting in public outreach. There are a lot of plastics in landfills. This approach is still being researched and developed, but could potentially be part of our waste reduction approach in the future.
Jeanne Norrgard	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/4a08iqt_document.pdf	The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. Reducing the amount of material being managed in the solid waste system provides the greatest environmental benefit. To truly be successful in waste reduction, upstream policies must be put into place by the Minnesota Legislature that result in the generation of fewer materials. MPCA supports minimizing disposal options (e.g., WTE and landfill) as much as possible. The plan focuses on waste reduction, recycling, and composting to meet the 75% diversion goal. The 75% disposal avoidance goal is determined by state statute and MPCA intends to aggressively push for improvement in all feasible areas. Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway.
Jenna Olson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/vs0ci90_document.pdf	Curbside collection of textiles has been discontinued by municipal programs due to the exposure to weather. Textiles must be dry and clean for both reuse and recycling. The Secondary Materials and Recycled Textiles (SMART) Association estimates that about half of new clothing end up donated. Of the clothing that is donated, about 20% are sold in reuse outlets, 25% are shipped overseas, 50% are used as absorbents/rags/stuffing, and about 5% head to landfills or WTE facilities. That means that over half of all textiles end up in the garbage. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse nor recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact.
Jennifer Hoesle	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/yc0zii3_document.pdf	Every collection program has varying implementation costs. In some communities, curbside organics will be absorbed into existing trash fees and compostable bags will be provided by their county. In other communities, a separate hauler collects the organics recycling. This is more expensive and residents experience higher fees for that type of service.
Jenny Cook	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ok05in1_document.pdf	Thank you for the feedback. We will re-examine how to better engage the public for the next iteration of the plan.

Name	Affiliation	Comment	Response
Jessica Kullander	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/3k0ziph_document.pdf	All the 7-county metro HHW drop-off sites are open to residents of any metro county. Aside from textile recycling, every site will collect the items you listed and many other types of household hazardous waste. The plan includes a strategy to provide additional drop sites or collection events for these items. Curbside collection of textiles has been discontinued by municipal programs due to the exposure to weather. Textiles must be dry and clean for both reuse and recycling. The Secondary Materials and Recycled Textiles (SMART) Association estimates that about half of new clothing end up donated. Of the clothing that is donated, about 20% are sold in reuse outlets, 25% are shipped overseas, 50% are used as absorbents/rags/stuffing, and about 5% head to landfills or WTE facilities. That means that over half of all textiles end up in the garbage. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse or recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact. Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
Jessica Strasser	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/230tgid_document.pdf	Bringing your own container for takeout is an effective source reduction behavior. Incentivizing that behavior through fee avoidance should encourage some to participate.
Jessica Tritsch	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/5y09lgo_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the Minnesota Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. Thank you for your feedback.
Jo Chambers	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/uy0n6tef_document.pdf	The Twin Cities metro area has some of the highest recycling rates in the nation. Our waste is managed locally, with some materials going to landfills in Wisconsin and Iowa, and therefore is not disposed of near an ocean. Additionally, MN statute 115A.95 does not allow for haulers to deliver source-separated recyclable materials unless the MPCA determines that no other disposal method is available. Minnesota has a robust local recycling market as well. Consumption behaviors need to shift to be less wasteful and it will require cooperation between government, retailers, manufacturers, and consumers.
Joel Jensen	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/lv0ni8d_document.pdf	The bag fee is an optional strategy that counties may choose to add to their plans. The strategy requires the adoption of an ordinance with a mandatory consumer charge for takeout containers and is open for counties to propose a different approach that achieves the same objective. Extended producer responsibility (EPR) laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. Packaging: The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting. Convenience is a critical component of success for organics recycling. The plan includes a strategy that would expand curbside collection of organics recycling to all cities with a population of 5,000 or greater. The plan includes a strategy for the management of organics recycling from large commercial food generators by 2030. It was optional in the draft and has been changed to required. MPCA has been working with the Departments of Agriculture and Health to create content for inspectors to educate licensed facilities about financial assistance, donation, and opportunities to reduce wasted food. The plan has been revised to include the MPCA's commitment to continue work with partner agencies on improved food rescue and prevention efforts. A strategy encouraging county engagement with health inspectors in individual county plans will remain in the plan to help accelerate adoption of the practice but will not be required.
John Borden	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/qp0kili_document.pdf	The draft plan did not include strategies for multi-family housing. Strategies for multi-family recycling, organics recycling, and reduction have been added to the final plan based on comments like yours.
John Gunyou	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/hb0uig9_document.pdf	Thank you for the feedback.
John Sullivan	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/290sidm_document.pdf	Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting.

Name	Affiliation	Comment	Response
Joseph Robinson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ff0nikj_.document.pdf	Resident education is addressed in that plan with a strategy that calls for a commitment to standardized outreach and education. We agree that the messaging reaching residents should be easy to understand. Piecemeal efforts by counties, cities, haulers, and other organizations are rarely collaboratively developed and therefore can lead to confusion over what materials can be recycled or composted. Assuring a consistent message from those within the solid waste system would help bring clarity to the users of the system. The Minnesota State Legislature has enacted laws to maintain the integrity of the recycling system. MN Statute 115A.95 was written to ensure that once material is collected for recycling, it must be taken to a recycling processing facility or end market. This law prohibits material that is collected as recycling from being taken to a landfill. This ensures that once material is collected for recycling, it is getting recycled. Minnesota has some communities that use the Pay-as-you-throw (PAYT) model and volume-based pricing is required in MN Stat. 115A.9301. Extended producer responsibility has been shown to be very effective tool to divert waste to recycling in Canada, Europe, and other states in the U.S. In order for Minnesota to utilize this type of program, the MN Legislature would have to create new laws with requirements on manufacturers. This plan does not have authority to make statewide changes. Policy recommendations for the MN Legislature are found in the MPCA's Solid Waste Policy Report.
Judy Huber	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/p70zill_.document.pdf	Please contact management at the Eagan Community Center with this request. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
Juli Albright	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/r70diou_.document.pdf	Contract for residential recycling and organics by 2030 is an optional strategy in the plan. Organized collection has numerous benefits and can lower costs for all types of service (i.e., MSW, recycling, organics) to residents of a community. The plan includes several strategies for reducing wasted food. Food donation is part of those recommendations.
Julie Ketchem	WM	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/sh0nlh6_.document.pdf ; https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/m30pici_.document.pdf	Contamination is a serious issue plaguing the recycling stream. The plan focuses on education strategies to mitigate this issue. Contract for residential recycling and organics by 2030 is an optional strategy in the plan. Organized collection has numerous benefits and can lower costs for all types of service (i.e., MSW, recycling, organics) to residents of a community. Every collection program has varying implementation costs. In some communities, curbside organics will be absorbed into existing trash fees and compostable bags will be provided by their county. In other communities, a separate hauler collects the organics recycling. This is more expensive, and residents experience higher fees for that type of service. Durable compostable bag systems reduce the number of trucks needed for collection, as the bags are placed in the garbage bins. There are opportunities for costs to residents and haulers to be minimized. Counties, cities, haulers, and the state will learn a lot about the best method to provide organics collection to residents as this program implemented. Interested parties have raised many concerns about the undue burden weekly recycling would have on their operations. Accordingly, this now appears in the plan as an optional strategy. MPCA position is that the settlement agreement about restriction on disposal with WM and Republic Services has been effective. The language that was agreed upon in the settlement negotiations has provided the flexibility to the landfills and to the waste-to-energy (WTE) facilities to navigate the challenge of when the facility is at capacity. The 14-day notification period addresses most of the concerns that you are stating about closures and outages. The landfills have 14 days to adjust and coordinate with WTE facilities to ensure capacity needs are met. MPCA has and will continue to focus on generators of waste. However, the pre-processing strategy is an acknowledgement that—despite our best education efforts—a certain percentage of residents will continue to discard recyclable material into the trash. MSW processing is needed to get county recovery rates closer to 75%. Education efforts will continue, and efforts will be made to tie those efforts to the values of our residents. Source separation is the best way to recover materials and to ensure the highest value of those materials. Human behavior is unpredictable. Preprocessing can recover additional recyclables, mainly metals. The cost of collection is the primary driver of cost to residents, but historically tip fees have not been the driver for cost. The plan has been modified to extend the timeline. Sustainable materials management (SMM) is the best way to reduce the impacts of our waste generation. The plan is consistent with the goals of SMM. The vast number of strategies creates a wide range of possible systems/programs. It wouldn't be possible to estimate costs for all outcomes. It is expected that metro counties consider costs of implementation as they select strategies for their County Solid Waste Plans. The current process for issuing CON is arduous. However, the MPCA also is tasked with ensuring that waste facilities are developed in an orderly and deliberate manner. The lengthy process ensures that there is need for a landfill to be developed. As such, MPCA views certificate of need as a critical step in the permitting process for MSW landfills. The revoke and reissue language appears in MN Rule 9215.0940. This rule grants MPCA the right to revoke and reissue CON. This aligns metro CON with the Greater Minnesota Rule. Additionally, the Metro Policy Plan is required to be consistent with existing rules and statutes when applicable. Historically, MPCA has never rescinded capacity from a landfill without also reissuing capacity. The plan has been revised to clarify that this requirement applies to landfills and WTE facilities. The composition analysis can also be conducted at apartment facilities. This requirement applies to all landfills and WTE facilities within the 7-county metro area. The result is that five additional sites will now be required to perform waste composition studies. Minnesota has a rechargeable battery law. Updates to the law are needed to address the full scope of the lithium battery issue. The MPCA is working with partners on legislative proposals to improve the collection and recycling of batteries. A strategy has been added to the plan to implement education programs on proper battery management. Creating safe storage spaces that minimize fire risks at waste facilities is challenging. The plan is consistent with protecting our existing infrastructure. Larger policy discussions on topics like the bottle bill and EPR should be handled through the legislative process. Additionally, legislative proposals are not discussed in the plan, because of their state-wide impacts.
Julie Schramke	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/3j0oi73_.document.pdf	Plastic resin codes may give the impression that all plastic is recyclable, but the recycling symbol was co-opted for this code system. Contamination is a serious issue plaguing the recycling stream. The plan focuses on education strategies to mitigate this issue.
Julie Svendahl	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/zq0ai2d_.document.pdf	Education must be a priority to improve our system. In addition, different types of education are important to reach different people. The plan calls for robust education in all seven metro counties. Resident education is addressed in this plan with a strategy that calls for a commitment to standardized outreach and education. We agree that the messaging reaching residents should be easy to understand. Piecemeal efforts by counties, cities, haulers, and other organizations are rarely collaboratively developed and therefore can lead to confusion over what materials can be recycled or composted. Assuring a consistent message from those within the solid waste system would help bring clarity to the users of the system.
Kait Sergenian	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/hh018y_.document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.

Name	Affiliation	Comment	Response
Kala Fisher	City of Saint Louis Park	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/uh0t4h_document.pdf	Feedback from our metro cities is so important to assure the success of our plan. On Strategy 4: Improve recycling data collection at businesses within the county. This strategy is optional and it intended to give counties a broader understanding of recycling rates. We will work with counties on their plans, and some may choose to incorporate this optional strategy. Several metro counties track business data. We will encourage a process that is not unduly burdensome. On Strategy 17: Work with health inspectors to educate restaurants and other establishments that have excess food to donate. This strategy has been amended to include diversion for inedible food waste. On Strategy 20: Implement a county policy encouraging all county and city-led events and food providers use reusable food and beverage service ware. Thank you for providing context on the implications of the strategy as it appeared in the draft. This strategy has been revised to clarify intended outcomes and to limit the scope to the county. On Strategy 21: Adopt an ordinance with a mandatory consumer charge for take-out single-use cups, containers, and utensils. This is an optional strategy that counties may choose to add to their plans. We will look to the counties to plan for an approach that will best serve the needs of their residents. This has been revised to allow more flexibility in how counties fulfill this strategy and also to better align with the waste hierarchy. On Strategy 25: Establish a curbside set-out day to allow residents to set out used items for reuse. This is an optional strategy that counties may choose to include in their solid waste plans. It is a good way to make reuse more convenient for residents. However, if any county wants to propose other reuse strategies, the provides them the freedom to do that. The plan includes a new strategy to require counties to promote their reuse outlets that are located in the county. On Strategy 28: Collect recycling weekly by 2025. Interested parties have raised concerns on the undue burden of weekly recycling. Accordingly, this now appears in the plan as an optional strategy. Strategy 34: Establish mandatory pre-processing of waste at resource recovery facilities and landfill by 2025. Source separation is the best way to recover materials and to ensure the highest value of those materials. However, despite our best efforts, human behavior is unpredictable. Preprocessing can recover additional recyclables, especially metals. The cost of collection is the primary driver of cost to residents. But historically tip fees have not been the driver for cost. The plan has been modified to extend the timeline and allow for alternative proposals. On Strategy 37: Make residential curbside organics collection available in cities with a population greater than 5,000. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers. The plan has been clarified to include language that this strategy is for single-family residential. On Strategy 38: Expand backyard composting outreach and resources for residents. Thank you for the feedback. The plan has been edited to allow for more flexibility in how counties promote backyard composting activities. On Strategy 40: Standardize the role of compostable products in organics recycling programs by 2025. This strategy has been edited for clarity.
Karen Kiener	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/h303iaf_document.pdf	Thank you for the feedback. A predraft meeting was held on May 26, 2021 with a comment period of 6 weeks afterward. We will evaluate our approach to the predraft notice and ways of gathering input for our next plan.
Karissa VanErem	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ea0pili_document.pdf	The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
Katherine Haun Schuring	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/t10icid_document.pdf	Thank you for the feedback and support of this plan. Reducing the amount of food waste that currently is managed through landfills and waste-to-energy is our goal. In Minnesota, the Department of Agriculture sets food labeling requirements. While best by and sell by date labeling is outside of the scope of this plan, the MPCA plays an important role in providing expertise and perspective to our fellow state agencies. Curbside collection of textiles has been discontinued by municipal programs due to the exposure to weather. Textiles must be dry and clean for both reuse and recycling. The Secondary Materials and Recycled Textiles (SMART) Association estimates that about half of new clothing end up donated. Of the clothing that is donated, about 20% are sold in reuse outlets, 25% are shipped overseas, 50% are used as absorbents/rags/stuffing, and about 5% head to landfills or WTE facilities. That means that over half of all textiles end up in the garbage. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse nor recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact. Private companies like Terracycle and Ridwell help fill the gaps by collecting materials that are difficult and costly for counties to process and manage. Black plastics are not recyclable due to limitations of the sorting equipment at recycling facilities. The optical sorter cannot read the resin type. Elimination of black plastic in packaging would be more beneficial than recycling it. Reusable takeout containers might be a better option to reduce the waste associated with takeaway food. This has been prioritized in the plan by requiring counties to provide grant funding to organizations to transition to reusable options.
Kathleen Karsko	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/aa0gi5o_document.pdf	The plan includes an optional strategy for counties to establish a reuse set out day. The plan requires counties to standardized outreach and education. This will address the concern that different terms are used throughout the metro and will help to address confusion.
Kathy Ulmer	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/rt0ei8m_document.pdf	MN statute 115A.95 does not allow for haulers to deliver recyclable materials collected from residents to landfills, unless the MPCA determines that no other disposal method is available. Due to the extensive reporting required by haulers and solid waste facilities, we have the data to prove our recyclables are being recycled. Minnesota has a strong recycling market and some of the highest recycling rates in the nation. While recyclables may end up in landfills in other states, Minnesota has a strong system of checks and balances to assure materials placed in recycling bins by residents are routed to facilities that truly recycle them.
Kelly Gryting	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/nh0oia_d_document.pdf	We received a lot of feedback about weekly recycling collection. Interested parties alerted us to the undue burden weekly recycling would have on their operations, both cities and haulers. Accordingly, this now appears in the plan as an optional strategy. We agree that the messaging reaching residents should be easy to understand. A strategy in the plan requires counties to commit to standardized outreach and education for residents. Piecemeal efforts by counties, cities, haulers, and other organizations are rarely collaboratively developed and can lead to confusion over what materials can be recycled or composted. Assuring a consistent message from those within the solid waste system would help bring clarity to the users of the system.
Kelly Lindsay	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/90081if_document.pdf	An HOA is a legal entity that may enforce rules in your neighborhood. The HOA restriction on placement of bins is outside the scope of the PCA's authority. Carver County may adapt a strategy to establish a curbside set-out day into their solid waste plan. Carver County staff operate their environmental center independently of the MPCA. Carver County may propose a strategy to extend the hours of the environmental center to be more accessible to the public. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers. There are several options for disposing of shredded paper, particularly document destruction organizations such as Shred-It. Those companies shred and recycle the documents that they manage and usually work with large commercial customers. They may also participate in document shredding days for residents that counties host. Your comment inspired a strategy that counties should establish a document destruction day for residents.
Ken Smith	Ever-Green Energy	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/pb0dgiqt_document.pdf	State statute defines yard waste as including garden wastes, leaves, lawn cuttings, weeds, shrub and tree waste, and prunings in Minn. Stat. § 115A.03. Sites that refuse large wood waste items like logs often lack the equipment or space to process these into small pieces. The Minnesota Department of Agriculture has enacted a quarantine to limit the movement of firewood. MPCA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. Wood waste is expected to increase and will require collaboration to find upstream solutions and assure there is adequate space at our wood yards. Planning will be required to avoid open burning. Market development for wood waste is called for in the plan. MPCA is aware that additional markets beyond St. Paul Co-generation will be needed to ensure outlets are available in the future. Markets can include composting, bio-char, lumber markets, or others that MPCA may not have yet considered. We will be looking to the county solid waste plans to propose solutions for supporting the continued operation of wood yards within their counties.

Name	Affiliation	Comment	Response
Ken Stewart	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/150b95f_document.pdf	The scope of this plan is dictated by Minn. Stat. § 473.149. This plan has many strategies for reduction, such as food waste reduction grants, increasing food rescue from restaurants and grocery stores, and sustainable purchasing policies at counties. However, the most effective waste reduction efforts will require legislative changes.
Kim B	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/910midv_document.pdf	Organics and recycling collected from schools tends to have higher contamination rates. Focusing education on students and staff to improve this behavior could help improve diversion rates. There is a required strategy in the plan to offer grants or rebates for organizations to transition to reusable food and beverage service ware. The school district can work with Washington County to purchase reusable trays to replace Styrofoam trays. Dakota County's ordinance to require commercial collection of organics has been a success. The plan has a strategy that would require counties to coordinate on their outreach and education efforts. Washington County has great resources for recycling and waste prevention, with a helpful website: https://www.ramseycounty.us/residents/recycling-waste/education/education-resources An HOA is a legal entity that is subject to state laws and may be subject to the strategies selected in your county's solid waste plan. The plan has an optional strategy for counties to adopt an ordinance with a mandatory consumer charge for take-out single-use cups, containers, and utensils. The Washington County Environmental Center in Woodbury is an excellent resource. This is the great challenge for this moment in our history. We are surrounded by easy consumption and disposal. Capturing products for a circular economy is challenging and will require support and advocacy by citizens like you. Establishing incentives for creating less waste is a great idea, but tracking it would be very difficult.
Kim Kuhn	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/460b84f_document.pdf	Curbside collection of textiles has been discontinued by municipal programs due to the exposure to weather. Textiles must be dry and clean for both reuse and recycling. The Secondary Materials and Recycled Textiles (SMART) Association estimates that about half of new clothing end up donated. Of the clothing that is donated, about 20% are sold in reuse outlets, 25% are shipped overseas, 50% are used as absorbents/rags/stuffing, and about 5% head to landfills or WTE facilities. That means that over half of all textiles end up in the garbage. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse nor recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact. The plan includes many waste reduction strategies that incorporate financial incentives.
Kim Rolie	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/m708f2f_document.pdf	The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
Kris Lovaas	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/s00cic3_document.pdf . https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/kq0ai3r_document.pdf	Thank you for the feedback. The plan has been revised to make the weekly collection strategy optional. This strategy has the opportunity to make collection frequency more convenient for residents, but may be cost prohibitive and further exacerbate the driver shortage. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
Ky Schmidt	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/v30qicr_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Laura Grevas	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/zb0wi93_document.pdf	The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
Lauren Allen	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ao0gi2p_document.pdf	The Minnesota Legislature passed a sweeping bill to address and prohibit PFAS in consumer products. The Minnesota Attorney General reached an \$850 million settlement with 3M. For more information about this, visit https://3msettlement.state.mn.us/ . To learn more about PFAS in Minnesota, visit https://www.pca.state.mn.us/pfas-in-minnesota .
Laurie Rossin	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ua0ci78_document.pdf	The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
Leanna Goose	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ox0eieg_document.pdf	E-waste recycling must be convenient. The plan calls for convenient drop site access for residents. The plan requires pre-processing at landfills to remove recyclable material, but we will continue to strive for e-waste collection upstream for the most effective recovery of materials.
Lee Mehrkens	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ld07ih4_document.pdf	Organics recycling is the highest and best use for inedible food waste. Single-use plastics can be recycled, but they can also be replaced with reusable options. The plan places greater emphasis on addressing the root problem and expanding reduction efforts.

Name	Affiliation	Comment	Response
Leigh Behrens	Partnership on Waste and Energy	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/c0w2n_document.pdf	Thank you for your support of our many impactful strategies. Thank you also for calling attention to the importance of being mindful of the words we choose. We have amended to plan to remove harmful terms. MPCA will defer to the expertise of counties to propose variations to strategies that will work for their residents and haulers. The plan has been amended to allow counties to provide alternative strategies. For required strategies, proposals must achieve comparable objectives. For optional strategies, counties should work with their PCA solid waste planner to determine the point value of the alternative strategy. Implementing strategy 60 for county owned buildings was the original intent of this strategy. The plan has been edited for clarity. Interested parties have raised many concerns about the undue burden weekly recycling would have on their operations. Accordingly, this now appears in the plan as an optional strategy. The public education and backyard composting strategies have been edited to address your concerns. Source separation is the best way to recover materials and to ensure the highest value of those materials. However, despite our best efforts, human behavior is unpredictable. Preprocessing is the process of pulling recyclables out of mixed waste and it can recover additional recyclables, especially metals. The cost of collection is the primary driver of cost to residents, but historically tip fees have not been the driver for cost. The plan has been modified to extend the timeline to allow facilities time to plan the best preprocessing system. MPCA will look to counties to interpret or adjust this strategy to achieve the best outcome given their resources and residents. Hauler reporting is a shared responsibility for the state and county. Without cooperation from counties and accurate license lists, the MPCA cannot rely on the information collected. Both the state and counties benefit from the collection of this data. Sharing in the responsibility ensures accuracy and efficiency. MPCA views increased compliance as a partnership effort. Counties need to maintain and share hauler license lists with the MPCA. State leadership is needed to assure consistency. Sustainable materials management (SMM) is the best way to reduce the impacts of our waste generation. The plan is consistent with the goals of SMM. The MPCA relies on EPA's WARM for decision-making but does not require counties to do the same if other models are found to be reliable and consistent with an SMM approach. Extended producer responsibility (EPR) laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. Packaging: The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting. MPCA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. Wood waste is expected to increase and will require collaboration to find upstream solutions. Planning will be required to avoid open burning. Market development for wood waste is called for in the plan because MPCA is aware that additional markets beyond St. Paul Co-generation will be needed to ensure outlets are available for wood waste in the future. Markets can be composting, biochar, lumber markets, or others that MPCA may not be considering at this time. The MPCA has a role in promoting use of compost with other agencies including MNDOT and the Department of Administration. Some metro counties and cities have already utilized this strategy in a way that has helped to bolster markets for food-derived compost. Expanding that practice in the region makes sense, in part because of where the most substantial food waste is generated. As such, its geographically close to metro construction projects. While the MPCA must also work with partner state agencies to promote more robust markets for compost - the MNDOT specification may not be the right tool for a statewide market development strategy for food derived compost. In many areas of the state food derived compost is not yet available and/or may be manufactured substantial distances away. Current MNDOT specifications do allow for use of food derived compost. However, requiring only food derived compost statewide is not currently feasible. The volume of compost used under MNDOT specifications exceeds the supply of food derived compost and some projects are located far from sources of food derived compost. These challenges are also why specifications must be flexible enough to offer compost from multiple varieties of feedstocks.
Leslie Frick	Sustainable Stillwater	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/d30hi2l_document.pdf	Thank you for your support of our many impactful strategies. On Strategy 21: Adopt an ordinance with a mandatory consumer charge for take-out single-use cups, containers, and utensils. This is an optional strategy that counties may choose to add to their plans. We will look to the counties to plan for an approach that will best serve the needs of their residents. This has been revised to allow more flexibility in how counties fulfill this strategy and also to better align with the waste hierarchy. The plan also requires counties to offer grants or rebates for organizations to transition to reusable food and beverage service ware. Washington County has developed many opportunities for reuse and reduction. The environmental center houses a free product room. The county organizes a group of repair volunteers for fix-it clinics and instructional videos. Their webpage also provides many resources and information on reuse. You can find more here: https://www.co.washington.mn.us/3175/Reduce-and-Reuse
Leslie Leik	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/ck0pip4_document.pdf	Interested parties have raised many concerns about the undue burden weekly recycling would have on their operations. Accordingly, this now appears in the plan as an optional strategy. Many communities in the Twin Cities Metro Area have enacted backyard burning/nuisance burning ordinances. These types of requirements are out of scope for this plan, but you may reach out to your local city to learn of similar ordinances. The draft plan did not include strategies for multi-family housing. Strategies for multi-family recycling, organics recycling, and reduction have been added to the final plan. The plan includes a strategy to incentivize treatment for affected trees. The language in this strategy has been revised to address a wider range of pathogens that affect other tree species as well. We advocate for home repair to the extent that is within scope of this solid waste plan.
Leslie Martin	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/sk0bireb_document.pdf	Compostable single-use products are a better option than conventional single-use products that cannot be recycled, but reuse is the best option. The plan requires counties to provide financial assistance to organizations to transition to reusable food and beverage service ware.
Libby Parker	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/ep0wiq4_document.pdf	The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
Lilita Keire	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/i10biu6_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Linda Bruemmer	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2_06566/assets/merged/c909i9d_document.pdf	Ridwell provides pickup for materials that counties tend to collect at their environmental centers or HHW drop-off sites. Some waste types are not appropriate for curbside collection and require residents to safely deliver them to environmental centers. Shredded paper is difficult for recycling centers to sort. Inquire with Ramsey County or St. Paul about shredding events if you'd like to recycling your shredded paper. Curbside collection of textiles has been discontinued by municipal programs due to the exposure to weather. Textiles must be dry and clean for both reuse and recycling. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse nor recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact. The preferred method to dispose of Teflon-coated cookware is through the trash. When other opportunities to recover these items exist, MPCA will promote them. Minnesota Statute 115A.95 does not allow for haulers to deliver source-separated recyclable materials to landfills unless the MPCA determines that no other disposal method is available. The State, counties, and cities assure collected recycling is being recycled.

Name	Affiliation	Comment	Response
Lisa Cerney	Hennepin County	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/rq0mic3_document.pdf	The plan has been revised to make the weekly recycling collection strategy optional. This strategy can make collection frequency more convenient for residents but may be cost prohibitive and further exacerbate the driver shortage. MPCA still sees weekly collection as a best practice but agrees that it should be a local decision. The commercial recycling strategy will remain as required. Counties have the flexibility to implement more stringent requirements than those presented in the plan. The Plan has been edited to allow for counties to pursue the regulatory approach, in addition to or in lieu of assistance. Source separation is the best way to recover materials and to ensure the highest value of those materials. However, despite our best efforts, human behavior is unpredictable. Preprocessing is the process of pulling recyclables out of mixed waste and it can recover additional recyclables, especially metals. The cost of collection is the primary driver of cost to residents, but historically tip fees have not been the driver for cost. The plan has been modified to extend the timeline to allow facilities time to plan the best preprocessing system. MPCA will look to counties to interpret or adjust this strategy to achieve the best outcome given their resources and residents. Hauler reporting is a shared responsibility for the state and county. Without cooperation from counties and accurate license lists, the MPCA cannot rely on the information collected. Both the state and counties benefit from the collection of this data. Sharing in the responsibility ensures accuracy and efficiency. MPCA views increased compliance as a partnership effort. Counties need to maintain and share hauler license lists with the MPCA. State leadership is needed to assure consistency. The plan has been amended to allow counties to provide alternative strategies. For required strategies, proposals must achieve comparable objectives. For optional strategies, counties should work with their PCA solid waste planner to determine the point value of the alternative strategy. MPCA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. Wood waste is expected to increase and will require collaboration to find upstream solutions. Planning will be required to avoid open burning. The wood waste section has been modified to reflect that treatment may be more cost effective for healthy trees. MPCA promotes the use of compost to MNDOT and enterprise wide. Food-derived compost requirements in some metro counties and cities has bolstered markets. The region's food waste can have a beneficial use in metro construction projects. MPCA must promote robust markets for compost. One avenue is through partnerships with other state agencies. However, the MNDOT specification may not be the right tool for a statewide market development strategy for food-derived compost. In much of Greater Minnesota, food-derived compost is not established. Facilities and compost sites may be remote. Current MNDOT specifications do allow for use of food-derived compost. However, requiring only food-derived compost statewide is not currently feasible. The volume of compost used under MNDOT specifications exceeds the supply of food-derived compost. Additionally, some projects are located far from sources of food-derived compost. These statewide specifications must be achievable through a variety of feedstocks. Implementing the building material management plan strategy for county-owned buildings was the original intent of this strategy. The plan has been edited for clarity.
Lisbeth Petersen	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/a906im3_document.pdf	Recycling refund legislation is very successful at increasing the collection of beverage containers. States with recycling refund often have capture rates greater than 80% for those materials that are covered by the redemption fee. MPCA advises the Minnesota Legislature in the Solid Waste Policy Report to implement a statewide deposit refund program.
Liz Borchardt	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/r106ikh_document.pdf	All metro counties have online resources on how and where to dispose of items banned from curbside collection bins. County HHW drop-off sites and many retail outlets collect clean, dry plastic bags for recycling. Reusable produce bags are a great option if you are looking to reduce your reliance on plastic. Curbside collection of textiles has been discontinued by municipal programs due to the exposure to weather. Textiles must be dry and clean for both reuse and recycling. The Secondary Materials and Recycled Textiles (SMART) Association estimates that about half of new clothing end up donated. Of the clothing that is donated, about 20% are sold in reuse outlets, 25% are shipped overseas, 50% are used as absorbents/rags/stuffing, and about 5% head to landfills or WTE facilities. That means that over half of all textiles end up in the garbage. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse nor recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
Lois Norrgard	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/r106ikw_document.pdf	The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the Minnesota Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. MPCA is still learning how best to engage with impacted communities with our planning processes and there is a long way to go to get the levels of engagement that we'd like. However, MPCA received six times the comments received for the prior plan. Most of these comments were from community members rather than our usual industry/county contacts. MPCA will continue to improve community outreach, but we are pleased with the progress made between this plan and the prior plan. The Minnesota State Legislature has enacted laws to maintain the integrity of the recycling system. MN Statute 115A.95 was written to ensure that once material is collected for recycling, it must be taken to a recycling processing facility or end market. This law prohibits material that is collected as recycling from being taken to a landfill. This ensures that once material is collected for recycling, it is getting recycled. In addition, Minnesota imposes a solid waste tax on every ton of solid waste disposed. Counties also impose a separate solid waste tax if material is disposed of in their county. Minnesota does not tax material that is taken to a recycling facility. In the 1990s private companies and the public sector made investments in the recycling system to make recycling more desirable. When overseas markets closed their borders to recyclable materials in 2017, Minnesota companies made even more investments to make sure material was clean and ready for end markets. Cleaner material and less contamination in bales of recyclable material mean companies will buy Minnesota's recyclable material over others and at a better price. Minnesota has good, stable end markets for recyclable materials because of the investments made over the last 30+ years. Recycling is important to Minnesota's local economy. Overall, recycling helps support nearly 78,000 jobs in Minnesota. Over 330 manufacturers in Minnesota use recycled material in their products. The single-use container fee is an optional strategy that counties may choose to add to their plans. We will look to the counties to select an approach that will best serve the needs of their residents. Counties will be required to offer grants or rebates for organizations to transition to reusable food and beverage service ware. Restrictions like a bag ban should be determined through county and/or city ordinances. The most effective way to reduce waste is to not create it in the first place. Compostable single-use products are a better option than conventional single-use products that cannot be recycled, but reuse is the best option.
loraine allison	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/320o01_document.pdf	Recycling refund legislation is very successful at increasing the collection of beverage containers. States with recycling refund often have capture rates greater than 80% for those materials that are covered by the redemption fee. MPCA advises the Minnesota Legislature in the Solid Waste Policy Report to implement a statewide deposit refund program.
Lori Belz	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/yo0i086_document.pdf	The plan was authored by MPCA staff. The length of the plan is due to the breadth of topics covered and complicated solid waste system of the Twin Cities Metro Area. The single-use container fee is an optional strategy that counties may choose to add to their plans. The strategy was edited to be more customizable for counties to include problematic materials. We will look to the counties to select an approach that will best serve the needs of their residents. Counties will be required to offer grants or rebates for organizations to transition to reusable food and beverage service ware. Restrictions like a bag ban should be determined through county and/or city ordinances. The most effective way to reduce waste is to not create it in the first place. Compostable single-use products are a better option than conventional single-use products that cannot be recycled, but reuse is the best option. The draft plan did not include strategies for multi-family housing. Strategies for multi-family recycling, organics recycling, and reduction have been added to the final plan. The plan includes a strategy to establish a curbside set-out day to allow residents to set out used items for reuse. This should lead counties to eliminate prohibitive ordinances and policies.

Name	Affiliation	Comment	Response
Lori Olinger	Coalition for Plastic Reduction	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/oid_206566/assets/merged/dt01117_document.pdf	Over-consumption is at the root of the planet's environmental crisis, with impacts beyond the waste produced at the end of useful life. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the MN Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The metro forecast was developed as described in the methodology included within Appendix F. Organics and recycling tonnages were calculated based on needed benchmarks to achieve the 75% recycling goal by 2030. Capacity has historically expanded as programs have come online and as needed. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The Minnesota Legislature passed a sweeping bill to address and prohibit PFAS in consumer products. The Minnesota Attorney General reached an \$850 million settlement with 3M. For more information about this, visit https://3msettlement.state.mn.us/ . To learn more about PFAS in Minnesota, visit https://www.pca.state.mn.us/pfas-in-minnesota . Removing PFAS from consumer products will lead to a reduction of PFAS in our solid waste stream. The most effective way to reduce waste is to not create it in the first place. Making a new product emits greenhouse gases that contribute to climate change and requires a lot of materials and energy - raw materials must be extracted from the earth, and the product must be fabricated then transported to wherever it will be sold. As a result, reduction and reuse are the most effective ways you can save natural resources, protect the environment, and save money. Counties measure and report to the PCA on reduction and reuse efforts. The plan includes many strategies to address food waste. MPCA advocates for diversion of food waste to the extent of the plan's authority. Food waste rescue activities beyond what is included in the plan would require legislative action and/or county/city ordinance passage. Extended producer responsibility (EPR) laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting. Minnesota has a rechargeable battery law. Updates to the law are needed to address the full scope of the lithium battery issue. The MPCA is working with partners on legislative proposals to improve the collection and recycling of batteries. A strategy has been added to the plan to implement education programs on proper battery management. Creating safe storage spaces that minimize fire risks at waste facilities is challenging. Much like EPR, legislative action will be necessary to implement changes. Recycling refund legislation is very successful at increasing the collection of beverage containers. States with recycling refund often have capture rates greater than 80% for those materials that are covered by the redemption fee. MPCA advises the MN Legislature in the Solid Waste Policy Report to implement a statewide deposit refund program. Thank you for these thoughtful suggestions for the county sustainable purchasing policy strategy. Adding more prescriptive language will ensure there is a metro-wide consistent movement toward waste reduction through purchasing activities. The plan is only for the metro area. MPCA's Solid Waste Policy Report has recommendations for EPR and other legislation that would have state-wide impacts regarding the use of plastics.
LuAnn Johnson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/oid_206566/assets/merged/sn0y9x_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the Minnesota Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. Extended producer responsibility (EPR) laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting.

Name	Affiliation	Comment	Response
Lucy Mullany	Minnesota Zero Waste Coalition	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/7908ief_document.pdf	All 7-county metro HHW drop-off sites are open to residents of any county. Every site will collect the items you listed and many other types of household hazardous waste. The plan includes a strategy to provide additional drop sites or collection events for these items. Continuous end-market development is paramount to a functional recycling system. MPACA agrees that strong markets for glass and other challenging materials is something that needs constant attention from the State and our partners. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPACA agrees that it must be more convenient for people to participate in greater numbers. The plan includes a strategy that would encourage the development of additional reuse infrastructure. The plan calls for waste composition to be conducted every 5 years, which is consistent with requirements that waste-to-energy facilities must follow. Consistency in requirements is important, so the 5-year time frame will remain. The counties rely on business data to track recycling information, and it is a county-level decision to require or ask for cooperation when they work to collect that information. Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting. This plan does not have authority to make statewide changes. Any bans or policy recommendations from MPACA can be found in our statewide Solid Waste Policy Report to the Minnesota Legislature. Efforts to improve the e-waste EPR law that exists in Minnesota are underway. Minnesota has a rechargeable battery law. Updates to the law are needed to address the full scope of the lithium battery issue. The MPACA is working with partners on legislative proposals to improve the collection and recycling of batteries. A strategy has been added to the plan to implement education programs on proper battery management. Creating safe storage spaces that minimize fire risks at waste facilities is challenging. MPACA has been working with the Departments of Agriculture and Health to create content for inspectors to educate licensed facilities about financial assistance, donation, and opportunities to reduce wasted food. The plan has been revised to include the MPACA's commitment to continue work with partner agencies on improved food rescue and prevention efforts. A strategy encouraging county engagement with health inspectors in individual county plans will remain in the plan to help accelerate adoption of the practice but will not be required. MPACA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPACA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Rulemaking for AD facilities has not yet occurred at the MPACA. Existing rules for similar facilities accepting similar materials exist, but we acknowledge that rules specific to AD facilities would be useful. With that said, MPACA has included guidance on AD in the Metro Plan for the time being and believe that we are able to permit AD facilities in a manner that is protective of the environment. The agency is responsible for ensuring compliance with state law. The Minnesota Zero Waste Coalition may contact elected officials to advocate for a change to Minnesota's state law. Minnesota already requires the most protective requirements on landfills. MPACA staff regularly evaluates landfill design to see if additional protections are needed and implement them as needed. Also, most landfills have air permits also to regulate air emissions, but more data is needed to assess the amount of fugitive emissions escaping off the working face. Source separation is the best way to recover materials and to ensure the highest value of those materials. However, despite our best efforts, human behavior is unpredictable. Preprocessing can recover additional recyclables, especially metals. The cost of collection is the primary driver of cost to residents, but historically tip fees have not been the driver for cost. The plan has been modified to extend the timeline so that facilities and counties have more time to prepare. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPACA intends to aggressively push for improvement in all areas that are feasible.
M T	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/k90hrib_document.pdf	A fee can be an effective strategy to reduce single-use bags from the solid waste system. Those are instituted at a city-level through the passage of an ordinance. Collecting recyclables is one way for an organization to raise funds. Container deposits in other states have been very effective in collecting those materials. Financial incentives to inspire behavior change can be successful. In order for Minnesota to utilize this type of program, the Legislature would need to pass new laws. Contract for residential recycling and organics by 2030 is an optional strategy in the plan. Organized collection has numerous benefits and can lower costs for all types of service (i.e., MSW, recycling, organics) to residents of a community. Convenience is a critical component of success. The plan includes a strategy that would expand curbside collection of organics recycling to all cities with a population of 5,000 or greater. Dumpster diving is not illegal in Minnesota, but it's important to adhere to local laws and ordinances pertaining to trespassing. Minnesota charges a solid waste management tax for trash. It is 9.75% of the sales price for residential waste and 17% for self-haul and commercial. Recycling and composting are tax-exempt to support those services and encourage participation in those programs. Minnesota Statute 115A.93 requires haulers and recyclers to report to MPACA. The plan calls for added emphasis on compliance in this area. Minnesota Statute 115A.9301 requires that larger volume containers must cost more than small containers, but the difference in cost is not outlined. Overtime, pay-as-you-throw systems have been shown to reduce the total amount of waste. While a compostable bag being disposed of in a curbside organics collection is better than a plastic bag being landfilled, moving toward a reusable option is the best way to reduce waste. A requirement for compostable plastic produce bags would require legislative action. Most cities have litter ordinances. Solid waste facilities have requirements in their permits to ensure that litter is picked up. Additionally, industrial storm water permittees are required to clean and maintain all impervious areas where debris may accumulate. Counties may propose a strategy to address litter in their solid waste plans. The plan does not carry the authority to phase out or tax advertisements and promotions. The plan includes a strategy to require reusable containers at county events. Counties are free to expand this requirement within the scope of authority of their county solid waste plans. The plan includes many strategies to increase reuse activities. We encourage counties to identify any of their own ordinances that work as a barrier for reuse. This plan does not have authority to create a tax rebate, but removing barriers to properly dispose of e-waste is important.
Maggie Yauk and Jonelle Hubbard	Anoka County	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/6w0xic8_document.pdf	County highway departments can incorporate SSOM compost in construction projects, which can be assured by creating a county policy. Cities can require the application of compost to help the site vegetation recover from the impact of the construction. MPACA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. Wood waste is expected to increase and will require collaboration to find upstream solutions. Planning will be required to avoid open burning. Implementing the Building Material Management Plan strategy for county owned buildings was the intent of this strategy. The plan has been edited for clarity. Contract for residential recycling and organics by 2030 is an optional strategy in the plan. Organized collection has numerous benefits and can lower costs for all types of service (i.e., MSW, recycling, organics) to residents of a community.
Marco Fields	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/960oi0c_document.pdf	MPACA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPACA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Marcus Buckley	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/p60biib6_document.pdf	MPACA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. Wood waste is expected to increase and will require collaboration to find upstream solutions. Planning will be required to avoid open burning.

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Margaret Anderson Keliher	City of Minneapolis Department of Public Works	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2/06566/assets/merged/ad011py_document.pdf	MPCA agrees that additional funding would benefit all levels of governance. Additional resources help create a better system, resulting in higher diversion rates. Compostable single-use products are a better option than conventional single-use products that cannot be recycled, but reuse is the best option. MPCA will look to counties to interpret or adjust this strategy to achieve the best outcome given their resources and residents. The strategy has been edited to incorporate the successful and vetted aspects of the Minneapolis ordinance. Congratulations on receiving the SWIFR grant to re-open the North Transfer Station. The residents will benefit from expanded reuse and recycling drop-off opportunities. Drop-off events hosted by the counties are popular with residents, but these events have been shown to be very expensive and time intensive for county staff to plan and execute. Advertising a special collection day at the existing permanent sites could have a similar impact to raise community awareness, perhaps outside of regular hours. Interested parties have raised many concerns about the undue burden weekly recycling would have on their operations. Accordingly, this now appears in the plan as an optional strategy. Minnesota has a rechargeable battery law. Updates to the law are needed to address the full scope of the lithium battery issue. The MPCA is working with partners on legislative proposals to improve the collection and recycling of batteries. A strategy has been added to the plan to implement education programs on proper battery management. Creating safe storage spaces that minimize fire risks at waste facilities is challenging. Source separation is the best way to recover materials and to ensure the highest value of those materials. However, despite our best efforts, human behavior is unpredictable. Preprocessing can recover additional recyclables, especially metals. The cost of collection is the primary driver of cost to residents, but historically tip fees have not been the driver for cost. The plan has been modified to extend the timeline to allow counties and facilities time to prepare. Thank you for the feedback. The plan has been edited to allow for more flexibility in how counties promote backyard composting activities. The plan has been amended to allow counties to provide alternative strategies. For required strategies, proposals must achieve comparable objectives. For optional strategies, counties should work with their PCA solid waste planner to determine the point value of the alternative strategy. The State of Minnesota has a "Green Meeting Policy" to reduce the waste associated with meetings. Additionally, our Office of Enterprise Sustainability addresses and promotes sustainability at affiliated events. This strategy has been revised to clarify intended outcomes and to limit the scope to the county. The vast number of strategies creates a wide range of possible systems/programs. It wouldn't be possible to estimate cost for all outcomes. It is expected that metro counties consider costs of implementation as they select strategies for their County Solid Waste Plans. This is an optional strategy that counties may choose to include in their solid waste plans. It is a good way to make reuse more convenient for residents. However, if any county wants to propose other reuse strategies, the provides them the freedom to do that. The plan includes a new strategy to require counties to promote their reuse outlets that are located in the county.
Margaret Oconnor	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2/06566/assets/merged/630pkl_document.pdf	Most cities have litter ordinances. Solid waste facilities have requirements in their permits to ensure that litter is picked up. Additionally, industrial storm water permittees are required to clean and maintain all impervious areas where debris may accumulate. Counties may propose a strategy to address litter in their solid waste plans. Recycling refund legislation is very successful at increasing the collection of beverage containers. States with recycling refund often have capture rates greater than 80% for those materials that are covered by the redemption fee. MPCA does not have the authority to require this type of legislation through this plan, because it would require action by the MN Legislature to enact that requirement on beverage manufacturers. Extended producer responsibility (EPR) laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For us to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. Packaging: The Partnership on Waste and Energy—which includes Hennepin, Ramsey, and Washington counties—are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. EPR can require proper labeling for reuse, recycling, or composting.
Marianne Brenckman	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2/06566/assets/merged/pv011ga_document.pdf	The plan prioritizes education with strategies to educate residents. The plan also prioritizes reuse strategies. Reducing the amount of material being managed in the solid waste system provides the greatest environmental benefit. The draft plan did not include strategies for multi-family housing. Strategies for multi-family recycling, organics recycling, and reduction have been added to the final plan. Composting and recycling bins in public places tend to become contaminated. Several counties have designated drop sites for residents to self-haul their source-separated organics to locked bins. This remains the best practice for communities without curbside collection. The MPCA's Solid Waste Policy Report to the Legislature contains recommendations to introduce extended producer responsibility (EPR) laws. EPR laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: • Influence manufacturer design to improve recyclability, repair and reuse • Reduce material use and toxicity • Improve recovery for reuse, repair and recycling • Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements • Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. In order for Minnesota to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. Packaging: The Partnership on Waste and Energy (Hennepin, Ramsey, Washington), are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. Compostable packaging: EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. Packaging labeling: EPR can require proper labeling for reuse, recycling, or composting.
Marissa Galan	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2/06566/assets/merged/ee08ik5_document.pdf	Contract for residential recycling and organics by 2030 is an optional strategy in the plan. Organized collection has numerous benefits and can lower costs for all types of service (i.e., MSW, recycling, organics) to residents of a community.
Mark D'Alencar	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2/06566/assets/merged/3h05ie8_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Mark Snyder	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2/06566/assets/merged/k20f11r_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the MN Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. Additional capacity requirements to expand recycling and composting operations will be addressed in the Resource Management Report to the Minnesota Legislature. Waste composition studies are a requirement for WTE facilities via all current air permits. Thank you for your feedback.
Martha Henderson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_2/06566/assets/merged/j60rinr_document.pdf	Increasing the types of materials collected in curbside programs and reducing/subsidizing costs would contribute to a higher recycling rate. One caveat is that curbside collection of textiles has been discontinued by municipal programs due to the exposure to weather and low quality materials. Textiles must be dry and clean for reuse and made from natural fibers for recycling. The Secondary Materials and Recycled Textiles (SMART) Association estimates that about half of new clothing are donated. Of the clothing that is donated, about 20% are sold in reuse outlets, 25% are shipped overseas, 50% are used as absorbents/rags/stuffing, and about 5% head to landfills or WTE facilities. That means that over half of all textiles end up in the garbage. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse nor recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact. Private companies like Terracycle and Ridwell help fill the gaps by collecting materials that are difficult and costly for counties to process and manage.

Name	Affiliation	Comment	Response
Mary Allen	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/jp04iiz_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Mary Forte	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ic04io9_document.pdf	A fee can be an effective strategy to reduce single-use bags from the solid waste system. Those are instituted at a city-level through the passage of an ordinance. Access to quality compostable bags is important to the success of a curbside collection program. The plan has been revised to address this concern. Black plastics are not recyclable due to limitations of the sorting equipment at recycling facilities. The optical sorter cannot read the resin type. Reducing black plastic in packaging and plant containers would be more beneficial than recycling it. The plan includes a strategy that would expand curbside collection of organics recycling to all cities with a population of 5,000 or greater. Convenience is a critical component of success. Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: • Influence manufacturer design to improve recyclability, repair and reuse • Reduce material use and toxicity • Improve recovery for reuse, repair and recycling • Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements • Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. For Minnesota to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. Metro counties offer helpful guides for recycling, organics recycling, and household hazardous waste. Recycling advertising can be very effective, but is also expensive and requires consistency. Educating children about the solid waste system early on can build good habits. Counties, cities and industry have focused on school programs as a cost-effective way of reaching school-aged children. The plan has an optional strategy for counties to adopt an ordinance with a mandatory consumer charge for take-out single-use cups, containers, and utensils. These items can be collected and self-hauled to scrap metal recyclers or county environmental centers. In small quantities, these items can be discarded in the garbage.
Mary Holm	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/880f95_document.pdf	All of the 7-county metro HHW drop-off sites—sometimes referred to as environmental center—are open to residents of any county. Many materials are collected for free, but some require a collection fee. Every collection program has varying implementation costs. In some communities, curbside organics will be absorbed into existing trash fees and compostable bags will be provided by their county. In other communities, a separate hauler collects the organics recycling. This is more expensive and residents experience higher fees for that type of service.
Mary Miller	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/wp0jiit_document.pdf	Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: • Influence manufacturer design to improve recyclability, repair and reuse • Reduce material use and toxicity • Improve recovery for reuse, repair and recycling • Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements • Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. In order for Minnesota to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers. The plan includes a strategy for the management of organics recycling from large commercial food generators by 2030. It was optional in the draft and has been changed to required, based on public comments.
Mary Sheehan	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ud0zi22_document.pdf	Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: • Influence manufacturer design to improve recyclability, repair and reuse • Reduce material use and toxicity • Improve recovery for reuse, repair and recycling • Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements • Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. In order for Minnesota to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question.
Mary Ann Hood McCann	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/k00mis5_document.pdf	Residents of Minnesota are not required to recycle. However, state law requires that residents have an opportunity to recycle. Our elected officials have deemed requirements to participate in recycling a step too far. Education is incorporated into several strategies in the plan. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers.
Matt Clark	Hennepin GRE	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/lk0eibp_document.pdf	MPCA supports the waste hierarchy and values the role of waste-to-energy in the system. Due to the unfolding events in Hennepin County, MPCA re-examined our approach to the waste-to-energy section of the plan. Included in those changes is a comparison of the impacts of waste-to-energy and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that there is a good plan in place when large infrastructure decisions occur to ensure that waste is managed with the least environmental impact. MPCA supports minimizing disposal options (WTE and landfill) as much as possible and the plan focuses on waste reduction, recycling, and composting in an effort to meet the 75% goal.
Meghan Kosowski	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/cd0pikg_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the MN Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. The Metro Plan has 14 strategies dedicated to reduction of waste and reuse efforts. There are also many strategies focused on recycling and organics collection - all of which will reduce the need for both WTE and landfilling if implemented.
Merle Davis Matthews	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/180vi7a_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the MN Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. Thank you for your feedback.

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Michael O'BRIEN	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/iqon7n_document.pdf	The MPCA can support reuse efforts through grants and no- or low-interest loans. Counties are required by this plan to offer grants for waste reduction, reuse, and repair. There are many scrap metal recycling collection points available in the metro area, including at each county-run environmental center and household hazardous waste drop-off site. County outreach and education strategies have been revised to increase awareness of this. This plan does not have authority to make changes like eliminating plastic bags. However, there is an optional strategy for counties to adopt an ordinance with a consumer charge or ban on disposable single-use items, which is open for a county to interpret as including plastic shopping bags. Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair, and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair, and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements. Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. Consumers must be responsible for ensuring that products at end-of-life are routed to the proper collection system. The Solid Waste Policy Report includes recommendations to the Minnesota Legislature to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. SCORE and LRDG funds are provided to counties for recycling programs and to support waste reduction and management of household hazardous wastes and problem materials. This funding is often passed through to cities and associated programs. The costs of curbside collection are determined by haulers. However, fees and taxes are placed on trash to support recycling, organics, and reuse programs. Organized collection systems have greater power to set volume-based costs for residents. The plan advocates for communities that have not yet done so to transition to organized collection.
Michele Fluhr Fraser	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/SyOlam_document.pdf	Minnesota has some of the best recycling rates in the nation. There are many systems and requirements in place that assure the materials in resident bins are routed to their intended place. MN statute 115A.95 does not allow for haulers to deliver source-separated recyclable materials to a disposal facility unless the MPCA determines that no other recycling options are available. The plan includes education requirements that should help create more informed residents. The plan prioritizes reuse and reusable water bottles are a great substitute for throw-away bottles.
Molly Libra	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/im0qdy_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the MN Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. Thank you for your feedback.
Nadine Teisberg	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ma0kim_k_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Nan Roberts	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/jc0gi7n_document.pdf	Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: Influence manufacturer design to improve recyclability, repair and reuse; Reduce material use and toxicity; Improve recovery for reuse, repair and recycling; Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements; Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. In order for Minnesota to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. Packaging: The Partnership on Waste and Energy (Hennepin, Ramsey, Washington), are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. Compostable packaging: EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. Packaging labeling: EPR can require proper labeling for reuse, recycling, or composting. MPCA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. Wood waste is expected to increase and will require collaboration to find upstream solutions. Planning will be required to avoid open burning. Organized collection systems provide many overall benefits to residents if implemented properly. MPCA views the establishment of an organized collection system as a local decision and therefore, this strategy will remain optional. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers. The plan includes a strategy to diversify and expand mobile collection sites for household hazardous waste. The plan includes many waste reduction strategies that incorporate financial incentives. This is a significant contributor to our waste system and has long been considered inert, which we now know to be false. Setting up systems to reuse a greater amount of building materials would reduce the amount of useful materials that are otherwise wasted. Websites that facilitate the free exchange of goods remove many barriers to waste reduction. Household hazardous waste collection centers are located throughout the metro area. Residents of any county may visit any of these locations to dispose of items not collected in curbside programs.
Nancy Williams	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/kp0mi1_g_document.pdf	This plan seeks to manage waste and materials at their highest and best use. Strategies to encourage restaurants to adopt a system of reuse is the main goal.
Nathan Wunrow	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/jw0mir_d_document.pdf	Most of the waste-to-energy facilities are exempt from the Carbon-Free by 2040 bill. HERC is the one facility that is not exempt from the bill.
Nell Pierce	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/fw0jiiv_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the MN Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. MPCA is still learning how best to engage with impacted communities with our planning processes and there is a long way to go to get the levels of engagement that we'd like. However, MPCA received six times the comments received for the prior plan. Most of these comments were from community members rather than our usual industry/county contacts. MPCA will continue to improve community outreach, but we are pleased with the progress made between this plan and the prior plan. Thank you for your feedback.

Name	Affiliation	Comment	Response
Nick Klisch	Cottonwood County	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/w806in8_document.pdf	MPCA supports the waste hierarchy and values the role of waste-to-energy in the system. Due to the unfolding events in Hennepin County, MPCA re-examined our approach to the waste-to-energy section of the plan. Included in those changes is a comparison of the impacts of waste-to-energy and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that there is a good plan in place when large infrastructure decisions occur to ensure that waste is managed with the least environmental impact. MPCA supports minimizing disposal options (WTE and landfill) as much as possible and the plan focuses on waste reduction, recycling, and composting in an effort to meet the 75% goal.
Pam Bain	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/fd05iqe_document.pdf	Minnesota Statute 115A.93 Subd. 3 prohibits haulers from imposing a greater charge on residents who recycle than on residents who do not recycle. The plan includes a strategy to diversify and expand mobile collection sites for household hazardous waste and bulky items. Organics recycling curbside collection requirements are included in this plan as well.
Pam Peterson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/gc0qif9_document.pdf	Organized collection (the city contracts with one hauler) has numerous benefits and can lower costs for all types of service (i.e., MSW, recycling, organics) to residents of a community. Contract for residential recycling and organics by 2030 is an optional strategy in the plan.
Pat Medford	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/jd02lqx_document.pdf	Available science does not suggest that separating dry and wet waste would provide beneficial results. However, the MPCA agrees that all recoverable material should be diverted from disposal for recycling and composting. Keeping organics and slimy waste out of the trash, could help with pulling additional recycling from the waste stream on the back end.
Paul Gardner	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/c50b9y_document.pdf	Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: • Influence manufacturer design to improve recyclability, repair and reuse • Reduce material use and toxicity • Improve recovery for reuse, repair and recycling • Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements • Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. In order for Minnesota to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question.
Peter Butler	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/dk0qim8_document.pdf	The costs of curbside collection are determined by haulers. However, fees and taxes are placed on trash to support recycling, organics, and reuse programs. Organized collection systems have greater power to set volume-based costs for residents. The plan advocates for communities that have not yet done so to transition to organized collection. Minnesota Statute 115A.9301 requires that larger volume containers must cost more than small containers, but the difference in cost is not outlined. Overtime, pay-as-you-throw systems have been shown to reduce the total amount of waste.
Rachel Jongeward	City of Saint Paul Parks & Recreation Department/Forestry	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/zb05i17_document.pdf	Wood waste is expected to increase and will require collaboration to find upstream solutions. MPCA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. Existing wood yards are often inundated with materials and the absence of a tip fee may not be feasible as more wood material is introduced. We will be looking to the county solid waste plans to propose solutions for supporting the continued operation of wood yards within their counties. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. As this plan is a roadmap for county solid waste plans, the wood burning ordinance strategy is for counties to review and update open burning ordinances they have. Counties may require cities to do the same. MPCA staff will work with counties on their solid waste plans and will evaluate if the inclusion of certain optional strategies are realistic and feasible. As the language of the wood waste section was revised to be inclusive of tree diseases and insect infestations, tree maintenance and treatment has a more solid role in supporting tree cover and reducing wood waste. The strategy to allow for assessments on property taxes is an optional strategy. We trust that counties will only include this if there is community buy-in for this approach.
Rachel Lindholm	City of Richfield	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/kq0wi10_document.pdf	The draft plan did not include strategies for multi-family housing. Strategies for multi-family recycling, organics recycling, and reduction have been added to the final plan. The plan includes a strategy for the management of organics recycling from large commercial food generators by 2030. It was optional in the draft and has been changed to required, based on public comments. Continuous end market development is paramount to a functional recycling system. The MPCA has been working to develop local end markets since the 1990's and continues to look for ways to strengthen local markets for recyclables. Minnesota has good, stable end markets for recyclable materials because of the investments made over the last 30+ years. Recycling is important to Minnesota's local economy. Overall, recycling helps support nearly 78,000 jobs in Minnesota. Over 330 manufacturers in Minnesota use recycled material in their products. In the 1990's private companies and the public sector made investments in the recycling system to make recycling more desirable. When overseas markets closed their borders to recyclable materials in 2017, Minnesota companies made even more investments to make sure material was clean and ready for end markets. Cleaner material and less contamination in bales of recyclable material mean companies will buy Minnesota's recyclable material over others and at a better price. Interested parties have raised many concerns about the undue burden weekly recycling would have on their operations. Accordingly, this now appears in the plan as an optional strategy. The most effective way to reduce waste is to not create it in the first place. Making a new product emits greenhouse gases that contribute to climate change and requires a lot of materials and energy - raw materials must be extracted from the earth, and the product must be fabricated then transported to wherever it will be sold. As a result, reduction and reuse are the most effective ways you can save natural resources, protect the environment, and save money. Source separation is the best way to recover materials and to ensure the highest value of those materials. However, despite our best efforts, human behavior is unpredictable. Preprocessing can recover additional recyclables, especially metals. The cost of collection is the primary driver of cost to residents, but historically tip fees have not been the driver for cost. The plan has been modified to extend the timeline to allow facilities and counties time to plan. We have considered bans on various materials over time, but often bans are not effective for materials that are easily hidden in garbage bags. They work quite well for large items like televisions because those can be diverted at the tip floor of facilities. The plan has been amended to allow counties to provide alternative strategies. For required strategies, proposals must achieve comparable objectives. For optional strategies, counties should work with their PCA solid waste planner to determine the point value of the alternative strategy. Partner organizations are identified when they can contribute to the effectiveness of a strategy. The organics section of the plan has been edited to include MNCC. MPCA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. Wood waste is expected to increase and will require collaboration to find upstream solutions. Planning will be required to avoid open burning. In 2019, the Minnesota Environmental Quality Board prepared an Emerald Ash Borer report with coordination from several state agencies. It can be found at this link. Emerald Ash Borer (EAB) Minnesota Environmental Quality Board (state.mn.us)
Rachel Wormer	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/f40yic9_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.

Name	Affiliation	Comment	Response
Randy Cameron	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/8f0961_document.pdf	The Hennepin County HHW drop-off facilities in Bloomington and Brooklyn Park accept cast iron sinks. The reciprocal use agreement among the metro counties allows residents of any county to use any of the 7-metro county sites. The MPCA website has a list of 450 medication collection sites with a site locator: https://www.pca.state.mn.us/news-and-stories/dont-flush-medicines-down-the-drain Prescription drugs can also be discarded in the trash. The label should be removed and the contents should be made unappealing by adding something inedible such as cat litter to the bottle. Your county, city, and hauler can provide resources for understanding how to use your curbside collection properly.
Rebecca Boyer	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/jr03i2n_document.pdf	While drop-off sites have served some, MPCA agrees that it must be more convenient for people to participate in greater numbers. The plan requires residential curbside organics collection region-wide in cities greater than 5,000. If your home is in a city with a population of at least 5,000, this service will be available to you within the timeframe of this plan.
Rebecca Gaida	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/5qduia1_document.pdf	MPCA agrees that it must be more convenient for people to participate in composting in greater numbers. The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. Many counties offer organics drop-off sites, which have been successful at capturing food waste for households without curbside collection. Planning and establishing additional drop-off sites for the collection of organics recycling has been added as an optional strategy to the plan. Fix-it clinics are effective at reducing waste by extending the life of existing items. Strategies to promote repair include establishing a Repair Ambassador program, bi-annual sustainable consumption challenges for residents, requiring a formal county sustainable purchasing policy that prioritizes reparability of goods, and grants that support repair operations. Thank you for your support of strategies that promote reuse and repair. County environmental centers and household hazardous waste (HHW) drop-off sites expand the scope of materials accepted based on a variety of factors. Some items require a fee for disposal due to the cost of safely disassembling and disposing of certain materials. Another approach is to establish disposal fees at the time of purchase, requiring legislative regulation. Thank you for your support of some of our most impactful strategies. We appreciate the feedback. The single-use container fee is an optional strategy that counties may choose to add to their plans. We will look to the counties to select an approach that will best serve the needs of their residents. Counties will be required to offer grants or rebates for organizations to transition to reusable food and beverage service ware.
Regina Kurandina	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/m30411_document.pdf	The plan calls for residential curbside organics collection to be required region-wide in cities greater than 5,000. MPCA agrees that it must be more convenient for people to participate in greater numbers. Recycled Textiles (SMART) Association estimates that about half of new clothing end up donated. Of the clothing that is donated, about 20% are sold in reuse outlets, 25% are shipped overseas, 50% are used as absorbents/rags/stuffing, and about 5% head to landfills or WTE facilities. That means that over half of all textiles end up in the garbage. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse nor recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact. Many of our metro counties have recycling ambassador programs. If your county has a program, you may sign up for the 6-week training, which will prepare you to volunteer at community events. MPCA is working in collaboration with DNR and local governments to create a cooperative plan for wood waste management. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. Wood waste is expected to increase and will require collaboration to find upstream solutions. The plan includes strategies to avoid open burning, incentivize treatment, and ease the financial burden on homeowners. Removing barriers to recycling and composting is the goal. The plan includes strategies for this and we'll look to the metro counties to develop solutions that are effective for their residents. Most of the TCMA counties have a Recycling Ambassador program that uses volunteers to help people recycle more effectively. We are sure they would love to have you as a volunteer.
Richard Olson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/x60q4n_document.pdf	Reducing waste is a keystone theme in this plan. Replacing single-use containers with reusable containers is an effective way to reduce waste. We encourage counties to address solutions to reduce reliance on single-use waste through several optional strategies.
Robert LeClaire	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ok02lqg_document.pdf	Children can be powerful change agents, encouraging their families to properly use curbside collection services. The plan addresses several strategies to increase education and outreach. While this strategy won't eliminate contamination, it should help to increase proper disposal among residents. MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. MPCA is able to issue CON as needed and does not need a no-HERC scenario in the Plan to issue future CON. Organics recycling is easily contaminated by even the well-intentioned individuals. Strategies to expand organics collection work best when paired with education, outreach, and guidance. The Minnesota State Legislature has enacted laws to maintain the integrity of the recycling system. MN Statute 115A.95 was written to ensure that once material is collected for recycling, it must be taken to a recycling processing facility or end market. This law prohibits material that is collected as recycling from being taken to a landfill. This ensures that once material is collected for recycling, it is getting recycled. In addition, Minnesota imposes a solid waste tax on every ton of solid waste disposed. Counties also impose a separate solid waste tax if material is disposed of in their county. Minnesota does not tax material that is taken to a recycling facility. If the facility exceeds 15% residual, the residual is subject to the solid waste management tax. Most facilities stay below that rate meaning that more than 85% of what is collected goes to new products. In the 1990s private companies and the public sector made investments in the recycling system to make recycling more desirable. When overseas markets closed their borders to recyclable materials in 2017, Minnesota companies made even more investments to make sure material was clean and ready for end markets. Cleaner material and less contamination in bales of recyclable material mean companies will buy Minnesota's recyclable material over others and at a better price. Minnesota has good, stable end markets for recyclable materials because of the investments made over the last 30+ years. Recycling is important to Minnesota's local economy. Overall, recycling helps support nearly 78,000 jobs in Minnesota. Over 330 manufacturers in Minnesota use recycled material in their products.
Robert Sieber	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/op0sikt_document.pdf	Educational requirements appear throughout the plan, most importantly a requirement for counties to standardize these messages. Our metro counties are tasked with assuring that information reaches all their residents. HHW sites are located in every metro county and accept all the materials you mention. Public space collection of waste that requires sorting has always been a challenge. However, resources exist that could help. We will work with our metro counties on their plans to assure we are regionally improving public education.
Rochelle Michel	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/200licl_document.pdf	As a school administrator, MPCA encourages you to work with your county and city to explore existing programs and funding opportunities.
Ruth Shaw	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/a40widv_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.

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Ryan O'Gara	SKB Waste Connections	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/eo0k90_document.pdf	Contamination is a serious issue plaguing the recycling stream. The plan focuses on education strategies. This issue will require several solutions and preprocessing can play an important role. Source separation is the best way to recover materials and to ensure the highest value of those materials. However, despite our best efforts, human behavior is unpredictable. Preprocessing can recover additional recyclables, especially metals. The cost of collection is the primary driver of cost to residents, but historically tip fees have not been the driver for cost. The plan has been modified to extend the timeline to allow for facilities and counties to plan. In addition, the plans states that pre-processing needs to happen, not that it must be done at each location. Weekly recycling collection was identified as a strategy that would be costly. In response, this strategy was moved from required to optional.
Sabrina Thompson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/dw06iin_document.pdf	A state-wide bag fee would require a legislative change.
Sandra Dascalos	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/r80pi8x_document.pdf	Resident education is addressed in this plan with a strategy that calls for a commitment to standardized outreach and education. We agree that the messaging reaching residents should be easy to understand. Piecemeal efforts by counties, cities, haulers, and other organizations are rarely collaboratively developed and therefore can lead to confusion over what materials can be recycled or composted. Assuring a consistent message from those within the solid waste system would help bring clarity to the users of the system. Strategies to promote repair include establishing a Repair Ambassador program, bi-annual sustainable consumption challenges for residents, requiring a formal county sustainable purchasing policy that prioritizes repairability of goods, and grants that support repair operations. Thank you for your support of strategies that promote reuse and repair.
Sandra Wolfe wood	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/pp0xipt_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the MN Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. Thank you for your feedback.
Sara Hollie	Ramsey County	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/og0bidi_document.pdf	Thank you for your support of this plan and for the clarifications you provided. Counties are required to complete an environmental justice review when developing their own solid waste plans. The requirements are laid out in Appendix B. With the addition of multi-family strategies in the plan, we believe this supports a solid waste system that strives for fair treatment and meaningful involvement of all people. The plan has been amended to allow for counties to propose optional strategies. We encourage all our metro counties to propose strategies that would directly address environmental justice. Thank you for calling attention to the importance of being mindful of the words we choose. We have amended to plan to replace the words identified in your letter. The plan went through a plain language review to increase accessibility. Based on comments received, it's clear that the MPCA needs to play a role in creating regional consistency. As the leading state agency, MPCA is committed to coordinating and facilitating regional meetings to discuss solid waste issues. The counties are responsible for submitting data to MPCA in a timely matter. Ultimately, the counties have a responsibility to ensure that their data sources provide information when needed. MPCA provides facility data to counties as soon as it is available after the March 1st deadline. Wood waste is expected to increase and will require collaboration to find upstream solutions. MPCA is working in collaboration with DNR and local governments to create a cohesive plan for wood waste management. The Environmental Quality Board released the Emerald Ash Borer in Minnesota report in 2019. This report provides many strategies that were incorporated into this plan. Existing wood yards are often inundated with materials and the absence of a tip fee may not be feasible as more wood material is introduced. We will be looking to the county solid waste plans to propose solutions for supporting the continued operation of wood yards within their counties. The plan has been modified to be inclusive of other tree disease issues, such as Oak Wilt. As this plan is a roadmap for county solid waste plans, the wood burning ordinance strategy is for counties to review and update open burning ordinances they have. MPCA promotes the use of compost to MNDOT and enterprise wide. Food-derived compost requirements in some metro counties and cities has bolstered markets. The region's food waste can have a beneficial use in metro construction projects. MPCA must promote robust markets for compost. One avenue is through partnerships with other state agencies. However, the MNDOT specification may not be the right tool for a statewide market development strategy for food-derived compost. In much of Greater Minnesota, food-derived compost is not established. Facilities and compost sites may be remote. Current MNDOT specifications do allow for use of food-derived compost. However, requiring only food-derived compost statewide is not currently feasible. The volume of compost used under MNDOT specifications exceeds the supply of food-derived compost. Additionally, some projects are located far from sources of food-derived compost. These statewide specifications must be achievable through a variety of feedstocks. MPCA has been working with the Departments of Agriculture and Health to create content for inspectors to educate licensed facilities about financial assistance, donation, and opportunities to reduce wasted food. The plan has been revised to include the MPCA's commitment to continue work with partner agencies on improved food rescue and prevention efforts. A strategy encouraging county engagement with health inspectors in individual county plans will remain in the plan to help accelerate adoption of the practice but will not be required. Points were awarded to strategies based on its place on the waste hierarchy and our best estimate of the level of difficulty. We appreciate the feedback on this strategy's point value and have adjusted it accordingly. As mentioned above, counties may propose optional strategies when developing their solid waste plans. Rulemaking for AD facilities has not yet occurred at the MPCA. Existing rules for similar facilities accepting similar materials exist, but we acknowledge that rules specific to AD facilities would be useful. The MPCA is working to incorporate our use to SMM and lifecycle analysis in our approach to emerging technology. While the waste hierarchy is a useful tool, we acknowledge it may be limited in its ability to assess the nuance of complicated and novel technologies.
Shane McCaldran	Hennepin CRA	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/a90gih0_document.pdf	MPCA has added strategies to the plan to address multi-family housing units.
Sharon Hansen	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/el0ilhi_document.pdf	A fee or ban on bags can be an effective strategy to reduce single-use bags from the solid waste system. Those are instituted at a city-level through the passage of an ordinance. Minnesota charges a solid waste management tax for trash. It is 9.75% of the sales price for residential waste and 17% for self-haul and commercial. Recycling and composting are tax-exempt to support those services and encourage participation in those programs. MPCA advises the MN Legislature in the Solid Waste Policy Report to implement a statewide deposit refund program. TCMA residents are able to use any household hazardous waste drop-site in any 7-metro county. The plan also calls to expand access via temporary drop-sites that rotate and cater to different areas throughout each county.
Sheree Bochenek	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/tu0dial5_document.pdf	A fee can be an effective strategy to reduce single-use bags from the solid waste system. Those are instituted at a city-level through the passage of an ordinance. Exposing e-waste to weather could result in transporting contaminants via stormwater and reduced usability of components/materials. These items are accepted at all HHW sites throughout the 7-county metro. All household hazardous waste (HHW) sites throughout the metro collect batteries and plastics (1, 2, and 5). Curbside collection of textiles has been discontinued by municipal programs due to the exposure to weather. Textiles must be dry and clean for both reuse and recycling. The Secondary Materials and Recycled Textiles (SMART) Association estimates that about half of new clothing end up donated. Of the clothing that is donated, about 20% are sold in reuse outlets, 25% are sold in reuse overseas, 50% are used as absorbents/rags/stuffing, and about 5% head to landfills or WTE facilities. That means that over half of all textiles end up in the garbage. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse nor recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact. If a reminder company like Ridwell can help counties to divert more materials from landfills and WTE facilities at a price that isn't burdensome to residents, the MPCA supports that approach. The MPCA cannot require stores to post signs that remind customers to bring along bags. However, customers can request this of management at stores. Trader Joe stores have a reminder sign.

Name	Affiliation	Comment	Response
Sherri Nichols	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/740wir_m_document.pdf	Retail drop off is far from ideal, but is currently the best option for plastic film recycling. We can encourage retailers to monitor their collection bins more closely to optimize collection efforts.
Sheryl Lewis	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/vm0hilt_document.pdf	Collecting bulky items from curbsides is challenging to coordinate and execute. We do encourage counties to follow the lead of several metro cities to establish curbside set-out days for items that can be reused through a strategy.
Soren Stevenson	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/520kidl_document.pdf	Minnesota Statute 609.671 subd. 13. outlines the solid waste disposal violations to be enforced by the MPCA. This is outside the scope of this plan and statute. MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. In response, we have re-examined our approach to the waste-to-energy section of the plan. Included in those changes is a comparison of the impacts of waste-to-energy and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that there is a good plan in place when large infrastructure decisions occur to ensure that waste is managed with the least environmental impact. MPCA supports minimizing disposal options (WTE and landfill) as much as possible and the plan focuses on waste reduction, recycling, and composting in an effort to meet the 75% goal. Cumulative air impact is outside of the scope of this solid waste document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The costs of curbside collection are determined by haulers. Organized collection can provide cities a chance to negotiate more favorable pricing to incentivize collection of materials higher on the waste hierarchy. Minnesota requires volume-based pricing, so smaller containers are less expensive. However, the current price breaks are not very significant. Larger price breaks have the potential to create a significant incentive. The plan requires residential curbside organics collection to be offered region-wide in cities with populations greater than 5,000. Organics recycling and food scrap programs must be more convenient for people to participate in greater numbers.
Stephani Booker	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/pv0zihi6_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
Stephanie Abbas	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/6y02iaz_document.pdf	Compostable single-use products are a better option than conventional single-use products that cannot be recycled, but reuse is the best option. MPCA will look to counties to interpret or adjust this strategy to achieve the best outcome given their resources and residents. The strategy has been edited to incorporate the successful and vetted aspects of the Minneapolis ordinance. Ramsey County will soon roll out curbside pick-up for food scraps: https://www.ramseycounty.us/residents/recycling-waste/collection-sites/food-scraps . Making this an easier option for residents should increase participation and divert more food waste from landfills.
Steven Bern	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/qd0vipd_document.pdf	Burning plastic does produce CO2. Logistically, it would be difficult to divert only plastic to landfills. However, landfills would still allow plastics to degrade, which produces two greenhouse gases, methane and ethylene. The best way to avoid this would be to reduce or ban plastic at it's source entirely, which is outside of the purview of this plan.
Susan J Sperl	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ph0nidw_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.
t k readio	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/ee0aigk_document.pdf	The Minnesota State Legislature has enacted laws to maintain the integrity of the recycling system. MN Statute 115A.95 was written to ensure that once material is collected for recycling, it must be taken to a recycling processing facility or end market. This law prohibits material that is collected as recycling from being taken to a landfill. This ensures that once material is collected for recycling, it is getting recycled. In addition, Minnesota imposes a solid waste tax on every ton of solid waste disposed. Counties also impose a separate solid waste tax if material is disposed of in their county. Minnesota does not tax material that is taken to a recycling facility. In the 1990's private companies and the public sector made investments in the recycling system to make recycling more desirable. When overseas markets closed their borders to recyclable materials in 2017, Minnesota companies made even more investments to make sure material was clean and ready for end markets. Cleaner material and less contamination in bales of recyclable material mean companies will buy Minnesota's recyclable material over others and at a better price. Minnesota has good, stable end markets for recyclable materials because of the investments made over the last 30+ years. Recycling is important to Minnesota's local economy. Overall, recycling helps support nearly 78,000 jobs in Minnesota. Over 330 manufacturers in Minnesota use recycled material in their products.
Tess Dornfeld	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/bs08iqv_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. The 5% waste reduction goal references the total generation of waste. Despite our best efforts, consumption influences waste generation. To truly be successful in waste reduction, upstream policies must be put into place by the MN Legislature that result in fewer materials being generated. The 75% goal is determined by state statute as the disposal avoidance goal and MPCA intends to aggressively push for improvement in all areas that are feasible. The plan includes required strategies for counties to reduce and divert food waste, launch bi-annual sustainable consumption challenges for residents, and to implement a formal county sustainable purchasing policy. There are also strategies to support reuse and repair through volunteer program, outreach, and grants. Thank you for your feedback.
Thea Ulen	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/240nlp6_document.pdf	Curbside collection of textiles has been discontinued by municipal programs due to the exposure to weather. Textiles must be dry and clean for both reuse and recycling. The Secondary Materials and Recycled Textiles (SMART) Association estimates that about half of new clothing end up donated. Of the clothing that is donated, about 20% are sold in reuse outlets, 25% are shipped overseas, 50% are used as absorbents/rags/stuffing, and about 5% head to landfills or WTE facilities. That means that over half of all textiles end up in the garbage. For a material to be recycled, it needs to be used to create a new product. Fast fashion has resulted in an onslaught of low-quality textiles that have no reuse nor recycling value. Durable textiles made from natural fibers and extending the life via proper care and repair can help reduce personal impact. County HHW drop-off sites and many retail outlets collect clean, dry plastic bags for recycling. Reusable produce bags are a great option if you are looking to reduce your reliance on plastic.

Name	Affiliation	Comment	Response
Thomas Picquet	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/gr0k9i_document.pdf	Extended producer responsibility laws have been shown to be a very effective tool to achieve the following, provided the right incentives and requirements are included in the EPR legal framework: • Influence manufacturer design to improve recyclability, repair and reuse • Reduce material use and toxicity • Improve recovery for reuse, repair and recycling • Help create a sustainable and circular economy for the materials and products covered by specific EPR requirements • Manufacturers and others along the product chain share in the financial and physical responsibility for collection, reuse, and recycling of products at the end of their useful lives. This includes the role for consumers that must be responsible for ensuring that end-of-life products get into the collection system that's provided. In order for Minnesota to utilize this type of program, the Minnesota Legislature would have to create new laws with requirements for manufacturers and other parties that have a role in the cycle of commerce for the products and materials in question. Packaging: The Partnership on Waste and Energy (Hennepin, Ramsey, Washington), are working on issues raised by MPP commenters regarding the need to address quantities, types, and management of packaging materials. Compostable packaging: EPR can provide a better pathway for compostable packaging to be collected and directed to a commercial composting facility. Packaging labeling: EPR can require proper labeling for reuse, recycling, or composting.
Tony Kwilas	Minnesota Chamber of Commerce	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/3p07ifd_document.pdf	Minnesota Statute 473.149 Subd 3 (b) states that revisions to the plan are exempt from rulemaking. The plan includes a robust public comment process, which provides interested parties an opportunity to provide feedback. The vast number of strategies creates a wide range of possible systems/programs. It wouldn't be possible to estimate cost for all outcomes. Metro counties should consider costs of implementation as they draft their County Solid Waste Plans. WasteWise is an important player in the metro area to assist businesses with waste reduction expertise.
Tracy Goetz	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/tm0ria_document.pdf	Styrofoam is difficult to transport and has low market value. These qualities make styrofoam an challenging feedstock for recycling. The plan contains an optional strategy to discourage use of single-use items such as plastic bags.
Whitney Khan	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/8029g_document.pdf	Maggots and flies play a very important role in the decomposition process, but the lifecycle from maggot to fly takes 3-4 weeks. Assure that your BPI-compostable bags are tied shut and that your bin is set out every week for pick-up. If maggots continue to be a nuisance, try cleaning your bin with vinegar occasionally. Many waste reduction requirements and suggestions appear in the plan. The incorporation of many different waste reduction approaches will provide the best outcome. The Minnesota State Legislature has enacted laws to maintain the integrity of the recycling system. MN Statute 115A.95 was written to ensure that once material is collected for recycling, it must be taken to a recycling processing facility or end market. This law prohibits material that is collected as recycling from being taken to a landfill. This ensures that once material is collected for recycling, it is getting recycled. In addition, Minnesota imposes a solid waste tax on every ton of solid waste disposed. Counties also impose a separate solid waste tax on material disposed of in their county. Minnesota does not tax material accepted at a recycling facility. In the 1990s, private and public investments in the recycling system made recycling more desirable and viable. When overseas markets closed their borders to recyclable materials in 2017, Minnesota companies made even more investments to make sure material was clean and ready for end markets. Cleaner material and less contamination in bales of recyclable material mean companies will buy Minnesota's recycled feedstock over others and at a better price. Minnesota has good, stable end markets for recyclable materials because of the investments made over the last 30+ years. Recycling is important to Minnesota's local economy. Overall, recycling helps support nearly 78,000 jobs in Minnesota. Over 330 manufacturers in Minnesota use recycled material in their products. Your county, city, and hauler can provide resources for understanding what is and is not recyclable for curbside collection. It can be confusing and the MPCA along with local governments is working on etter education materials.
Darla Evanosky	Resident	https://scs-public.s3-us-gov-west-1.amazonaws.com/env_production/oid333/did200071/pid_206566/assets/merged/o90siju_document.pdf	MPCA received many comments of concern about the continued operation of the Hennepin Energy Recovery Center. We have re-examined our approach to the waste-to-energy (WTE) section of the plan. Changes include a comparison of the impacts of WTE and landfills and acknowledgement of the possible closure that will be determined by the Hennepin County Board. It is critical to ensure that large infrastructure decisions are being made with consideration to environmental and environmental justice impacts. MPCA supports minimizing disposal options of WTE and landfill as much as possible and the plan focuses on waste reduction, recycling, and composting to meet the 75% goal. Cumulative air impacts are outside of the scope of this document. Air quality impacts will be addressed as part of the cumulative air impact rule-making effort that is underway. Thank you for your feedback.

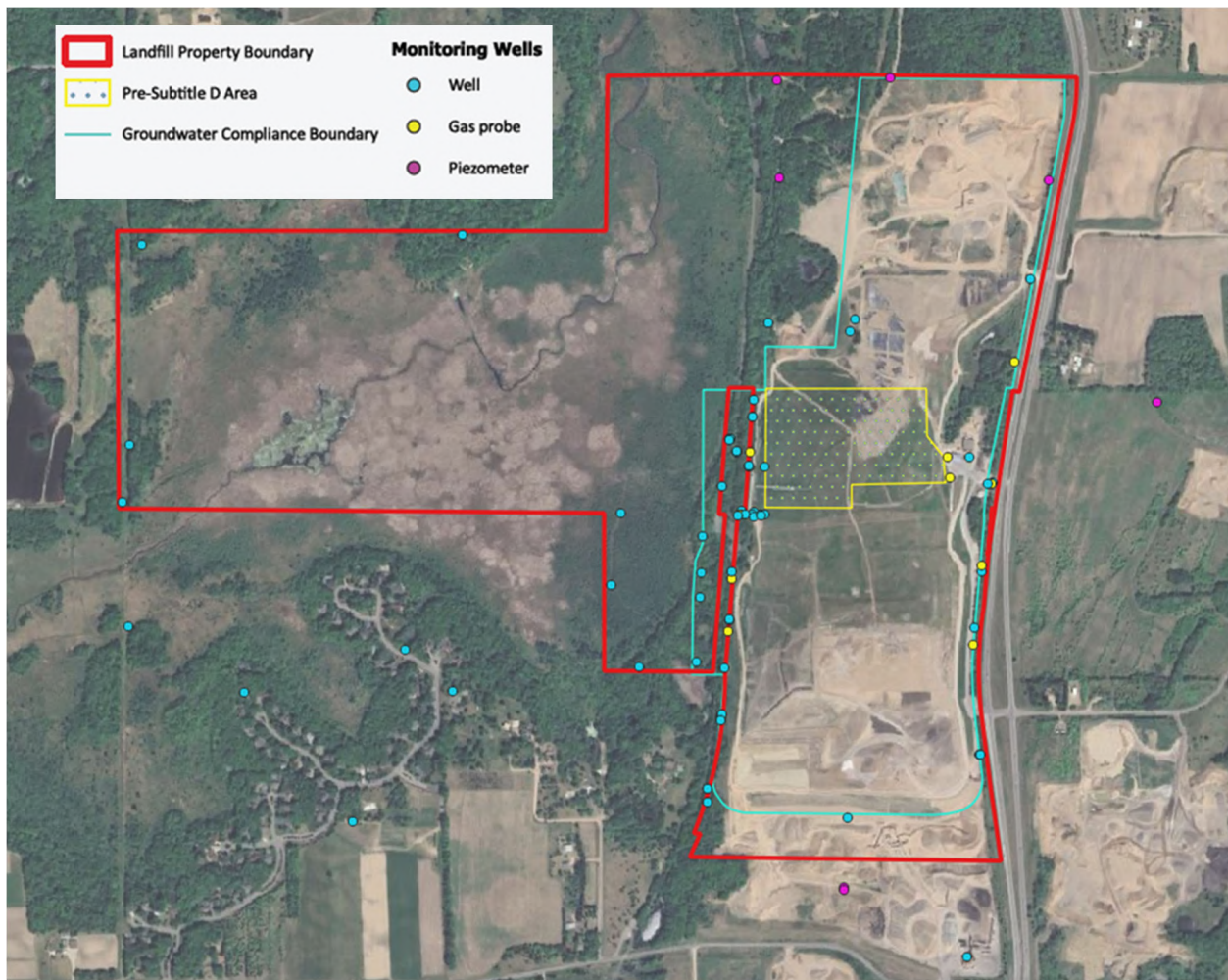
EXHIBIT 4

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EXHIBIT 5

Prepared by: EOR
For Sherburne County

ELK RIVER LANDFILL: Review of Groundwater Contamination Issues



October 13, 2025

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ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

<i>Abiotic degradation</i>	Degradation of compounds through natural and chemical processes (other than biological degradation)	<i>Cometabolic biodegradation</i>	Biodegradation of a contaminant while growing on a different compound. No benefit to the microbe and may have some toxic effects to it.
<i>Aerobic degradation</i>	Degradation of compounds using microorganism metabolic pathways that require oxygen	<i>Compliance Boundary</i>	Area around landfill required to meet intervention limits (See aqua outline in cover map)
<i>Anaerobic degradation</i>	Degradation of compounds using microorganism metabolic pathways that do not require oxygen	<i>Compliance Wells</i>	Wells located in close proximity to the landfill
<i>Anoxic</i>	Complete lack of oxygen	<i>CO₂</i>	Carbon Dioxide
<i>Biodegradation</i>	Degradation of compounds with use of microorganisms	<i>Downgradient</i>	Position down along a gradient
<i>Capping</i>	A type of cover over landfill material to prevent the spread of contamination	<i>EOR</i>	Emmons & Olivier Resources
<i>Chlorinated ethenes</i>	Common organic contaminate, includes trichloroethene (TCE)	<i>ERL</i>	Elk River Landfill
<i>HHRA</i>	Human Health Risk Assessment A process to evaluate the nature and probability of adverse health effects in humans	<i>Terminal electron acceptors</i>	Last compound to receive an electron in an electron transport chain
<i>HRL</i>	Human Risk Limits	<i>TOC</i>	Total Organic Carbon
<i>Hydraulic Conductivity (K)</i>	Ability for liquid to flow through a porous medium	<i>Trichloroethene (TCE)</i>	Toxic volatile chemical with 3 chlorines

<i>IL</i>	Intervention Limit	<i>Vinyl Chloride</i>	Toxic chlorinated ethene with 1 chlorine
<i>Liners</i>	Synthetic barriers that mitigate the migration of leachate.	<i>XRD</i>	X-Ray Diffraction. Using x-ray beams to identify atomic structure of compounds.
<i>MDH</i>	Minnesota Department of Health	<i>Cis-1,2-dichloroethene (cis-DCE)</i>	Product of trichloroethene degradation. With 2 chlorines
<i>MNA</i>	Monitored natural attenuation. Naturally occurring contaminant reduction.	<i>95% Confidence Interval</i>	In all samples, 95% of them will contain the true [value] between value A and value B
<i>MPCA</i>	Minnesota Pollution Control Agency		
<i>ND</i>	Non-detected		
<i>ORP</i>	Oxidation Reduction Potential A measurement of how aerobic or anaerobic a water sample is		
<i>PCE</i>	Tetrachloroethylene, a toxic volatile organic compound		
<i>pH</i>	Measure of acidity or basicity		
<i>Reductive dechlorination</i>	Cleaving of covalent bond between chlorine and carbon, releasing chloride ions. Occurs only under anaerobic (no oxygen) conditions		

1. EXECUTIVE SUMMARY

Emmons & Olivier Resources, Inc. (EOR) developed a Groundwater Contamination report for the Elk River Landfill site on behalf of Sherburne County. This report evaluates the effectiveness of the monitored natural attenuation (MNA) remediation approach for groundwater contamination at the Elk River Landfill (ERL). Portions of the landfill, including several cells constructed between 1972 and the mid-1980s, were built without liners, contributing to a contamination plume in the lower sandy aquifer southwest of the landfill. The primary contaminant of concern is vinyl chloride, with additional detections of trichloroethene (TCE), cis-1,2-dichloroethene (cis-DCE), and elevated sulfate levels.

ERL is currently in a state implemented groundwater corrective action plan, which includes MNA and the replacement of residential water supply with deeper wells. This approach was selected based on guidance from the Minnesota Pollution Control Agency (MPCA) and previous corrective action evaluations. Sherburne County has requested an independent review of remediation documents to assess the ongoing effectiveness of MNA in addressing groundwater contamination downgradient from ERL. This report summarizes the findings of that review based on technical assessments provided by Barr Engineering. Overall, the ERL has been evaluated quite thoroughly. However, there are three main issues with the MNA method as it is applied in the 2024 Initial Performance Evaluation report.

Issue #1: A primary assumption used in the projection calculations is not met

The assumption that the contaminant plume is stable is inaccurate, because the assumption relied on data from well P-342L as evidence of the plume's stability. However, given that this well is located beyond the plume's predicted terminus, coupled with the fact that other wells have detected rising chloride levels, it becomes apparent that the claim that the plume has achieved steady state is inaccurate.

Issue #2: Bulk attenuation projections do not address the real problem

The second issue pertains to a set of scenarios in the 2024 Initial Performance Evaluation that predict the behavior of vinyl chloride contamination in the groundwater beneath ERL and evaluate the effectiveness of natural attenuation in reducing contaminant concentrations before reaching residential water supplies.

- Scenario A projects the highest allowable concentration at the Compliance Boundary that would naturally attenuate before reaching residential wells.
- Scenario B estimates the highest concentration at well P-342L that would attenuate before reaching residential wells.
- Scenario C predicts how far vinyl chloride will travel before decreasing below regulatory limits.

The report's methodology has key limitations. Scenarios A and C rely on wells that are too close to the landfill boundary and do not account for higher vinyl chloride concentrations farther downgradient, making their projections misleading. Additionally, using average concentrations in what is essentially a Human Health Risk Assessment (HHRA) may be inappropriate, and an upper 95% confidence interval should be considered instead.

Scenario B is currently irrelevant, because no vinyl chloride had been detected at P-342L as of August 2023. The source of the concentration values used in Table H3 is unclear, and if the scenario were rerun using

upgradient wells that have vinyl chloride concentrations, it shows that contamination above regulatory limits will reach residential wells. Revised scenarios using more appropriate wells indicate a greater risk to drinking water supplies than initially projected.

Issue #3: Revised bulk attenuation projections give very different results

The third issue addresses how revised bulk attenuation projections produce different results compared to the original report. When recent vinyl chloride concentrations from mid-plume wells and appropriate well distances were used, it became apparent that the original projections may have underestimated the extent and persistence of vinyl chloride contamination. In revised Scenario A, mid-plume wells (P-325L, P-326L, P-338L, and P-334L) failed the test, with predicted concentrations 1.5 to 3x higher than those in the original scenario. In revised Scenario C, additional wells, including P-323L, were included due to previous detections of cis-DCE and TCE. Their concentrations were converted to vinyl chloride molar equivalents. All wells failed the revised test for the Intervention Limit (IL), and two wells exceeded even the higher Health Risk Limit (HRL). The projected travel distances to drop below the IL extend 750 to 4,284 feet past the first residential well, potentially affecting six to seven additional residential wells.

Other Vinyl Chloride-related Issues

Several related issues have been identified regarding vinyl chloride contamination at ERL. First, increasing vinyl chloride trends have been observed in some downgradient wells (P-694477, P-338L and P-334L), which supports the conceptual release model predicting that higher concentrations originated from past releases over 30 years ago. Additionally, no effort has been made to estimate the loss rate of vinyl chloride due to physical processes such as dilution and dispersion, which are important components of monitored natural attenuation (MNA). The low estimated attenuation rate at ERL suggests that most of the observed reduction in contamination is due to physical processes rather than biodegradation. Furthermore, there is a significant need for better plume delineation, particularly on the south side where contamination could potentially impact private wells. The current monitoring wells primarily define the plume along its centerline, leaving gaps in data on both the southern and northern edges. Additional monitoring wells are needed to clarify the full extent of contamination, especially in areas where vinyl chloride concentrations exceed health risk limits, but data is currently insufficient.

Other Groundwater Contaminants

In addition to vinyl chloride, other groundwater contaminants such as Freon and PFAS have been detected at ERL. Freon 21 has been found in multiple monitoring wells, often exceeding an estimated IL of 5 µg/L. Regarding PFAS, MPCA requested for groundwater samples to be collected from nineteen wells downgradient of ERL as part of a statewide landfill screening effort. Six of these wells were outside of the delineated vinyl chloride plume. No PFAS was detected in the wells outside of the vinyl chloride plume. Eleven different PFAS compounds were detected in samples from wells within the plume, with three exceeding the MDH HRL in at least three wells. Sulfate contamination from the landfill is also a concern due to its proximity to Rice Lake, a wild rice water with a sulfate standard of 10 mg/L. Groundwater flows toward Tibbetts Creek, with sulfate levels in monitoring wells reaching up to 132 mg/L, suggesting a potential plume moving toward Rice Lake. However, monitoring is difficult in the wetland area, and limited data exist on groundwater-surface water interactions. If groundwater discharges directly into Rice Lake, sulfate

contamination could be an issue, but if upwelling occurs in the wetland, sulfate may be converted into immobile compounds, reducing the risk of contamination.

2. BACKGROUND

Elk River Landfill (ERL) is a municipal solid waste facility, owned and operated by Waste Management (WM). Portions of the landfill, including cells 1 through 5, 7, 9, and the northern portion of cell 6 (6N), were constructed without liners between 1972 through the mid-1980s. The unlined area is approximately 28 acres and contains roughly 5 million cubic yards of waste, placed between 1972 and 1990. Subtitle D, which regulated landfill standards, was enacted in 1991. Certain situations which involved modifications to current Municipal Solid Waste Landfills, held extensions until 1997 to reach compliance. The unlined areas have since been capped (last 5 cells in 1997, doc #998) or covered with lined construction and demolition (C&D) debris for cells DC-1 through DC-3.

The groundwater contamination issue of greatest concern at ERL is the plume of vinyl chloride that exists in the lower sandy aquifer to the southwest of the landfill. Trichloroethene (TCE) and cis 1,2-dichloroethene (cis-DCE) have also been detected in the contaminant plume. Through biodegradation (removal of chlorines, Figure 1), TCE can be transformed to cis-DCE and vinyl chloride, which is more toxic than TCE. Elevated sulfate concentrations are found in the groundwater as well.

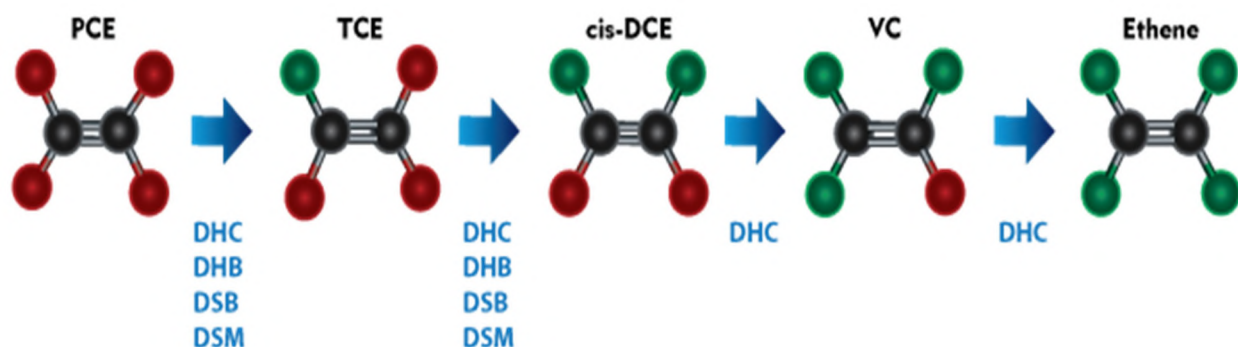


Figure 1. Chloroethene Degradation.

ERL is currently in a state implemented groundwater corrective action plan, initiated in April, 2021. The five (5) year Groundwater Corrective Action Performance Evaluation report is due in Quarter 1 of 2027. ERL's current form of ground water corrective action involves monitored natural attenuation (MNA) of the groundwater plume ("ERL contaminant plume") and residential water supply replacement with new, deeper wells. MNA was evaluated and selected in accordance with an MPCA Natural Attenuation guidance document (MPCA 2006) and a Corrective Action Alternatives Screening (Barr 2019, doc #969). The selected actions appear to have been reasonable at the time. Note that only very low vinyl chloride concentrations had been detected at the time in well P-334L, and well P-338L was not yet installed.

Sherburne County requested that EOR review documents related to the ongoing MNA remedy to determine if it has been and will be effective in remediating groundwater contamination downgradient from ERL. The following documents (all by Barr Engineering) were received from Sherburne County and reviewed:

- Work Plan for 2014 Groundwater Monitoring Network Augmentation Elk River Landfill Elk River, Minnesota Prepared for Elk River Landfill, Inc. February 2014 (Document #732)

- Groundwater Corrective Actions Screening Report Elk River Landfill (SW-74) Elk River, Minnesota Prepared for Elk River Landfill, Inc. July 2019 (Document #969)
- Groundwater Natural Attenuation Evaluation Report Elk River Landfill (SW-74) Elk River, Minnesota Prepared for Elk River Landfill, Inc. February 2020 (Document #998)
- Groundwater Corrective Action Evaluation Report Elk River Landfill (SW-74) Elk River, Minnesota Prepared for Elk River Landfill, Inc. June 2020 (Document #1002)
- Sampling and Analysis Plan Elk River Landfill Elk River, Minnesota Prepared for Elk River Landfill, Inc. March 2021 (Document #1042)
- Groundwater Corrective Action Work Plan Elk River Landfill (SW-74) Elk River, Minnesota Prepared for Elk River Landfill, Inc. March 2021 (Document #1050)
- 2023 Summer Quarterly Report, Elk River Landfill, Elk River, Minnesota (Document #1114)
- 2023 Annual Water Quality Monitoring Report Elk River Landfill (SW-74) Prepared for Elk River Landfill, Inc. March 2024 (Document #1124)
- Groundwater Corrective Action Report - Initial Performance Evaluation Elk River Landfill (SW-74) Elk River, Minnesota Prepared for Elk River Landfill, Inc. April 2024 (Document #1126)
- Sampling and Analysis Plan Elk River Landfill Elk River, Minnesota Prepared for Elk River Landfill, Inc. April 2024 (Document #1127)
- 2024 Fall Quarterly Report, Elk River Landfill, Elk River, Minnesota (Document #1145)
- Groundwater Corrective Action – Supplemental Groundwater Investigation Work Plan Elk River Landfill (SW-74) Prepared for Elk River Landfill, Inc. Prepared by Barr Engineering Co. December 2024 (Document #1142)
- 2024 Fall Quarterly Report, Elk River Landfill, Elk River, Minnesota (Document #1146)
- 2024 Annual Water Quality Monitoring Report Elk River Landfill (SW-74) Prepared for Elk River Landfill, Inc., March 2025 (Document #1149)
- 2024 Groundwater Data Submittal, Elk River Landfill (SWF-1) (Document #1150)
- 2025 Spring Quarterly Report, Elk River Landfill (SW-74) (Document # 1159)
- Groundwater Corrective Action – Supplemental Groundwater Investigation Report Elk River Landfill (SW-74) Prepared for Elk River Landfill, Inc. Prepared by Barr Engineering Co. July 2025 (Document #1162)
- 2023-2025 PFAS Groundwater Data Elevation Report Elk River Landfill, Prepared for Elk River Landfill, Inc. Prepared by Barr Engineering Co. August 2025 (Document #1163)

Document # 1126: Groundwater Corrective Action Report - Initial Performance Evaluation, was the most relevant document and was reviewed in detail. All comments below relate to this document unless otherwise stated.

3. GEOCHEMISTRY/BIODEGRADATION CONCEPTUAL MODEL FOR ERL

3.1. Geology

The groundwater investigation area includes the South part of the Elk River Landfill and areas to the east and southeast (Figure 2). The cross sections in Figure 3 and Figure 4 show that the bedrock below the landfill

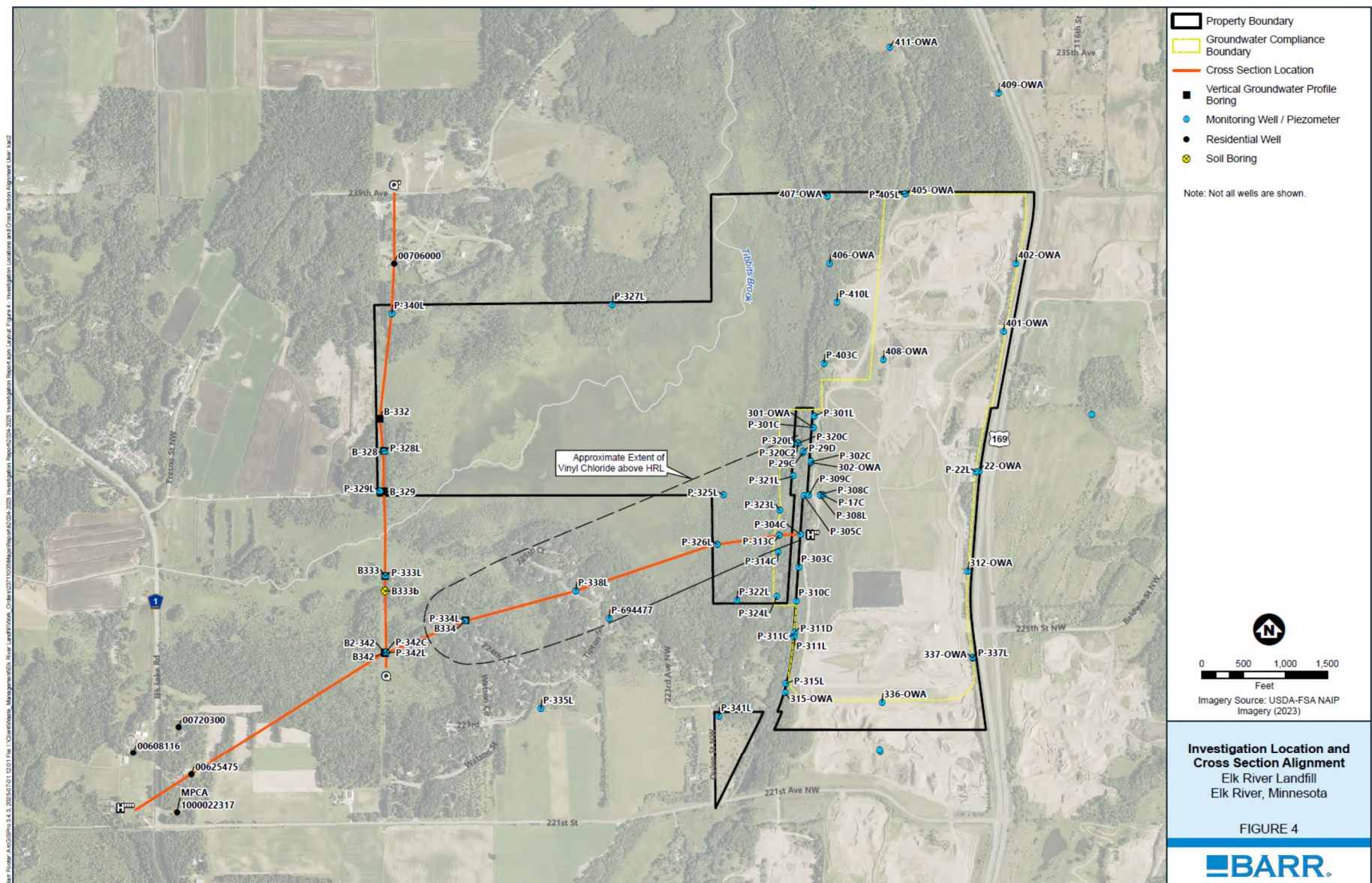


Figure 2. Investigation Area, Cross Section Locations, and Approximate Extent of Vinyl Chloride Plume above HRL (Barr Engineering, 2025)

H'
WEST

H''
EAST

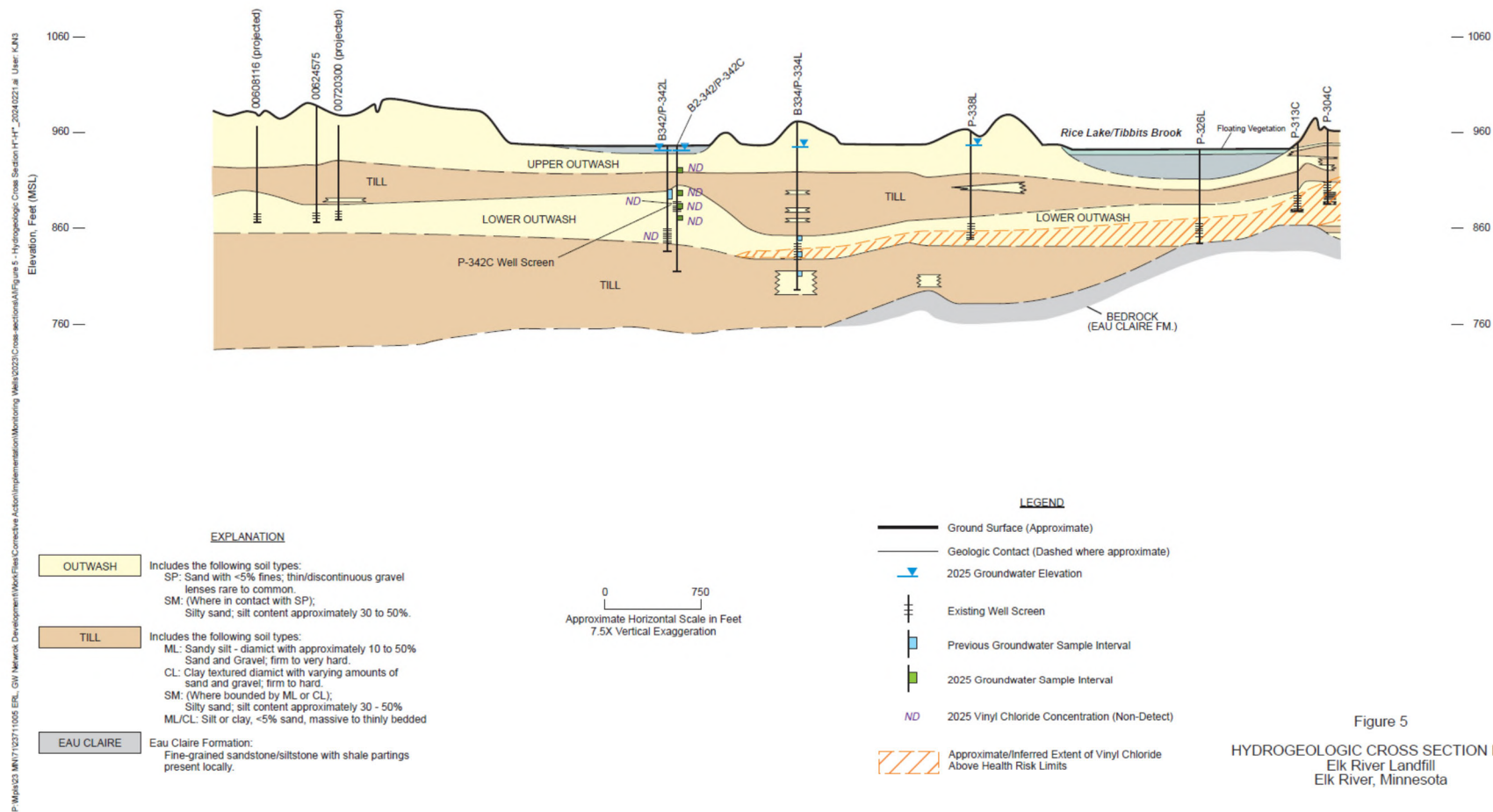


Figure 3. Cross Section H-H' (Barr Engineering, 2025)

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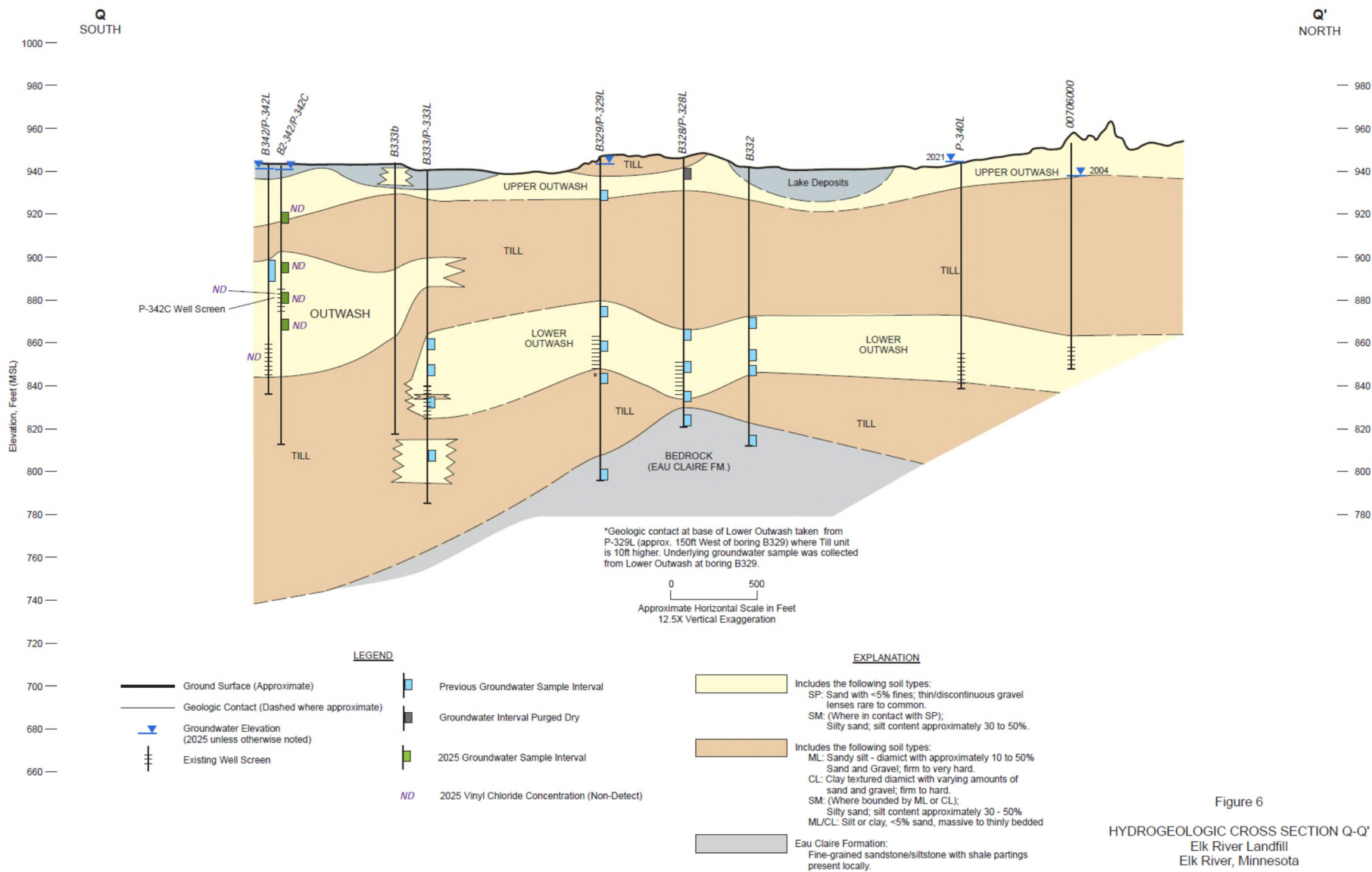


Figure 4. Cross Section Q-Q' (Barr Engineering, 2025)

generally slopes to the southwest. Above the bedrock are approximately 40 to over 100 feet of unconsolidated, primarily glacial deposits.

The unconsolidated deposits have 5 main layers, from top to bottom:

1. Recent deposits of vegetation and organic muck in wetland areas.
2. Upper outwash consisting of coarse sand and silty sand. This is the uppermost or water table aquifer.
3. Upper till later consisting of silt and clay. This layer acts as a confining layer between the upper and lower outwash aquifers.
4. Lower outwash consisting of coarse sand and silty sand. This is the aquifer where the bulk of the groundwater contamination is found.
5. Lower till layer consisting of silt and clay. This layer acts as a confining layer between the lower outwash and the bedrock.

Groundwater flow below the south part of the landfill is primarily to the southwest. The extent of the VC plume can be seen in Figure 2. The plume has been confined to the lower outwash aquifer. Because the volatile organic compounds illustrated in Figure 1 are denser than water, the contaminant plume is found at the bottom of the lower outwash aquifer, above the lower till confining layer, as indicated in Figure 3 .

3.2. Background geochemistry

Before evaluating the existing MNA, it is important to understand why MNA was selected over other remediation options. Section 4 (Document #1126), prepared by Barr Engineering, describes the geochemical conditions downgradient of ERL based on site data, as well as the potential biodegradation and abiotic degradation that could occur under those conditions. Dissolved oxygen (DO) is generally less than 1 mg/l near the land fill boundary and is conducive to anerobic biodegradation of chlorinated ethenes. Measured pH values are also in the range conducive to this process. Alkalinity is high compared to background likely due to production of CO₂ from microbiological degradation of landfill wastes. ORP measurements are described as erratic but clearly lower downgradient of ERL. Chloride cannot be used as an indicator of biodegradation of chlorinated ethenes because contaminant concentrations are so low. Total organic carbon (TOC) concentrations are slightly elevated near ERL (up to 40 mg/l) but decline downgradient to 1 toward the end of the vinyl chloride plume. Where detected, sulfide concentrations are very low. Terminal electron acceptors are discussed; oxygen was partially discussed above. It was suggested that oxygen is low enough for reductive dechlorination of PCE or TCE to cis-DCE, and yet possibly still high enough for aerobic biodegradation of vinyl chloride. Nitrate was ND throughout most of the plume. Elevated concentrations of reduced iron and manganese occur downgradient of the land fill and it is believed iron and manganese reduction are the predominant geochemical conditions in the plume. Sulfate is slightly depleted near ERL but is present in the downgradient plume at concentrations above 10 mg/l, suggesting minimal sulfate reduction. Significant methane concentrations were only seen near the ERL boundary.

Magnetic susceptibility testing was done to measure magnetite, an iron mineral known to be involved in abiotic degradation of chlorinated ethenes (Ferrey et al, 2004). It was concluded that these reactions could be occurring but would be limited for degradation of vinyl chloride.

To summarize, anaerobic degradation of TCE or PCE would likely occur within and immediately downgradient of ERL. Conditions for possible aerobic or anaerobic biodegradation of cis-DCE and vinyl chloride exist in downgradient areas of the plume. Abiotic degradation could be occurring.

3.3. Other conditions not discussed in reports

As stated previously, overall, the ERL has been evaluated quite thoroughly. However, an independent investigation was prompted to confirm previous evaluations. Some degradation mechanisms that may be relevant to ERL were not discussed; cometabolic biodegradation and abiotic degradation due to iron minerals other than magnetite or due to precipitated iron sulfide (FeS).

Cometabolic biodegradation often occurs downgradient of landfills due to methane production in the anaerobic portion of the landfill followed by the plume migrating into aerobic groundwater. Methane oxidizing bacteria can grow on methane and can also carry out cometabolic biodegradation of TCE, DCE and vinyl chloride (Wiedemeier et al, 1999). These reactions likely occurred early on near the ERL, especially during the diffused oxygen aeration period (2003-2008), however, aeration was not widespread and has ceased. Cometabolic biodegradation is likely not a relevant process in the plume now.

Iron minerals involved in abiotic degradation (EPA 2009) other than magnetite were not measured, including FeS which may have been produced near ERL where sulfate reduction occurred. Because degradation/loss rates appear to be low in the downgradient portion of plume, it is not likely these minerals are present or reactive. X-ray diffraction (XRD) could detect these minerals in soil boring samples.

Vinyl chloride can be degraded by a variety of mechanisms under many geochemical conditions. Long vinyl chloride plumes are quite rare. This plume is likely persisting for one of, or combination of, the following reasons. This discussion is included as a possible explanation to why sufficient vinyl chloride degradation is not occurring in the ERL plume.

- Other than municipal waste (garbage), ERL did not appear to contain large inputs of easily biodegradable organic compounds (ketones, alcohols, BTEX, other hydrocarbons) often found at other landfills, that produce a deep, long-lasting anaerobic zone. At ERL the anaerobic zone was just sufficient to transform TCE, and most of the cis-DCE produced, to vinyl chloride.
- The lower outwash is a confined deeper aquifer which likely contains minimal oxygen if any, due to the presence of municipal waste. Conflicting DO and ORP readings occur at many sites for many reasons (See frequently asked question FAQ #14, Adamson and Newell 2014). Thus, aerobic or cometabolic biodegradation reactions with vinyl chloride are likely not occurring though they may have occurred during the diffusive aeration (2003-2008).
- Anaerobic biodegradation reactions for cis-DCE and vinyl chloride have been proposed in the literature under iron and manganese reducing conditions as well as in the presence of humic acids (Bradley and Chappelle, 1996, Bradley et al 1998a, 1998b). In more recent years, those reactions have been questioned or explained by other mechanisms by the same authors who did the original studies (see Introduction section in Bradley et al., 2012).

Very low levels of oxygen as described above appear to be an explanation for what was thought to be anaerobic degradation.

- Microorganisms have regulatory mechanisms to turn on degradative pathways (induction) when compounds they can grow on are present. At some low concentration, microorganisms cannot make a living (grow) off some compounds and the pathway (even if present) will not be induced. Vinyl chloride concentrations below 1 ug/l may be in that range. See Bradley (2012) for a study on vinyl chloride biodegradation under very low oxygen conditions that are considered anoxic. The lowest vinyl chloride concentration tested was 6 ug/l (chapter 3, Fig 4). It is not clear from the figure that any degradation rate is observed at that low concentration. It is also possible that microorganisms that can grow on vinyl chloride are simply not present in the lower outwash.

In summary, very low concentrations (< 2 ug/l) of vinyl chloride at ERL have had 50+ years and 4000 feet (to well P-334L) to biodegrade and yet, degradation does not seem to be occurring at a significant (enough) rate. This may be an instance of a rare combination of circumstances: very low vinyl chloride concentrations combined with no oxygen and no abiotic degradation.

4. MONITORED NATURAL ATTENUATION REVIEW

The overall approach in the 2024 Initial Performance Evaluation appeared to follow standard analytical methods but failed to consider all aspects required for a thorough investigation. Most of the relevant technical issues in biological and abiotic degradation were addressed. Contaminant concentrations are low at the site, the source concentrations appear to be declining, and the plume is moving relatively slow considering the distance to receptors.

However, significant flaws were found in the future projections of how far the plume would travel, or if vinyl chloride concentrations would reach residential water supply wells in the path of the plume. The flaws include use of a critical assumption which appears to not be met, use of average concentrations (and distances) in what is essentially a Human Health Risk Assessment (HHRA) calculation, and no reality check calculations using additional wells within the plume. These and additional less important issues are discussed on the following page.

4.1. ISSUE #1 - A primary assumption used in the projection calculations is not met

A natural attenuation method was used that is well accepted for analyzing plumes (Newell & Rifai et. al, 2002). The problem is the conditions observed at ERL do not fit one of the primary assumptions required for using the method. In the 2024 Initial Evaluation document, calculations were done to estimate attenuation rate (how fast vinyl chloride is going away) as well as projection calculations for time (to drop below the IL) and travel distance based on those rates.

A primary assumption in applying the method is that the plume has achieved steady-state (i.e., is stable/not expanding). This assumption is stated by the authors of the method (Reference below). In the 2024 Initial Evaluation, the following 2 reasons were presented as why the authors believe this assumption was met:

"....steady state assumption is valid at ERL (based on current data), given the long operational history of the facility and non-detect concentrations at distal well P-342L...." (Document #1126, p.280, 5th paragraph of Appendix H)

The conceptual release model for the site (Section 2.5, p 10) states:

"Based on the Site history, the leading edge of the plume is anticipated to result from higher vinyl chloride concentration flux from the 1990s (or prior; Barr, 2020a), and current vinyl chloride flux appears to be substantially lower...."

Because higher concentrations left the landfill 35 to 45 years ago (prior to capping), the basic assumption that the plume is at steady state is not met. Additional assumptions in section 3.2 in MPCA (2006) are likely not met, specifically, knowledge about contaminant mass and having wells along the plume axis.

"Also, without knowing the mass entering the system from a source, a "true" biodegradation rate cannot be measured. Additional assumptions are that the contaminant plume is "stable", lateral dispersion is negligible, and monitoring well locations are positioned along the axis of ground water and contaminant flow."

In addition, well P-342L, is beyond where the terminus of the plume is predicted to be based on the conceptual release model and ground water velocity calculations, and therefore, non-detect concentrations could be expected at P-342L.

Chloride can often be used as a conservative tracer of ground water as it travels at almost the exact same velocity as the ground water itself. Chloride concentrations are elevated near ERL; chloride concentration in P-17C was > 900 mg/l in 2012 and ~ 300 mg/l in 2023. The chloride concentration at P-334L was 3.6 mg/l when first sampled in April 2018. The chloride concentration had risen to 17 mg/l by 2023. This gives a timeframe for the arrival of landfill water at P-334L which is upgradient of well P-342L. The current chloride concentration at P-342L is low (1 mg/l) indicating water from the landfill has not yet reached this well, so the vinyl chloride has not had the chance to reach here either. Therefore, stating that the "non-detect" observation at P-342L is evidence for the vinyl chloride plume being stable is inaccurate.

4.2. ISSUE #2: Bulk attenuation projections do not address the real problem

The 2024 Initial Evaluation report analyzes the degradation of organic contaminants as they move away from the landfill boundary. However, we know vinyl chloride concentrations varied in time and vary throughout the plume (based on the conceptual release model and current data), and we know what current concentrations are downgradient from the landfill. A separate analysis should have been performed starting from those points. Presented here is the analysis in the 2024 Initial Evaluation.

On p 281 (Appendix H), a summary of projections is discussed. The 3 scenarios (A, B, and C) are presented below; all are direct quotes. For 'Scenario A', well P-305C was used as the well at the compliance boundary.

Scenario A:

"What is the estimated highest vinyl concentration at the Compliance Boundary that would naturally attenuate below the IL or detection limit (0.05 micrograms per liter [$\mu\text{g/l}$]) before reaching nearest residential water supply user in the direct downgradient flow path of the mapped vinyl chloride extent if the groundwater flow path is complete³.

- a. Range: 0.23 to 11 $\mu\text{g/l}$ b. Average: 1.0 $\mu\text{g/l}$

This scenario suggests that, on average, vinyl chloride concentrations at or below 1.0 $\mu\text{g/l}$ at the Compliance Boundary will attenuate before reaching the nearest residential well downgradient of P-342L."

Scenario B:

"What is the estimated highest vinyl chloride concentration at monitoring well P-342L that would naturally attenuate below the IL or detection limit (0.05 $\mu\text{g/l}$) before reaching nearest residential water supply user in the direct downgradient flow path of the mapped vinyl chloride extent if the groundwater flow path is complete³.

- a. Range: 0.08 to 0.32 $\mu\text{g/l}$ b. Average: 0.14 $\mu\text{g/l}$

This scenario suggests that, on average, vinyl chloride concentrations at or below 0.14 $\mu\text{g/l}$ in groundwater at well P-342L will attenuate before reaching the nearest downgradient residential well."

Scenario C:

"How far is vinyl chloride projected to travel downgradient of the Compliance Boundary considering peak 2023 concentrations reported near Compliance Boundary (0.48 $\mu\text{g/l}$ at P-321L) if the groundwater flow path is complete³.

- a. Range: 3,200 to 11,300 feet b. Average: 5,900 feet

"This scenario suggests that, based on average bulk attenuation rates, the vinyl chloride detected in groundwater at well P-321L will travel a distance of 5,900 feet before decreasing below the IL or detection limit (0.05 $\mu\text{g/l}$). For context the nearest residential water supply user in the direct downgradient flow path of the mapped vinyl chloride extent is approximately 7,700 feet downgradient of the Compliance Boundary.

The vinyl chloride concentration (or potential vinyl chloride concentration) in the vicinity of 5 wells (P-323L, P-325L, P-326L, P-338L and P-334L) is predicted to reach and go past several residential water wells (Table 2). The approximate predicted time of arrival at the first residential well is 31 years for P-334L and 65 years for P-323L. Future monitoring at P-342L would improve the arrival estimate. If left unchecked with no treatment, this could mean an exposure time above the IL of more than 30 years.

Because higher vinyl chloride concentrations exist in the plume far downgradient of the compliance boundary near the landfill, the projections in Scenario A and C are misleading since they only used wells/concentrations near the landfill boundary. It may also be inappropriate to use average concentrations

in what is essentially a Human Health Risk Assessment (HHRA) calculation. Assuming the data is accurate, any or all data points could be used in the calculations. At the minimum, perhaps an upper 95% confidence interval should be used.

Scenario B (which uses P-342L) is irrelevant at this time because no vinyl chloride had been detected there as of August 2023. Yet, in the scenario, Table H3 contains 6 concentration values and an average value that was used in the projection. It is not clear where these input values came from. If scenario B is rerun using wells upgradient of P-342L which have vinyl chloride concentrations, different results are obtained. Revised scenarios using other wells are presented below and show that concentrations of vinyl chloride above the IL will very likely reach the nearest drinking water wells.

4.3. ISSUE #3: Revised bulk attenuation projections give very different results

Bulk attenuation rates were discussed in section 4.3.2 with reference to Appendix H for detailed calculations. We were able to reproduce the predictive results obtained. Using the same calculations (Table H3, p 292) but substituting recent vinyl chloride values for mid plume wells and the appropriate well distances, different results are obtained. Boundary compliance wells used in the original scenarios were included to ensure the formulas were correct. Results for those wells agreed with the stated result in the report.

Wells P-325L, P-326L, P-338L and P-334L are approximately 890 ft, 1037 ft, 2933 ft, and 4329 ft, respectively, downgradient of well P-305L near the compliance boundary. In revised scenario A (Table 1), all the mid plume wells fail the test to be below the IL at the nearest residential well (orange highlights) and 2 wells come close to failing (red highlights) even if the higher HRL is used (calculations not shown in tables below). Predicted vinyl chloride concentrations are 1.5 to 3.8X higher than those predicted in the original scenario A.

In revised scenario C, P-323L (approximately 300 ft downgradient of P-321L) was included along with the mid plume wells in revised scenario A. P-323L was included because cis-DCE and TCE were detected there in significant concentrations in 2021. Cis-DCE concentrations were included for the other wells where present. TCE and cis-DCE concentrations were converted to vinyl chloride molar equivalents. As shown in Table 2, all wells fail this revised test for the IL and one well fails even if the higher HRL is used as the standard. The projected travel distances to drop below the IL are 750 to 4284 ft past the first residential well and could include up to 6 or 7 additional residential wells (see Figure 6).

Table 1. Natural attenuation model results – Revised Scenario A

Well	Approximate distance downgradient from P-305C (feet)	Distance (feet) from well (column A) to nearest residential water well (22275 Elk Lake Road) *	Vinyl chloride concentration (ug/l) that will drop below C IL before reaching water supply well	Vinyl chloride concentration (ug/l) that will drop below HRL before reaching water supply well	Current or highest recent (2022-2024) vinyl chloride concentration (ug/L)	GW velocity (feet/year)	k (overall attenuation rate in ug/l/year)	Notes
P-305C	LF boundary well (Example from Barr, 2024, p 281)	7966	1.00	4.02	1.00	117	0.045	
P-325L	890	7076	0.71	2.83	1.44	117	0.045	2022 vinyl chloride data
P-326L	1037	6929	0.61	2.44	0.96	117	0.045	2022 vinyl chloride data
P-338L	2933	5033	0.31	1.23	1.02	117	0.045	2023 vinyl chloride data
P-334L	4329	3637	0.18	0.73	0.69	117	0.045	2024 vinyl chloride data

Test results: Will Natural Attenuation lower the VC concentration below the HRL or C IL before this groundwater reaches the nearest drinking water well?

Yellow = Natural Attenuation will reduce concentrations below the HRL and approximately the C IL
Orange = Natural Attenuation will reduce concentrations below the HRL but above the C IL
Red = Natural Attenuation will reduce contaminants at this well to approximately the HRL and above the C IL

* Distances were observed and calculated using QGIS version 3.34.10-Prizren, and are slightly different then the Barr scenarios.

Health Risk Limit concentration (HRL) = 0.2 ug/l

Intervention Limit concentration (C IL) = 0.05 ug/l

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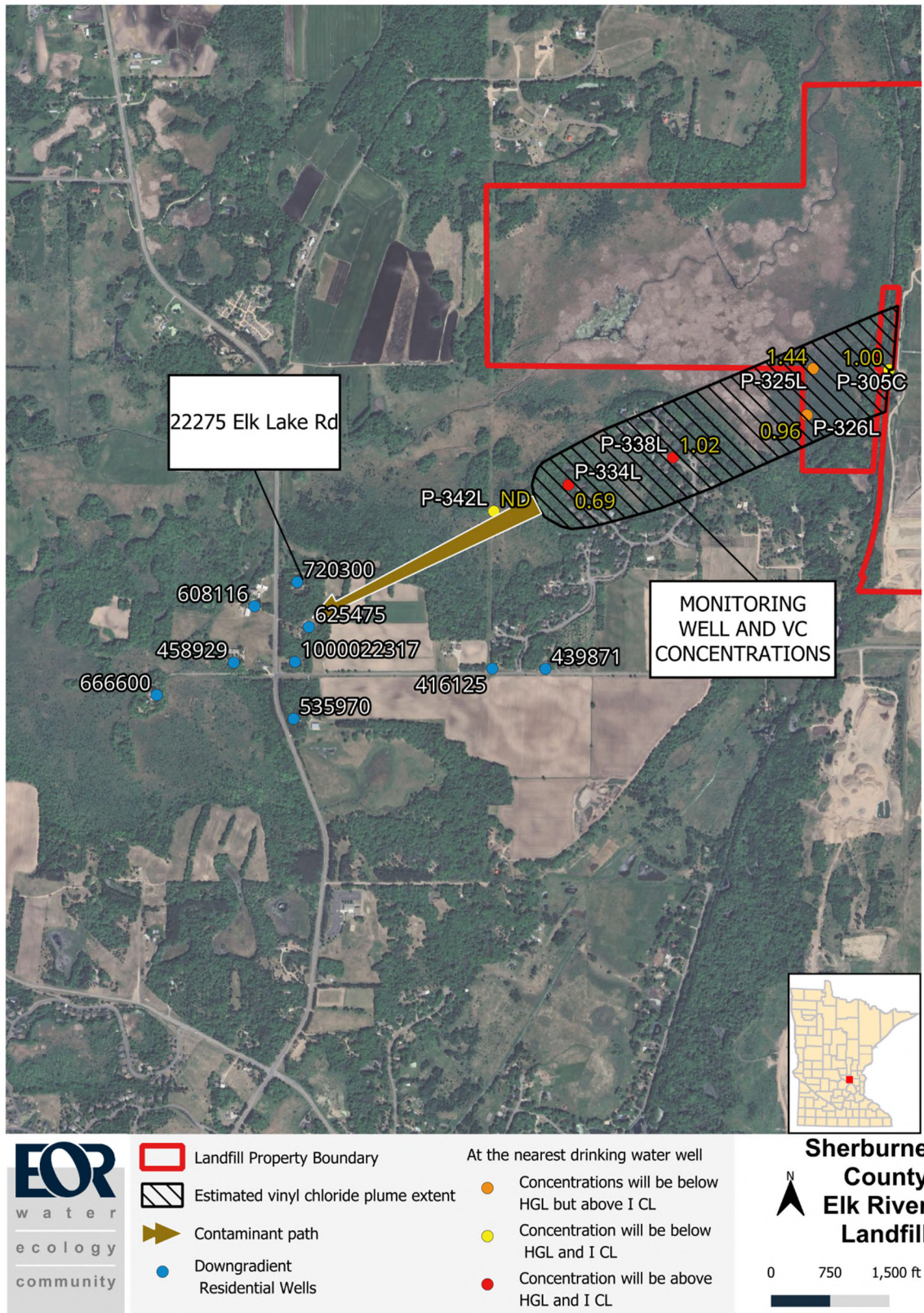


Figure 5. Results of Natural Attenuation Calculations - Revised Scenario A

Table 2. Natural attenuation model results – Revised Scenario C

Well	Current or highest recent (2021-2024) vinyl chloride concentration (ug/l)	Travel distance (feet) to drop below C IL (formula Table H3 p 292)	Travel distance (feet) to drop below C HRL	Distance (feet) from well in column A to nearest water supply well (22275 Elk Lake Rd)	GW velocity (ft/year)	k (overall attenuation rate in ug/l/year) from Barr	Notes
P-321L (Barr example well on p 281 of 2024 doc)	0.48	5881	0	7945	117	0.045	
P-323L	4.9	11921	8317	7637	117	0.045	Includes cis-DCE and TCE that could become vinyl chloride
P-325L	1.44	8737	5133	7076	117	0.045	2022 data
P-325L	1.8	9317	5713	7076	117	0.045	Includes cis-DCE that could become vinyl chloride
P-326L	0.96	7683	4078	6929	117	0.045	2022 data
P-326L	1.66	9107	5502	6929	117	0.045	Includes cis-DCE that could become vinyl chloride
P-338L	1	7789	4185	5033	117	0.045	
P-338L	1.45	8755	5151	5033	117	0.045	Includes cis-DCE that could become vinyl chloride
P-334L	0.69	6824	3220	3637	117	0.045	2024 data

Test results: Will Natural Attenuation lower the VC concentration below the HRL or C IL before this groundwater reaches the nearest drinking water well?

Yellow	= Natural Attenuation will reduce concentrations below the HRL and the C IL
Orange	= Natural Attenuation will reduce concentrations below the HRL but above the C IL
Red	= Natural Attenuation will reduce concentrations above the HRL and the C IL

* Distances were observed and calculated using QGIS version 3.34.10-Prizren, and are slightly different then the Barr scenarios.

Health Risk Limit concentration (HRL) = 0.2 ug/l

Intervention Limit concentration (C IL) = 0.05 ug/l

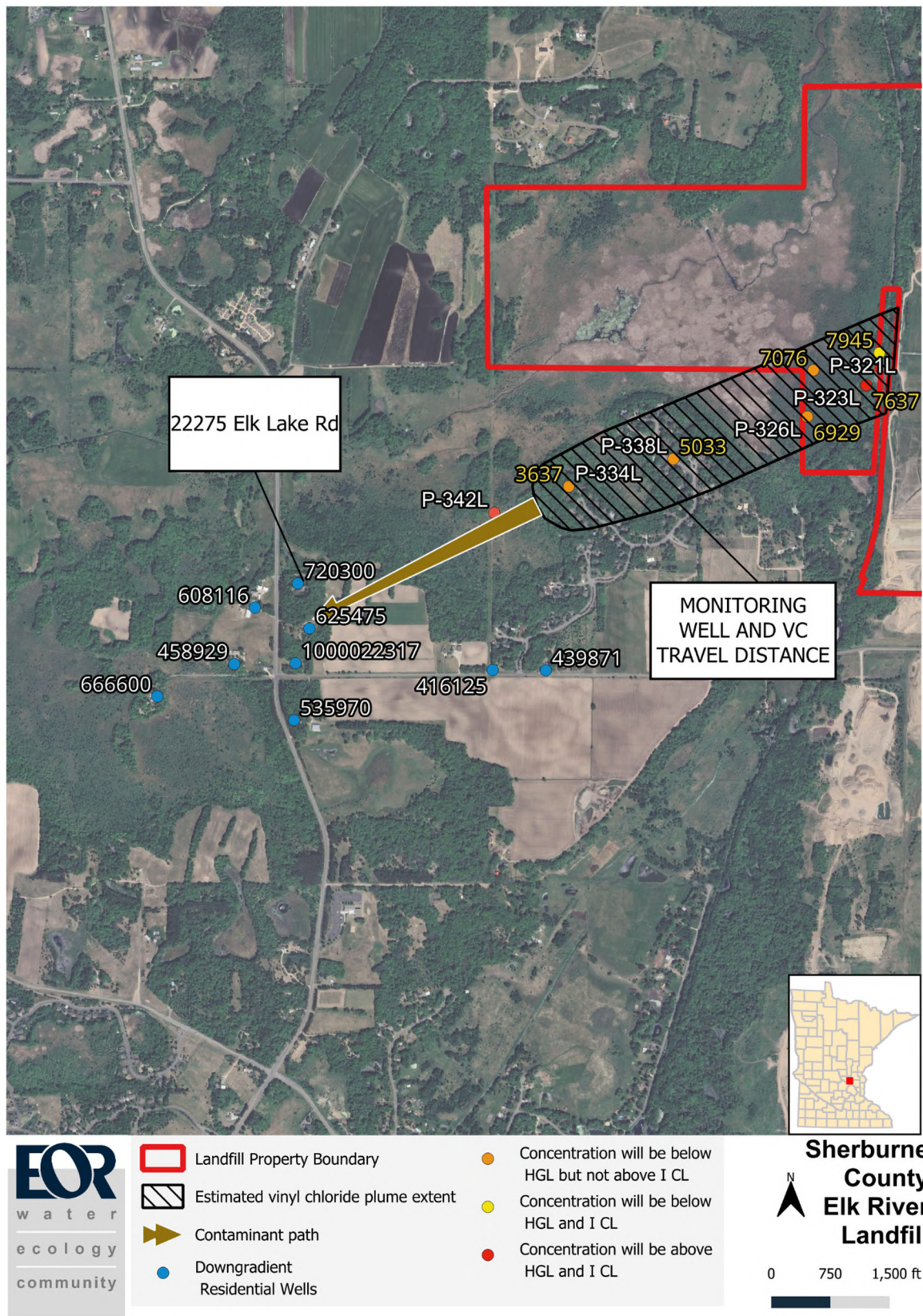


Figure 6. Results of Natural Attenuation Calculations – Revised Scenario C

The above calculations indicate MNA as a lone remedial strategy will not be sufficient to reduce vinyl chloride concentrations below acceptable health risk limits.

5. OTHER VINYL CHLORIDE-RELATED ISSUES

5.1. Vinyl chloride trends are increasing in some downgradient wells.

Figure 2 (Appendix E, Doc #1151) shows 3 distant downgradient wells (P-694477, P-334L, P-338L) have increasing vinyl chloride trends. This agrees with the release conceptual site model that has a pulse of higher concentrations leaving the ERL 30+ years ago.

5.2. No estimate for a loss rate for vinyl chloride due to physical processes alone was made.

Since physical losses (dilution, dispersion) are acceptable in an MNA remedy, this estimate would merely confirm that a “preferred” active degradation mechanism and rate (λ) exists. In section 3.2 (MPCA 2006), biodegradation rates and total loss rates are discussed. In that document, a sample calculation was done for a site with a ground water velocity of 124 ft/yr, very close to the 117 ft/yr for ERL. The total overall attenuation rate (k) was estimated to be 0.2 yr^{-1} .

“The biodegradation rate, I , is estimated from the overall attenuation rate with estimates of the retardation constant (for details on this derivation, see Appendix A, Equation 3) and dispersion values along the plume axis. Using the site data for Figure 5 yields a I of 0.12 yr^{-1} or approximately 60 percent of the overall attenuation rate, k , that includes attenuation due to adsorption and dilution. The biodegradation rate of 0.12 yr^{-1} is relatively low compared to many values found in the literature, which can range from 1.2 to 1.8 for microcosm studies or other field data (61).”

By subtraction, this example site indicates a loss rate due to physical processes of 0.08 yr^{-1} or 2/3 of the biodegradation rate. The total overall attenuation rate (k) used in the calculations for the ERL plume was estimated to be 0.045 yr^{-1} . This is approximately half the loss rate due to physical processes in a plume with the same groundwater velocity, and approximately 1/3 of the low biodegradation rate described in the example above. This implies that most of the observed rate at ERL is due to physical processes only and there is minimal degradation. Since chloride concentrations leaving ERL vary over time and location and connected flow paths cannot be established with the limited number of wells, a simple calculation using chloride as a conservative tracer cannot be done.

5.3. There is a need for better plume delineation.

The downgradient plume (presented as the HRL extent in all figures) is at least 1200 feet wide and yet is primarily defined by wells believed to be along the centerline of the plume (P-326L, P-338L, P-334L). There appears to be a need for better delineation on the south side of the plume especially if the estimated extent of vinyl chloride above the IL on the south side is the same as the north side (Doc #1126, Fig. 8). Additional delineation both south and downgradient of P-694477 (see #1 above) should be done, because this well is currently greater than twice the HRL and the concentration is trending upward. The direction of groundwater flow indicates the southern side of the plume is most likely to impact downgradient private wells should it reach them. Well P-694477 is in an area where it appears more

monitoring wells could be installed. There also appears to be a need for better plume delineation along a more northern flow path downgradient of P-325L. Both P-325L and P-323L have higher vinyl chloride concentrations than P-326L and contain cis-DCE and TCE (P-323L only) that can become vinyl chloride. Currently, there are no wells downgradient on a flow path through P-325L. Doc #1126 acknowledges that the northern portion of the plume is not well characterized (Section 4.3.1 as an example). It is recognized that even though Figure 7 shows the estimated vinyl chloride concentration exceeding the IL extending a considerable distance beyond the approximate extent of the HRL, this area is inaccessible for installing monitoring wells due to Tibbet's Brook and Rice Lake.

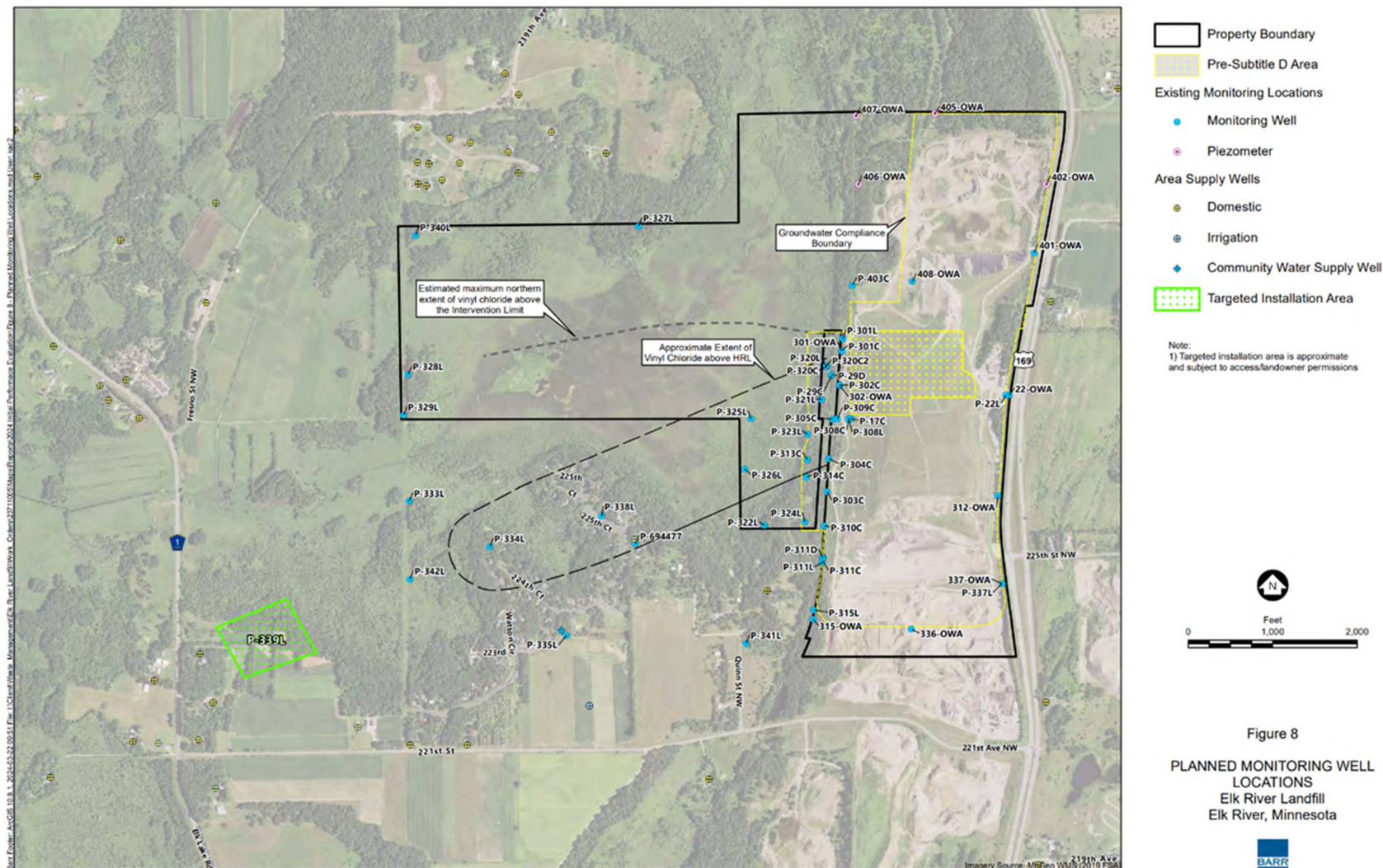


Figure 7. Planned Monitoring Well Locations (Barr Engineering, 2025)

6. OTHER GROUNDWATER CONTAMINANTS

6.1. Freon

Freon 21 (Dichlorofluoromethane) has been detected in several monitoring wells. There is no IL for Freon 21, just an "RAA17" (Remedial Action Advisory 2017) of 20 ug/l listed under HRL. Since most ILs are 0.25 of the HRL, this could imply that the IL could be approximately 5 ug/l. Freon 21 exceeded this value in several wells for many sampling events.

6.2. PFAS

Perfluoroalkyl substances (PFAS) are present in the ERL. PFAS include compounds that are highly fluorinated and sometimes contain sulfonate groups or acidic groups (ex: PFOA or perfluorooctanoic acid or its salts). PFAS compounds are generally considered to not be biodegradable. Acid or salt versions like PFOA are soluble and have a low retardation factor in ground water (ex: ~ 1.5), meaning they would travel a considerable distance like vinyl chloride. PFAS has become a serious contaminant of concern in the last 10 years. The EPA established a maximum contaminant level (MCL) of 4.0 ng/l in August 2025. The Minnesota Department of Health (MDH) set a health risk limit (HRL) level of 0.0079 ng/l (7.9 picograms/l) for PFOA in 2025.

The Minnesota Pollution Control Agency (MPCA) collected groundwater samples at several wells downgradient from ERL and analyzed for PFAS. The sampling was part of a larger effort by MPCA to screen for PFAS near landfills across the state. Samples were collected in October 2023 from 6 wells: P-22L, P-308L, P-321L, P-323L, P-325L and P-326L (Barr doc #1163). PFAS was sampled previously in 2 more downgradient wells (P-334L and P-342L) in August 2023. Well P-342-L was sampled again in April 2024.

Because of the problem described above for vinyl chloride, the County was concerned that the more downgradient wells (P-338L and P-334L) will eventually become contaminated by PFAS, and well P-694477 had never been sampled. PFAS samples were collected in a split sampling event with Sherburne County in wells P-334L, P-338L and P-694477 in April 2025.

Calculations were performed to determine whether natural attenuation could effectively remediate PFOA and PFBA to below the EPA MCL of 4 ng/l. Revised scenarios, like Table 2 above, were created for PFOA and PFBA using the highest detected concentrations at various wells. The PFOA results are summarized in Table 3 and Figure 8. The PFBA results are summarized in Table 4 and Figure 9.

The calculations assumed that groundwater would flow directly from upgradient wells to the nearest downgradient water supply well, located at 22275 Elk Lake Road. Wells P-325L and P-338L both failed the test for PFOA, all wells failed the test for PFBA. If the MDH level of 0.0079 ng/l were to be used for PFOA instead of the MCL of 4 ng/l, it is almost certain that most of the wells within the documented plume would fail.

Table 3. PFOA concentrations at sample wells and distances required for natural attenuation

Well	PFOA (perfluorooctanoic acid) 2023 or 2025 concentration (ng/l)	Distance (ft) from well to nearest water supply well (22275 Elk Lake Road) *	Calculated travel distance (ft) to drop below MCL (Formula from Barr, 2024, Table H3, p 292)	Compound's groundwater transport velocity (ft/yr)**	PFOA EPA MCL (PPT or ng/l)	k (Overall attenuation rate in ug/l/year) ***	Notes
P-325L	381	7076	7898	78	4	0.045	Sampled 6/23
P-326L	85	6929	5298	78	4	0.045	Sampled 10/23
P-338L	96	5033	5509	78	4	0.045	Sampled 4/25
P-334L	16.2	3637	2424	78	4	0.045	Sampled 4/25

Test results: Will Natural Attenuation lower the PFOA concentration below the HRL before the groundwater reaches the nearest drinking water well?

Green = Natural Attenuation will reduce the PFOA concentration below the HRL
Red = Natural Attenuation will not reduce the PFOA concentration below the HRL

* Distances were observed and calculated using QGIS version 3.34.10-Prizren, and are slightly different than the Barr Engineering reports.

** Retardation for PFOA compounds including perfluorohexanoic acid is slightly higher than for vinyl chloride, ~1.5; the GW velocity has been adjusted.

*** k for the site includes physical and degradation processes for vinyl chloride; degradation is essentially nonexistent for PFAS/PFOA, so the calculation is conservative

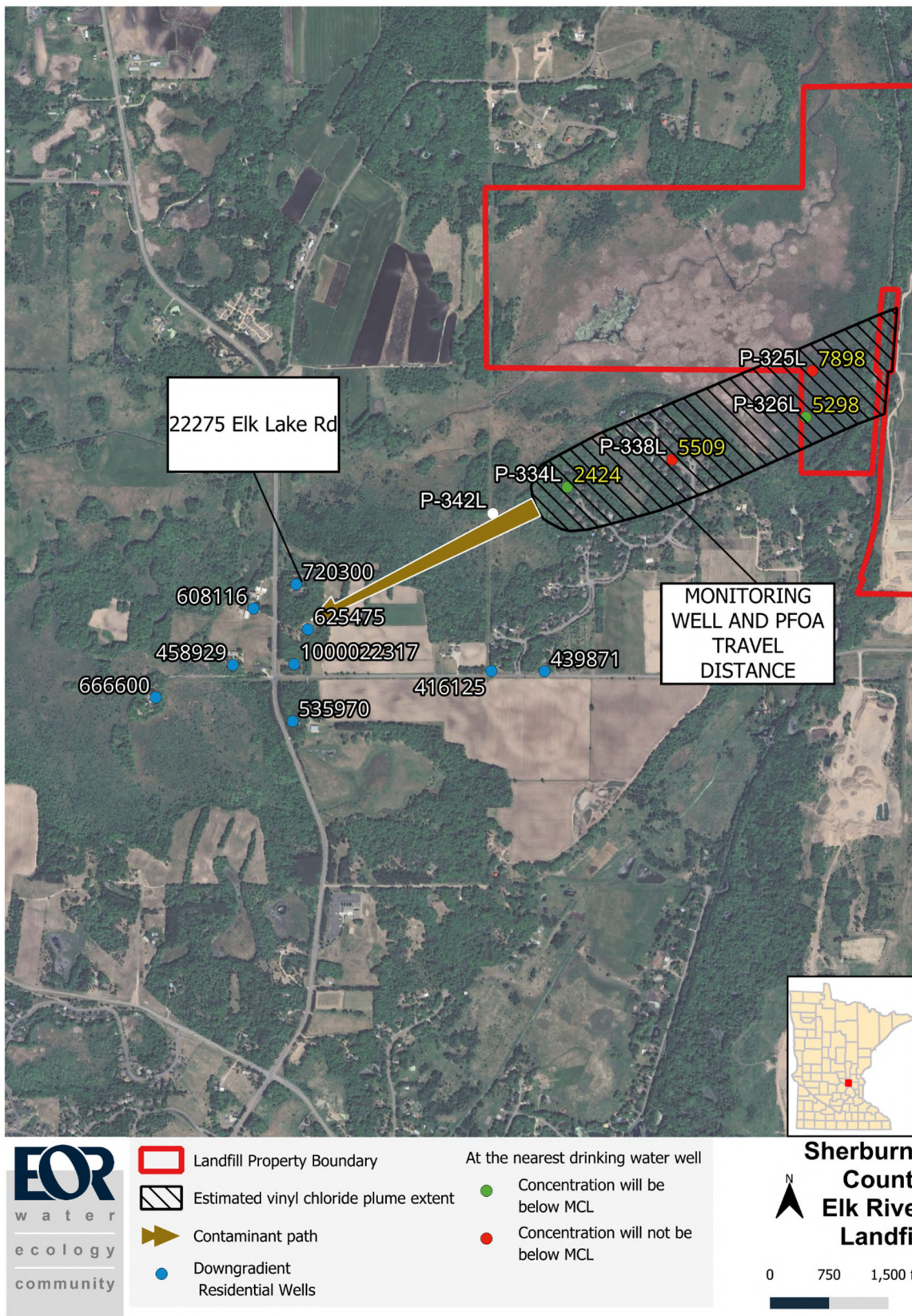


Figure 8. Results of Natural Attenuation Calculations – PFOA

Table 4. PFBA concentrations at sample wells and distances required for natural attenuation

Well	2023 or 2025 PFBA (perfluorobutanoic acid) concentration (ng/l)	Distance from well in column F to nearest water supply well (22275 Elk Lake Rd) *	Calculated travel distance to drop below MCL (Formula from Barr, 2024, Table H3 p 292)	Compound's groundwater transport velocity (ft/yr)**	PFBA EPA MCL (PPT or ng/l)	k (Overall attenuation rate in ug/l/yr)***	Notes
P-325L	639	7076	10824	96	4	0.045	Sampled 6/23
P-326L	196	6929	8303	96	4	0.045	Sampled 10/23
P-338L	105	5033	6971	96	4	0.045	Sampled 4/25
P-334L	45.5	3637	5187	96	4	0.045	Sampled 4/25

Test results: Will Natural Attenuation lower the PFBA concentration below the HRL before this groundwater reaches the nearest drinking water well?

Red = Natural Attenuation will not reduce concentrations below the HRL

* Distances were observed and calculated using QGIS version 3.34.10-Prizren, and are slightly different than in the Barr Engineering reports.

** Retardation for PFBA is slightly higher than for vinyl chloride, ~1.21; the groundwater velocity has been adjusted.

*** k for the site includes physical and degradation processes for vinyl chloride; degradation is essentially nonexistent for PFBA, so the calculation is conservative

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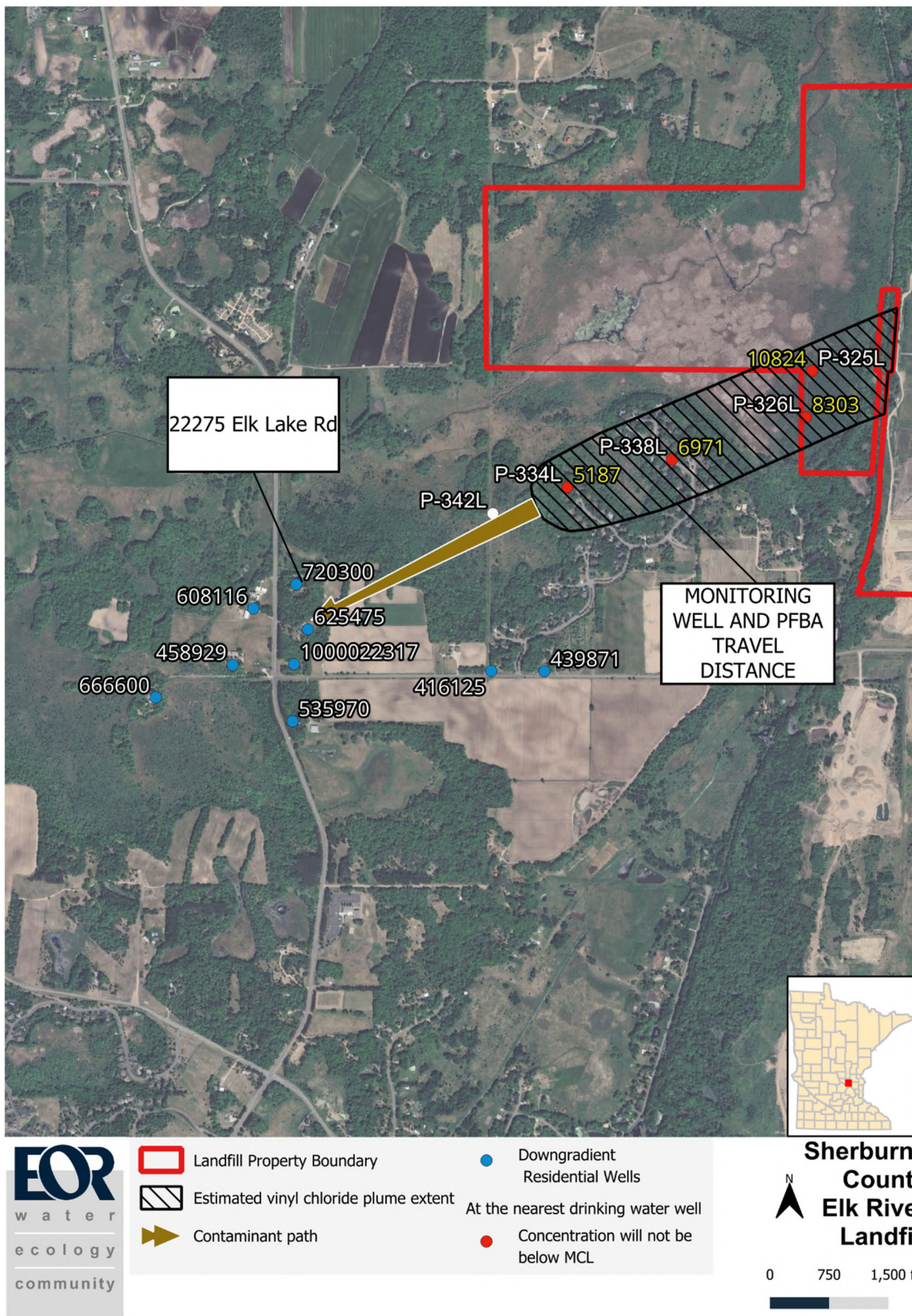


Figure 9. Results of Natural Attenuation Calculations – PFBA

6.3. Sulfate

Sulfate is a potential contaminant of concern because of the proximity of Rice Lake and Tibbetts Creek to the landfill. Rice Lake is classified as a wild rice water. The sulfate standard for wild rice waters is 10 mg/l.

Shallow groundwater generally flows from east to west, toward Tibbetts Creek as shown on Figure 10. Sulfate concentrations in shallow aquifer monitoring wells near the landfill are as high as 132 mg/l (Figure 11). A plume of high sulfate groundwater is likely to develop away from the landfill in the direction of groundwater flow. If the plume were to extend as far as Rice Lake, the landfill could be cited as a cause of high sulfate concentrations in the lake.

Groundwater transport of sulfate from the landfill to Rice Lake would occur through the upper sandy aquifer. The current extent of high sulfate groundwater is not known because groundwater monitoring is very difficult in the wetland area west of the landfill. Previous attempts to install monitoring wells in the wetland have not been successful. There is also a lack of data about the groundwater/surface water interactions in the landfill due to upwelling groundwater.

If shallow groundwater is discharging only to Rice Lake and Tibbetts Creek, then sulfide contamination is a potential problem. If upward groundwater gradients exist in the wetland, and if groundwater is coming to the surface through the bottom of the wetland, then sulfate contamination will be less of a potential problem. The bottom of the wetland is a reducing environment, so sulfate in the groundwater would be reduced to ferric sulfide or magnesium sulfide. Both compounds are relatively immobile, so the sulfate/sulfide would not reach Rice Lake in significant concentrations.

7. REMEDIAL ALTERNATIVES

Remedial alternatives for vinyl chloride in the ERL and groundwater were evaluated in the Corrective Action Alternatives Screening Report (CAAR 2019, Doc #969) and are listed below.

1. No action
2. Monitored natural attenuation (MNA)
3. Enhanced natural attenuation via air sparging or aerobic/anaerobic in situ injections
4. Permeable Reactive Barrier (PRB) via injections
5. Hydraulic capture with consideration to onsite and offsite treatment and discharge
6. Establishment of treatment or alternative water supply via point of entry system (POE) or well replacement.

MNA was selected as the primary remedy along with #6 (alternative water supply/well replacement) as the contingency remedy. Given this was 2019 and very little MNA data had been collected (which could rule MNA out), this selection was not unreasonable. However, recent data suggests that MNA alone may not reduce concentrations of vinyl chloride fast enough to be protective of nearby drinking water supplies.

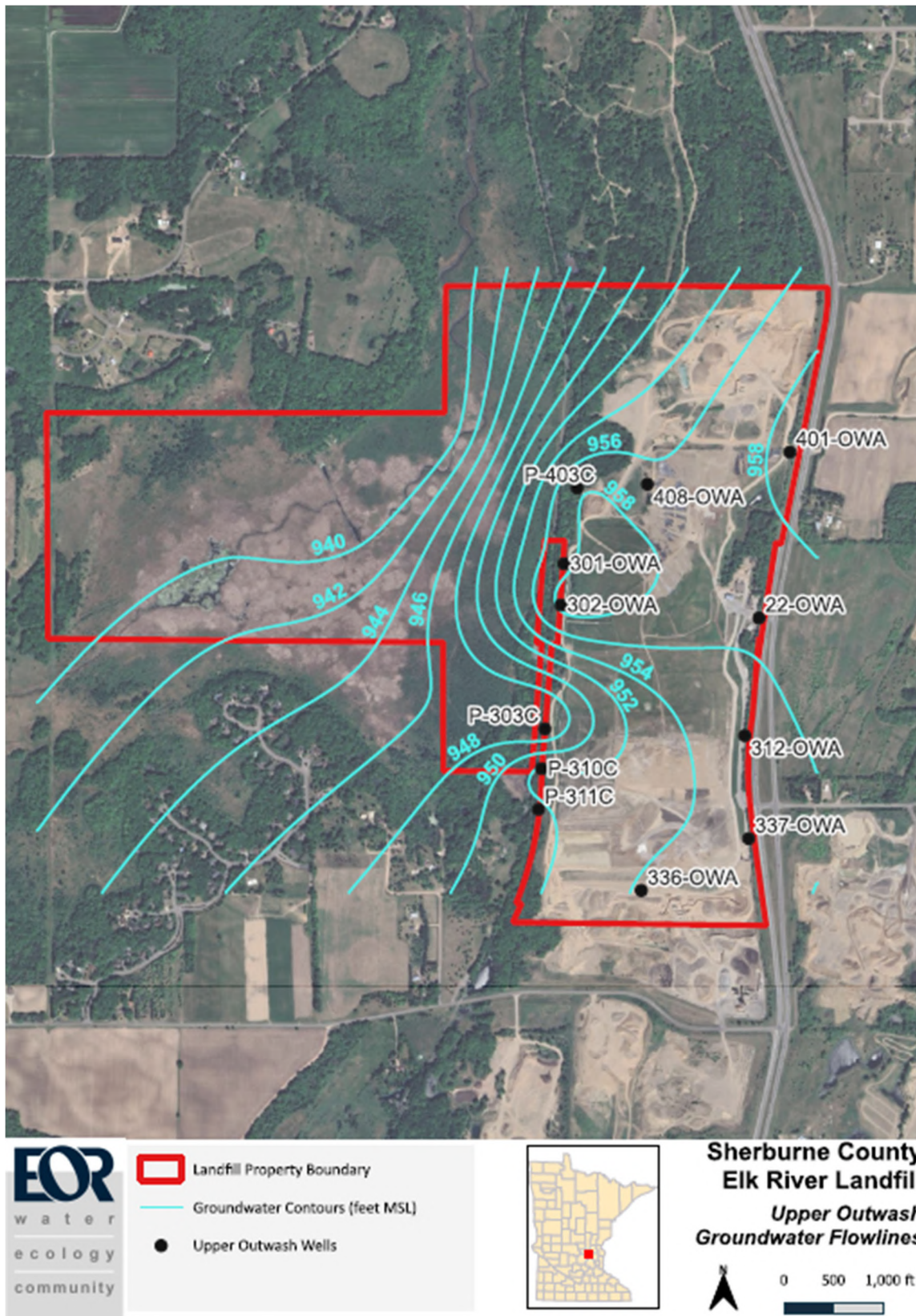


Figure 10. Upper Outwash Aquifer Groundwater Contours (2024)

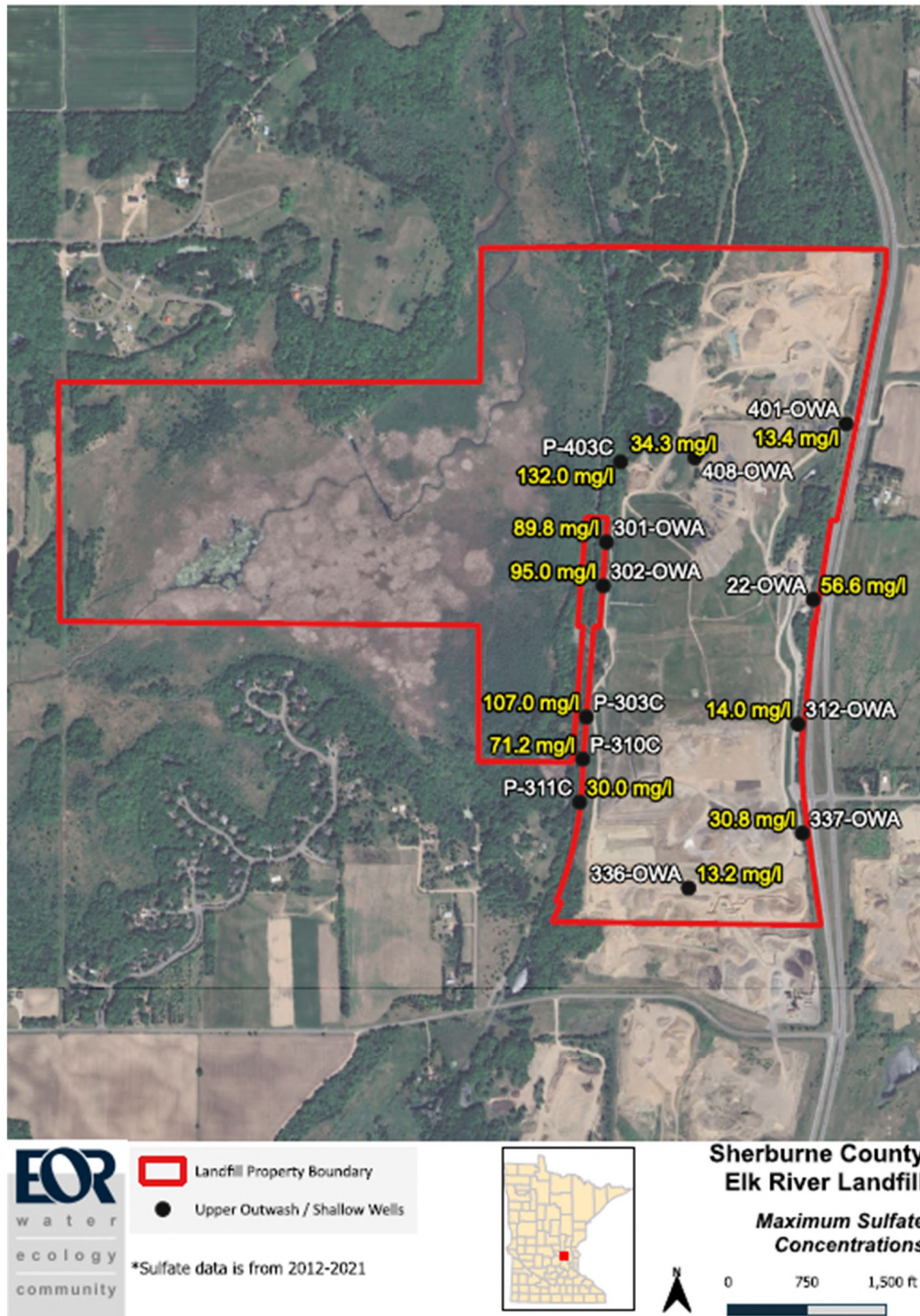


Figure 11. Maximum Sulfate Concentrations in Groundwater

The current most downgradient monitoring well that is non-detect for vinyl chloride, P-342L, is ~ 8.7 years in ground water travel time downgradient of P-334L. Vinyl chloride was detected above the HRL in 2021 when P-334L was first sampled. The arrival of vinyl chloride above the IL at P-342L is thus expected to be in approximately 2030. The arrival of vinyl chloride should be preceded by a rise in the chloride concentration a year or two earlier. P-342L is also the last monitoring well before the residential wells and appears to be in an area where a corrective measure such as #5 above (hydraulic capture and treatment) might be implemented. A short transect of borings north and south of P-342L could be installed and sampled at the time of chloride arrival at P-342L. Depending on the sampling results from those borings, a short transect of monitoring wells can then be installed north and south of P-342L to define the lateral extent of the plume.

8. CONCLUSION

In conclusion, this report highlights several key concerns regarding the migration and attenuation of contaminants at the Elk River Landfill. Vinyl chloride concentrations vary throughout the plume, with revised bulk attenuation projections indicating that natural attenuation may not be sufficient to prevent contamination of residential wells. Additionally, increasing vinyl chloride trends in some downgradient wells, the need for better plume delineation, and uncertainties in physical loss rates further complicate risk assessments. Other contaminants, including Freon 21, PFAS, and sulfate, pose additional concerns. PFAS compounds were detected in multiple wells within the plume. The current health risk limits are not clear. If the EPA's MCL of 4 ng/l is used, a number of wells in the plume will fail the test of reaching down gradient drinking water wells. Sulfate contamination, if transported through groundwater, could impact Rice Lake, though wetland conditions may mitigate its mobility. Overall, the findings suggest that natural attenuation alone may not be a reliable long-term solution, emphasizing the need for continued monitoring, improved plume characterization, and potential remediation efforts to protect water quality.

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EXHIBIT 6



#1126

Groundwater Corrective Action Report - Initial Performance Evaluation

Elk River Landfill (SW-74)

Elk River, Minnesota

Prepared for
Elk River Landfill, Inc.

April 2024

Certification

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Geologist under the laws of the State of Minnesota.



James M. Eidem Jr.
PG #: 44064

April 1, 2024

Date

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.



Anthony D. Neuens
PE #: 50822

April 1, 2024

Date

Groundwater Corrective Action Report - Initial Performance Evaluation

April 2024

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Abbreviations

Barr	Barr Engineering Co.
bgs	below ground surface
C&D	construction and demolition
CAER	Groundwater Corrective Action Evaluation Report
cDCE	cis-1,2-dichloroethene
CVOC	chlorinated volatile organic compound
DCE	dichloroethylene
ERL	Elk River Landfill
HRL	Health Risk Limit
IL	intervention limit
MDH	Minnesota Department of Health
MNA	monitored natural attenuation
molar tCVOC	total chlorinated ethene molar concentrations
MPCA	Minnesota Pollution Control Agency
MSL	mean sea level
NDA	North Development Area
ORP	oxidation-reduction potential
PCE	tetrachloroethylene
RCRA	Resource Conservation and Recovery Act
RL/TB	Rice Lake/Tibbits Brook
SAP	Sampling and Analysis Plan
SDA	South Development Area
TCE	trichloroethylene
VOC	volatile organic compound

1 Introduction

On behalf of Elk River Landfill, Inc., Barr Engineering Co. (Barr) has prepared this Groundwater Corrective Action Report-Initial Performance Evaluation (Initial Performance Evaluation) to summarize the corrective actions completed to date at the Elk River Landfill (ERL or Site; Figure 1) per the Groundwater Corrective Action Work Plan (Work Plan; Barr, 2021). This Initial Performance Evaluation also includes an assessment of the corrective action protectiveness to human health and the environment based on the approved potable well replacements and the initial three years of monitored natural attenuation (MNA) data collected at and downgradient of the Elk River Landfill per the Work Plan.

Consistent with Minnesota Pollution Control Agency's (MPCA) process for evaluating corrective actions at solid waste facilities, ERL has evaluated the physical setting and hydrogeologic framework at and in the vicinity of the Site (Barr, 2015a), the extent and magnitude of vinyl chloride in groundwater (Barr, 2016 and 2018), groundwater geochemical conditions and organics concentration trends (Barr, 2020a, 2020b, 2023), and the feasibility of implementing various groundwater corrective action alternatives (Barr, 2019 and 2020b). As a result of this process, monitored natural attenuation (MNA) and residential water supply replacement (Alternative #1; Barr 2020b) was selected as the most cost-effective alternative that achieves the best balance of the feasibility criteria (assuming MNA is sufficient).

The primary and near-term goal for implementing corrective action at ERL is to protect human health by preventing exposure to organic compounds in water supply wells. The secondary, longer-term corrective action goal is to increase the certainty of protectiveness by meeting appropriate groundwater criteria at the facility. Vinyl chloride and trichloroethylene (TCE) are the constituents of concern (COCs) and the drivers for consideration of corrective actions at the Site (Barr, 2020b). Based on TCE's limited extent (and overlap with vinyl chloride) in groundwater at ERL, the Initial Performance Evaluation primarily focuses on vinyl chloride.

The Initial Performance Evaluation is organized into the following sections:

- Section 2, Background, describes the facility, the existing groundwater monitoring program, area water supply wells, and the hydrogeologic conceptual site model.
- Section 3, Corrective Action Implementation, describes actions taken to protect human health by replacing water supply wells, augmenting the groundwater monitoring network, and conducting initial performance monitoring.
- Section 4, Natural Attenuation Evaluation, provides an evaluation of the initial three years of natural attenuation data collected, including a review of geochemical conditions, plume stability, concentration trend analyses, and estimated attenuation rates.
- Section 5, Initial Protectiveness Evaluation, provides an evaluation of the corrective action approach based on the primary and secondary corrective action goals.
- Section 6, Next Steps, describes the planned actions, sequencing, and schedule for upcoming work.

2 Background

The following sections provide an overview of the Site background.

2.1 Facility Description

ERL is authorized for operation as a solid waste disposal facility by the MPCA under Solid Waste Permit SW-74 and licenses and permits from Sherburne County and the City of Elk River. ERL was initially permitted for waste disposal in 1972. A portion of the landfill, including cells 1 through 5, 7, 9, and the northern portion of cell 6 (6N), was constructed prior to the effective date of Resource Conservation and Recovery Act (RCRA) Subtitle D regulations. This Pre-Subtitle D area consists of 28.1 acres of unlined landfill cells which contain approximately 5 million cubic yards of waste that was placed between 1972 and 1990 (approximately). Waste Management acquired ERL in 1995 after unlined filling had ceased. Unlined landfill cells 1 through 5, 7, and 9 are capped (closed) with final cover or covered with lined construction and demolition (C&D) debris disposal cells DC-1 through DC-3. Cell 6N was constructed with a Pre-Subtitle D liner consisting of 80-millimeter-thick, high-density polyethylene and a leachate collection system. All landfill cells other than those described previously in this Section 2.1, including C&D debris disposal cells DC-4A and DC-5A, were constructed with composite liners and leachate collection systems. The leachate collected from the lined cells is disposed off-site at publicly owned treatment facilities. Figure 2 shows the Site layout and groundwater monitoring locations. MPCA Permit SW-74 provides additional details on ERL's construction and operating history.

2.2 Groundwater Monitoring Program

The ERL established the current monitoring program in accordance with the requirements of Minnesota State Rules 7035.2815, subpart 14 and Solid Waste Permit SW-74 (MPCA, 2015). Routine monitoring events are based on Permit SW-74 as reflected in the Sampling and Analysis Plan (SAP) dated November 2021 and subsequent updates (Barr, 2022), annual reports, and recommendations made under separate covers. Groundwater sampling is conducted by Alliance Technical Group of Circle Pines, Minnesota (Alliance). Alliance works in a similar capacity for the MPCA, including groundwater sampling at various closed landfill facilities in the State of Minnesota. Groundwater samples are analyzed by Pace Analytical National Center for Testing and Innovation in Mount Juliet, Tennessee (Pace National). Pace National is accredited by the Minnesota Department of Health (MDH) for groundwater testing.

The 2023 groundwater monitoring network includes approximately 51 monitoring wells and seven piezometers for a total of 58 monitoring locations (Figure 2). The monitoring network targets the outwash to provide early detection of potential releases and will be used for ongoing monitoring of corrective actions. The lower outwash is a sand deposit overlain (confined) by fine-grained till. The lower outwash is present from approximately 60 to 100+ feet below ground surface (bgs) west of the landfill, is laterally continuous beneath ERL and Rice Lake/Tibbits Brook (RL/TB) (Barr, 2018), and is the focus of the corrective actions based on the presence of organics in groundwater. Most wells identified with a "C" suffix are screened at the top or middle of the lower outwash. Most wells identified with an "L" are constructed at the bottom of the lower outwash deposit, near the bedrock (or at comparable elevations near cell 20

where the bedrock surface drops in elevation). Monitoring wells P-29D and P-311D are screened in the uppermost bedrock aquifer, the Mt. Simon Sandstone, for vertical groundwater compliance monitoring purposes (Barr, 2022). Table 1 identifies the hydrostratigraphic unit in which each well is completed and well construction details are provided in Table 2.

2.3 Area Water Supplies

The ERL and surrounding area are not serviced by public water. Water at the ERL office is provided by a 360-foot well (unique ID #420558) referred to as the ERL Shop Well (Barr, 2020b). With the exception of the Ridges of Rice Lake Development community supply well (unique well ID #626766) and the seven replacement water supply wells located immediately southwest of the Site¹, residences downgradient of the Site have individual domestic water supply wells that are known or assumed to be completed in the lower outwash unit. The Ridges of Rice Lake Development well is completed in an outwash near the base of buried bedrock valley between 294 and 325 feet bgs (approximate elevations 699-668 feet relative to mean sea level [MSL]), and the water supply wells located within a half mile of the Site are completed to total depths of 299 feet or more in the Mt. Simon Aquifer or deep sand (similar to the Ridges of Rice Lake Development well).

The ERL samples (i.e., offers to sample) nine domestic wells, the Ridges of Rice Lake community supply well, and the ERL Shop well annually per Permit SW-74. Nine additional residential wells have been sampled as part of past hydrogeologic investigations (Barr, 2018); four of these wells are subject to ongoing sampling (contingent on owner's permission) as part of Work Plan implementation. No organics have been detected in the residential wells. Appendix A provides a summary of the water supply wells located west of the Site (Table A1) and includes water supply well sampling results from 2011 – 2023 (Table A2). The locations of the area residential wells are shown on Figure 3.

2.4 Hydrogeologic Conceptual Model

Detailed hydrogeologic studies have been completed at ERL (Geomatrix, 1998, 1999, and 2000), the North Development Area (NDA; Geomatrix, 2003), the South Development Area (SDA; Geomatrix, 2005a), and in/near RL/TB (Geomatrix, 2004a, 2005b, and 2007; Barr, 2016 and 2018). These investigations have included geologic core logging, installation of monitoring wells, and collection of hydrogeologic data. The hydrogeologic investigation report for the NDA was submitted as part of the facility permitting process (Geomatrix, 2003). The NDA is permitted and partially developed for the disposal of C&D debris and approved industrial waste. A revised hydrogeologic investigation report for the SDA was submitted in 2005 (Geomatrix, 2005a). The investigation of groundwater flow and water quality west of the landfill in the vicinity of RL/TB began in 2003 and was completed in 2018. The findings from these investigations were incorporated into site-wide hydrogeologic evaluation reports (Barr, 2015a, 2016, and 2018) and are incorporated into the following hydrogeologic conceptual model.

¹ Six residential wells were replaced per the Work Plan. One residential well was replaced in 2015.

The geology at ERL includes 100 to 200 feet of glacial deposits overlying Paleozoic bedrock (Figure 4). The predominant glacial deposits include two outwash units, referred to as the upper and lower outwash, and sandy-silt textured till that is the result of ice advances from the northeast (i.e., Cromwell and older Pre-Wisconsinan tills). The upper outwash consists primarily of fine-to-medium sand and varies in thickness from 130 feet (the bottom 10 to 40 feet of which is saturated) on the east side of the Site to less than 10 feet in some areas west of the Site where the unit is confined by a surficial till deposit (Cromwell and/or New Ulm locally). Farther west of the Site, the upper outwash merges into RL/TB. The lower outwash generally grades downward from fine-to-medium sand to coarse sand with discontinuous gravel lenses near the base of the unit. The lower outwash extends west of the Site beneath and beyond the RL/TB (Barr, 2016 and 2018) (Figure 5). The till is present approximately 80 feet bgs east of the Site and at the ground surface to the west, largely due to ground surface elevation changes. The till is inferred to be discontinuous under the central (Pre-Subtitle D) portion of ERL (Barr, 2015b). The Eau Claire Formation, a regional confining unit, is the uppermost continuous bedrock unit at the Site. The Eau Claire Formation forms a local bedrock high in the southwestern portion of the Site and, in places, is capped by clayey, Pre-Wisconsinan till and/or a thin mantle of fine sandstone/siltstone from the basal Wonewoc Formation (Barr, 2015a). The Mount Simon Sandstone is the uppermost bedrock aquifer in the area and is underlain by crystalline Pre-Cambrian bedrock.

The upper and lower outwash units constitute the uppermost permeable groundwater flow pathways at the Site. The groundwater flow direction in the lower outwash unit is east-to-west in the central portion of the Site and transitions to the southwest in the southern portion of the Site (Figure 6). Groundwater at the base of the lower outwash flows to the west-southwest beneath RL/TB and is likely somewhat constrained near the Site by the local bedrock high. Vertical hydraulic gradients are downward between the upper and lower outwash units in the east, central, and southern portions of the Site, indicating the potential for downward flow/recharge in these areas. Upward vertical gradients are present between the lower outwash and RL/TB. Based on the magnitude of the upward gradient, the potential for groundwater discharge from the lower outwash through the till to RL/TB exists.

2.5 Conceptual Release Model

ERL has been the subject of numerous hydrogeologic investigations and more than 40 years of groundwater monitoring. The evidence from these activities points to both leachate and landfill gas from the Pre-Subtitle D area as the source area for organic impacts to groundwater at ERL (Barr, 2020b and 2015a; Geomatrix, 1998).

Past corrective actions, including final cover placement and the installation of an active gas extraction system, appear to have significantly reduced the magnitude of the release from the Pre-Subtitle D area. Additionally, in response to a slug of leachate that affected groundwater observed at well P-17C, ERL installed and operated a diffusive oxygen system to degrade non-chlorinated organics via cometabolic degradation between 2003 and 2008. As a result of the past corrective actions, the Pre-Subtitle D portion of the facility appears to have diminished as a source, and the high organics concentrations documented in groundwater at wells P-17C and P-43B in the early to mid-1990s are no longer present in groundwater near/southwest of the Pre-Subtitle D portion of the facility (Barr, 2020b).

West-southwest of the facility, low concentrations of vinyl chloride and other organics in groundwater are limited to the base of the lower outwash (Barr, 2018). Water quality data from 2023 indicate the western (distal) fringe of the vinyl chloride plume is between wells P-334L and P-342L (Figure 2). Vinyl chloride and other volatile organic compounds (VOCs) were not detected in 2023 samples from well P-342L; however, vinyl chloride was detected above the Health Risk Limit (HRL) in 2023 at well P-334L and P-694477 (Barr, 2024). Based on the Site history, the leading edge of the plume is anticipated to result from higher vinyl chloride concentration flux from the 1990s (or prior; Barr, 2020a), and current vinyl chloride flux appears to be substantially lower, likely as a result of past groundwater corrective actions (i.e., final cover, active gas extraction, and the P-17C Area diffusive oxygen system). The groundwater velocity in the lower outwash unit (where organics mass transport is occurring) is estimated to be approximately 117 feet/year, based on the observed extent of organics downgradient of the landfill.

2.6 Corrective Action Approach

The corrective action approach involves preventing vinyl chloride exposure to downgradient residents by replacing residential water supply wells with deeper wells and the development of a groundwater monitoring network and program to evaluate and document the effects of natural attenuation (Barr, 2021). Corrective action activities completed to date are summarized in Section 3.

A framework to manage monitoring-triggered contingencies in a timely fashion was also established (Barr, 2021). Scenarios that would trigger contingency actions include:

1. Organic compound detection in a water supply well sample; and
2. Confirmed organic compound detection in a sentinel well sample.

Table 3 summarizes the contingency scenarios, actions, and approximate implementation timing. Each scenario relates to the detection of an organic compound(s) in groundwater that is attributable to ERL at a water supply well or a monitoring well. No contingencies have been triggered by monitoring results to date.

3 Corrective Action Implementation

The following sections describe corrective actions completed since the Work Plan was published (Barr, 2021).

3.1 Water Supply Well Actions

The Work Plan presented an evaluation of water supply wells in the context of plume location combined with other factors to determine well replacements. Based on the evaluation presented in the Work Plan, ERL replaced selected four residential wells for replacement (Unique Well IDs 00626780 and 00655131 and MPCA well IDs ZW00214 and ZW00215). ERL also voluntarily replaced the residential wells to the two southernmost residences in the neighborhood southwest of the landfill (Unique Well IDs 00527979 and 00638355) despite them being located beyond the evaluation criteria presented in the Work Plan. Each replacement well was installed in a deeper hydrogeologic unit that is not in communication with the lower outwash (i.e., the Mt. Simon Sandstone or outwash at the base of the bedrock valley). A summary of well replacement activities is included in Appendix B, and replacement well locations are shown on Figure 7.

Permitting, drilling, well installation, development, pump installation, and connection work were conducted by a licensed well contractor in accordance with Minnesota Rules Chapter 4725 (Well Code) and applicable rules/codes. Water samples were collected by the driller at the end of well development activities and analyzed for general parameters required by Minnesota Rule 4725.5650 (e.g., coliform bacteria, nitrate-nitrogen, and arsenic). ERL also collected a water sample for organic compounds analysis (via USEPA Method 8260) to verify the groundwater is free of organics (data are included in Appendix A). In 2023, after the wells were connected to the residences, water samples were collected from the kitchen spigots for lead and manganese analysis per MDH guidance (MDH, 2022). Organics were not detected in any of the replacement wells and other analyte concentrations met applicable groundwater criteria. After the connections were completed and the new well was operational, the original water supply wells (plus an additional well encountered at 12163 223rd Avenue NW) were sealed by the licensed well contractor. The southernmost replacement well (22130 Quinn St. NW) has not yet been connected to the residence due to owner non-responsiveness. The Well Construction Records and Well Sealing Records are included in Appendix B.

Four additional wells (Unique Well IDs 00625475, 00720300, 00608116, and 1000022317) are sampled per the Work Plan (see Figure 7 for locations). Sample results are included in Appendix A. Organics were not detected in any of the samples collected at these locations and other analyte concentrations met applicable groundwater criteria.

3.2 Monitoring Network Enhancements

Four monitoring wells were installed to supplement the groundwater network downgradient of ERL per the Work Plan. Monitoring well locations are shown on Figure 2, construction details are summarized in Table 2, and well logs are included in Appendix C.

- Well P-338L was installed between wells P-325L/P-326L and well P-334L to monitor organics concentrations along the plume centerline. The groundwater data from this location is used to assess the stability of the organics plume, refine the degradation rate estimates, and assess in-plume groundwater geochemical conditions.
- Well P-340L was installed along the northwestern corner of the ERL property, north of P-328L and west of P-327L, as requested by Sherburne County. Data from this location is used for sentinel monitoring, better constraining the plume delineation west-northwest of the Pre-Subtitle D area, and for providing additional hydraulic head data near the northern edge of RL/TB.
- Well P-341L was installed south of the plume and used for sentinel monitoring, better constraining the plume delineation to the southwest, assessing geochemical conditions and groundwater flow direction south of the plume. Data from this well is also considered in groundwater contingency monitoring.
- P-342L was installed at the base of the lower outwash aquifer downgradient of well P-334L (i.e., beyond the current delineated plume extent) to assess plume stability and geochemical conditions near/beyond the plume terminus. A groundwater sample was collected from a temporary well screened at the top of the lower outwash aquifer due to the greater-than-anticipated thickness of the lower outwash aquifer observed during the installation of P-342L. The observed thickness of the lower outwash at P-342L (58 feet) was 34 feet greater than the lower outwash at upgradient location P-334L (24 feet). Vinyl chloride was not detected in P-342L or the temporary well.

As detailed in Appendix C, drilling and monitoring well construction were conducted by a licensed well contractor in accordance with Minnesota Well Code. Drilling was conducted using rotasonic techniques using field methods that were largely consistent with previous well installation efforts at the Site.

One well, P-339L, was planned for installation downgradient of well P-334L for sentinel MNA monitoring purposes; however, this well has not been installed because the property owner has not granted access for well installation². As a result, P-342L was installed in an accessible area and the installation of P-339L further downgradient (Figure 8) is delayed until access is granted by the landowner.

3.3 Initial Performance Monitoring (2021-2023)

The MNA network includes the following wells located in and outside of the vinyl chloride plume.

- Near source (landfill edge): P-17C, P-302C, P-304C, and P-308L
- Downgradient (compliance boundary): P-313C, P-321L, and P-323L
- Mid-plume (property boundary): P-325L, P-326L, P-338L

² The property owner provided (and continues to provide) access to install and monitor wells P-333L and P-342L.

-
- Distal Plume: P-334L, P-342L
 - Sentinel: P-339L (planned location – see Section 3.2 for details)
 - Upgradient: P-22L
 - Sidegradient: P-340L and P-341L

The locations of existing and planned monitoring wells are shown on Figure 8. The MNA network provides spatial coverage in the plume and achieves the criteria for verification and long-term monitoring phases for natural attenuation remedies (USEPA, 1998; MPCA, 2006). The parameters analyzed as part of the natural attenuation monitoring program are based on USEPA (1998) and MPCA (2006) technical protocols for evaluating natural attenuation and include:

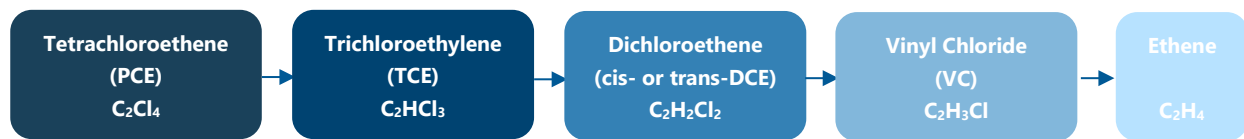
- Vinyl chloride and other organic compounds on the USEPA Method 8260 list. The vinyl chloride and organics concentration data which are used to assess point-specific concentration trends, organics degradation rates, precursor-daughter product ratios, and plume stability;
- Field parameter data (e.g., dissolved oxygen, oxidation-reduction potential, conductivity, pH, temperature) which are used to assess geochemical conditions in and around the plume; and
- Natural attenuation indicator parameter data (i.e., methane, ethane, ethene, total organic carbon, sulfate, sulfide, manganese species, and iron species) which are used to assess groundwater redox state and support the evaluation of natural attenuation pathways, mechanisms, and/or limitations.

MNA monitoring was conducted in conjunction with routine triannual groundwater monitoring events (i.e., spring, summer, and fall quarterly events) over the period of 2021 to 2023. MNA monitoring results are tabulated in Appendix D and evaluated in Section 4.0. The MNA monitoring results have undergone quality assurance review as described in ERL quarterly monitoring reports published since 2021.

4 Natural Attenuation Evaluation

Natural attenuation includes destructive processes (biodegradation and abiotic degradation) and nondestructive processes (dispersion, sorption, and volatilization) that affect the fate and transport of organic compounds in groundwater systems (USEPA, 1998). Biodegradation is generally considered the most important destructive attenuation mechanism and commonly occurs under strongly reducing groundwater conditions near source areas and under less reducing or aerobic conditions farther away from source areas. In areas with lower organic compound concentrations, non-destructive processes can be more significant than destructive processes. The rates at which these non-destructive processes reduce concentrations are a function of groundwater flow, aquifer, and chemical parameters.

One process for biodegradation of chlorinated ethenes is reductive dechlorination, which occurs under anaerobic/reducing groundwater conditions typically found near source areas. In this process, electron donors (typically hydrogen atoms) sequentially replace chlorine atoms, transforming highly chlorinated compounds (e.g., tetrachloroethylene [PCE] and TCE) into lesser chlorinated compounds and ultimately to ethene, as depicted below.



PCE and TCE are degraded under anaerobic conditions. Vinyl chloride and DCE may be degraded under aerobic or anaerobic conditions. Dechlorination of vinyl chloride is a slower process compared to the biodegradation of more highly chlorinated compounds. Vinyl chloride can also be degraded under less reducing conditions (with the formation of CO₂ and/or methane), under aerobic conditions (aerobic direct metabolism or co-metabolism), or with other abiotic processes in the presence of certain minerals such as magnetite.

The following sections present an evaluation of the initial three years of natural attenuation data at ERL.

4.1 Geochemical Conditions

The following sections present the findings of geochemical analyses performed during Initial Performance Monitoring.

4.1.1 General Indicator Parameters of Reductive Dechlorination

Natural attenuation indicator parameters were monitored at MNA network wells per the Work Plan to better understand subsurface processes influencing the reductive dechlorination downgradient of ERL. The results are included in Appendix D. Summer 2023 data for several parameters presented below are displayed on maps included as Appendix E. The discussion below summarizes the general indicator parameter concentrations in groundwater at ERL.

- Dissolved Oxygen (Figure E1): Dissolved oxygen is routinely measured with a field probe during groundwater sampling at ERL. Past results have been somewhat erratic due in part to suspected groundwater interferences (especially at well P-17C); however, more recent data have been collected with a newer probe and/or field titration kit to improve data quality. Dissolved oxygen concentrations in the lower outwash aquifer along the western edge of ERL are generally around or less than 1 mg/l. These low oxygen conditions are consistent with the confined outwash setting and are conducive to anaerobic biodegradation of chlorinated compounds.
- pH: pH values downgradient of ERL are consistently near neutral (pH 6 to 8) and do not pose issues to the progression of biodegradation.
- Alkalinity (Figure E2): Increasing carbon dioxide concentrations from microorganism activity can increase alkalinity in groundwater through reactions with aquifer materials (NJDEP, 2022). Alkalinity concentrations within the extents of the vinyl chloride distribution are generally 2x to 5x greater than upgradient of ERL at well P-22L, at sidegradient locations wells P-340L and P-341L, and downgradient well P-342L. The alkalinity concentration at well P-334L, located at the distal end of the plume, is comparable to upgradient/background conditions. The increased alkalinity near the western edge of the landfill is conducive to and can be indicative of biological activity in this region of the aquifer with an apparent reduction in activity beyond the property boundary. Alkalinity concentrations (increases) may also be affected by leachate or landfill gas effects.
- Oxidation-Reduction Potential (ORP, Figure E3): ORP is routinely measured with a field probe during groundwater sampling at ERL. Attaining an accurate measurement of ORP can be difficult due to the in-situ heterogeneity in aquifers and redox conditions. Results have been somewhat erratic (especially at well P-17C); however, ORP values indicate an overall reduction in groundwater conditions downgradient of ERL.
- Chloride: Many MNA studies typically utilize chloride concentrations as an indicator of reductive dechlorination as it is released into groundwater during the biodegradation process so that chloride is elevated compared to background conditions. Chloride is not an effective MNA indicator at ERL due to the comparatively low concentrations of chlorinated solvents in groundwater at ERL, the high chloride concentrations in leachate, and the chloride concentrations related to road deicing in the area (e.g., 100s ppm upgradient of ERL). It is noted that chloride concentrations drop from approximately 17 mg/L to 1 mg/L between wells P-334L and P-342L (Appendix D, Table D1).
- Total Organic Carbon (Figure E4): Organic carbon serves as an energy source for microorganisms that drive reductive dechlorination. Organic carbon concentrations greater than 20 mg/l are desired in an area with anaerobic biodegradation. Organic carbon concentrations are greatest along the western facility edge downgradient from the Pre-Subtitle D Area (18 - 41 mg/l) and lower (~2 - 10 mg/L), extending through the plume to P-338L. Low organic carbon concentrations near the detection limit (~1 mg/L) are present along the fringe of the vinyl chloride extents at P-334L. The low organic carbon may be a limiting factor for reductive dechlorination at locations downgradient of the western edge of the landfill but do not prohibit other potential degradation pathways.

- Sulfide: Sulfide can be toxic to dechlorinating microorganisms at concentrations greater than 20 mg/L. Where detected, sulfide concentrations were below 1 mg/L in collected samples; therefore, sulfide toxicity does not appear to be a limiting factor to biodegradation.

4.1.2 Terminal Electron Acceptors

Chlorinated ethenes act as electronic acceptors under anaerobic conditions, and organic carbon or other co-mingled organics in groundwater act as electron donors. The progression of terminal electron acceptors (TEA) under groundwater conditions with active biodegradation is well documented and provides additional information regarding prevailing geochemical conditions and attenuation processes. After depletion of dissolved oxygen, nitrate (NO_3^-) is utilized as the preferred TEA followed by reduction of manganese (Mn^{4+}) and iron (Fe^{3+}). Strongly reducing conditions can facilitate use of sulfate (which produces sulfide), and under even stronger reducing conditions, methanogens can use carbon dioxide as an electron acceptor to produce methane. The initial TEA data is discussed below and shown on the referenced figures.

- Dissolved Oxygen (Figure E1): Dissolved oxygen concentrations are generally around or less than 1.0 mg/L in groundwater in the lower outwash downgradient of ERL. These low oxygen conditions are consistent with the confined outwash setting and are conducive to anaerobic biodegradation of chlorinated compounds. While anaerobic settings are necessary to degrade highly chlorinated compounds via reductive dechlorination (PCE and TCE), lesser chlorinated compounds (DCE and vinyl chloride) may also degrade under aerobic settings (i.e., aerobic respiration where vinyl chloride is metabolized by bacteria or mineralization through direct oxidation).
- Nitrate (NO_3^- ; Figure E5): Nitrate is the first TEA utilized for respiration by microorganisms in anaerobic conditions. Nitrate was non-detect at all well locations (where analyzed) over the period of 2021-2023 except for one sample at P-341L located sidegradient of the vinyl chloride extents; therefore, nitrate is either not present or rapidly utilized where present. Based on the absence of nitrate upgradient of ERL, nitrate is not anticipated to be a significant TEA for the groundwater system downgradient of the facility.
- Reduced Iron (Fe^{2+} ; Figure D6) and Manganese (Mn^{2+} ; Figure E6): Ferric iron (Fe^{3+}) and manganese (Mn^{4+}) are utilized as TEAs following exhaustion of nitrate. Compared to background conditions, elevated concentrations of reduced iron (Fe^{2+}) and manganese (Mn^{2+}) are present along the western edge of the landfill. Generally, concentrations of reduced iron above 1 mg/L is indicative of microbial degradation of organic compounds. Reduced iron concentrations are greatest along the western edge of the landfill. The presence of significantly reduced iron and manganese suggests that iron/manganese reduction is the dominant reducing geochemical condition downgradient of ERL.
- Sulfate (SO_4^{2-} ; Figure E7): The absence of sulfate can be used as a TEA to identify strongly reducing conditions. Sulfate is depleted after nitrate, iron, and manganese have been depleted. Sulfate concentrations below 20 mg/L, and lower than background conditions, are generally indicative of active anaerobic biodegradation. P-17C and P-308L have lower concentrations of

sulfate than upgradient well P-22L. Based on the sulfate concentrations (and the presence of dissolved iron and manganese), some sulfate reduction may be occurring in/upgradient of the P-17C/P-308L area; however, sulfate reduction does not appear to be occurring to a significant degree further downgradient of ERL.

- Methane (CH₄, Figure E8): Methane concentrations greater than 0.5 mg/L can signal organics degradation by methanogenesis under strongly reducing conditions. Concentrations at/greater than 0.5 mg/L are present along the western edge of the landfill and the methane distribution generally aligns with the vinyl chloride in groundwater. Strongly reducing conditions are generally not observed farther downgradient of ERL in RL/TB; therefore, methanogenesis is not anticipated to be a significant TEA downgradient of ERL. It is noted that methane concentrations in groundwater at P-302C have been greater than 20 mg/L in most samples collected in recent years. These P-302C methane concentrations are one to two orders of magnitude greater than concentrations at other locations, which may indicate strongly reducing conditions beneath the Pre-Subtitle D portion of the facility and landfill gas effects (although P-302C is completed as a submerged screen in the top of the lower outwash).

4.1.3 Aquifer Matrix – Magnetic Susceptibility Testing

The presence of certain reactive iron-bearing soil minerals such as mackinawite, pyrite, siderite, magnetite, green rust, and goethite with adsorbed Fe (II) in the aquifer can substantially contribute to the overall attenuation of chlorinated compounds in groundwater via abiotic degradation on the mineral surfaces (Hu et al., 2009). These minerals are typically found in iron and/or sulfate-reducing environments. As indicated in the previous section, elevated concentrations of reduced iron are present in the lower outwash aquifer downgradient of ERL. Additionally, abiotic degradation of cis-DCE has been well-studied at another Minnesota site where the primary reactive mineral was magnetite (Ferrey et al., 2004).

Magnetite is the most abundant mineral in natural sediment that exhibits magnetic behavior, but no direct chemical test is available for quantification of magnetite; however, magnetite and the potential for abiotic degradation at/downgradient of ERL was assessed by performing magnetic susceptibility analyses on aquifer materials. The magnetic susceptibility analysis results can then be compared to surface area and degradation rate constant data from microcosms and other sites to assess the potential for abiotic degradation. If there is sufficient magnetic susceptibility in aquifer sediment, magnetic materials may facilitate additional degradation of chlorinated compounds at ERL (i.e., via abiotic processes).

Nine samples of saturated till and outwash units were collected during well installation activities at wells P-342L and P-410L in 2023 for magnetic susceptibility testing by Microbial Insights. The testing results are presented in Appendix F. The magnetic susceptibility values (average = $1.3 \times 10^{-6} \text{ m}^3/\text{kg}$) are consistent with published values at other sites where abiotic degradation of chlorinated compounds is occurring (He et al., 2009), but the associated first-order rate constants for vinyl chloride at ERL are lower than anticipated when compared to the published values. Based on the magnetic susceptibility testing of lower outwash and till samples collected from P-342L and P-410L, it appears that abiotic degradation is a potential attenuation mechanism at ERL, but the overall contribution to the attenuation of vinyl chloride may be limited.

4.1.4 Summary of Geochemical Conditions

Based on the geochemical data described above, conditions are generally suitable for reductive dechlorination near the western edge of ERL, particularly in and downgradient of the P-17C Area. The decrease in concentrations of chlorinated compounds over time in this area and the sparsity of vinyl chloride precursors in groundwater support this finding. The dominant reducing environment in the groundwater system downgradient of the landfill appears to be iron/manganese reduction (which is favorable for reductive dechlorination). Some sulfate reduction may be occurring in the P-17C/P-308L area or beneath the Pre-Subtitle D portion of the facility; however, sulfate reduction does not appear to be significant downgradient of ERL. Near and beyond the property boundary, conditions for reductive dechlorination become less suitable as organic carbon levels are lower. Farther downgradient, corresponding with generally lower vinyl chloride mass, groundwater conditions are more amenable to limited attenuation of vinyl chloride via other mechanisms such as aerobic or abiotic degradation processes.

4.2 Plume Stability

The following sections provide an assessment of the stability of the vinyl chloride plume at ERL.

4.2.1 Vinyl Chloride Plume Extent Delineation

The overall extent of the vinyl chloride plume remains consistent with the delineation provided in the Work Plan (Barr, 2021). No organics (including vinyl chloride) have been detected in samples collected from sentinel wells P-327L, P-340L, P-328L, P-329L, P-333L, P-335L, and P-341L or at well P-342L. The absence of vinyl chloride (and other organics) and low chloride concentrations (~1 mg/L) in groundwater at well P-342L supports the distal extent of vinyl chloride is defined at the base of the lower outwash.

The thickness of the lower outwash encountered during the installation of well P-342L was greater than observed elsewhere in the study area. For comparison, the lower outwash is approximate 58 feet thick at well P-342L and approximately 24 feet thick at well P-334L, which is located approximately 1,000 feet to the east-northeast (upgradient). Due to the increased thickness of the outwash, a temporary well was placed in soil boring B-342, which was placed approximately 21 feet west of well P-342L and screened from 45 to 55 feet below ground surface (i.e., near the top of the outwash deposit). No organics were detected in the groundwater sample from B342. Further discussion of the monitoring well installations, boring B-342, and the thickness of the lower outwash near P-342L are provided in Appendix C.

Given the thickness of the outwash at P-342L, additional groundwater investigation is recommended in the well P-342L area to further evaluate hydrogeologic conditions in the lower outwash within this area.

4.2.2 Well Concentration Trend Analysis

Vinyl chloride concentrations were evaluated using graphical and statistical methods as described below. Concentration plots and the Mann-Kendall statistical analysis are included in Appendix G.

4.2.2.1 Vinyl Chloride Trend Analysis

Overall vinyl chloride trends are summarized below. For wells with sufficient datasets³, a statistical analysis (Mann-Kendall) was performed as a general assessment of the vinyl chloride concentration trends since 2015 (when low-level analysis for vinyl chloride began and the reporting limit was reduced to 0.05 µg/L). The results of the Mann-Kendall statistical analysis are provided in Appendix G and are discussed below by relative area in the vinyl chloride plume. Figure 9 illustrates the well locations with statistically increasing and decreasing vinyl chloride concentration trends (and well locations of stable/no trend). Vinyl chloride concentration trend plots for individual wells are provided on Figure G1.

- Southern two-thirds of the vinyl chloride plume: vinyl chloride concentrations continue to decrease or are stable in groundwater in the central and southern portions of the plume (i.e., approximately the southern two-thirds of the plume) along the western edge of the landfill.
 - o A statistically significant (>95% confidence level) decreasing trend was observed at six locations (wells P-304C, P-313C, P-314C, P-321L, P-323L, and P-326L) in this area of the plume.
 - o A stable or no statistically significant trend was observed at two locations (wells P-308L and P-309C).
 - o No statistically significant increasing trends were observed in this area of the plume.
 - o At several wells located near the compliance boundary (P-313C, P-314C, P-321L, P-323L), vinyl chloride concentrations have decreased to near or below the HRL (and periodically are not detected).
- Northern one-third of the vinyl chloride plume: vinyl chloride concentrations in the northern portion of the plume along the western edge of the landfill have generally been stable except for P-302C, which has shown an increasing trend.
 - o No statistically significant decreasing trends were observed in this area of the plume.
 - o A stable or no statistically significant trend was observed at six locations (P-29C, P-301C, P-320C, P-320C2, P-320L, and P-325L).
 - o A statistically significant increasing vinyl chloride trend was observed at one location (P-302C).
 - o Vinyl chloride concentrations at well P-321L, located upgradient of P-325L, peaked around 2016 and have since decreased. The observed increase in concentrations during 2020-2021 at P-325L may be related to the downgradient migration of groundwater previously observed at P-321L. Vinyl chloride concentrations at P-325L subsequently decreased in 2022-2023.
- Vinyl chloride concentrations in the distal (western) portion of the plume generally show increasing trends; however, vinyl chloride was not detected downgradient of P-334L.

³ Eighteen wells did not have enough data above the reporting limits for vinyl chloride to complete the trend analysis. See Appendix G for details.

- o A statistically significant increasing trend was observed at two locations (P-334L and P-694477). Vinyl chloride concentrations at these locations have been increasing since approximately 2020.
- o Consistent with previous results, no vinyl chloride was detected at distal wells P-333L, P-335L, or P-342L located downgradient of the plume.
- o There is insufficient data above reporting limits to complete the trend analysis at the other locations where vinyl chloride has been detected in the distal part of the plume (P-338L).
- o Based on historic organics concentration data at ERL and estimated groundwater flow velocities, it is possible that the remnants of the slug of elevated organics concentrations observed at P-17C in 1994 may be reaching the distal portion of the plume (Barr, 2020a)

It is noted that the statistical trend analysis of vinyl chloride concentrations can be complicated/misleading where higher chlorinated precursor compounds are present and sequential dechlorination is occurring due to variable reaction rates that degrade precursor compounds (such as TCE and DCE) to produce daughter compounds (such as vinyl chloride). In such cases, stable or increasing concentration trends for daughter products, such as vinyl chloride, may be the result of more rapid precursor product degradation that results in increased daughter product concentrations, which results in masking the actual degradation rate of the daughter product (which occurs at a slower rate).

4.2.2.2 Vinyl Chloride Precursors and Molar Mass Concentrations

Chlorinated ethene precursors to vinyl chloride in the reductive dechlorination attenuation process, including TCE and cis-1,2-dichloroethene (cDCE), are present in groundwater along and downgradient of the western edge of the landfill in the vicinity of the P-17C Area (Figure E10). Over the period of 2021 to 2023, TCE was detected in groundwater at three wells P-304C, P-313C, and P-323L). cDCE was also detected in groundwater at each of the three locations where TCE was detected but also extended further downgradient to wells P-338L and P-694477 (Figure E10). Time series plots for these compounds, in addition to total chlorinated ethene molar concentrations (molar tCVOCs), at these wells are included in Appendix G (Figure G2). Concentrations of TCE, cDCE, and molar tCVOCs at these wells show stable or declining trends.

As described in Section 4.0, vinyl chloride is produced as a daughter product via reductive dechlorination from cDCE. The sequential dechlorination pathway (stepwise removal of a chlorine atom and replacement with hydrogen atom), which includes cDCE and vinyl chloride, is commonly from more highly chlorinated compounds tetrachloroethylene (PCE) and TCE. Because vinyl chloride is a daughter product of cDCE dechlorination, the extent of vinyl chloride in groundwater can be directly related to where cDCE degrades to vinyl chloride along the flowpath. For example, 1 µg/L of cDCE degrades to an equivalent micromolar mass of vinyl chloride with a concentration 0.6 µg/L⁴ (lower concentration because the molecular weight of vinyl chloride is lower than cDCE); therefore, the low concentrations of cDCE that are observed in

⁴ Similarly, 0.083 µg/L of cDCE degrades to an equivalent micromolar mass of vinyl chloride with a concentration 0.05 µg/L (Intervention Limit).

groundwater can degrade to vinyl chloride concentrations well above the reporting limit (0.05 µg/L). This process can mask the overall magnitude of vinyl chloride degradation. To further explore the relationship of cDCE to vinyl chloride downgradient of ERL, a low-level analysis of cDCE was implemented for 2023 to achieve a lower reporting limit (the reporting limit reduced from 1.0 µg/L to 0.1 µg/L). The low-level analysis results show that cDCE is present in groundwater at P-338L and absent at P-334L where vinyl chloride concentrations have demonstrated an increasing trend recently. As a result, it appears that the degradation of cDCE to vinyl chloride in the P-338L area is contributing to the vinyl chloride concentrations in the groundwater system, thereby extending the vinyl chloride plume downgradient (i.e., to well P-334L). The absence of cDCE in groundwater at well P-334L suggests that vinyl chloride isn't being produced in groundwater at P-334L, which in turn supports a plume terminus downgradient of well P-334L as a result of vinyl chloride attenuation.

4.2.3 Vinyl Chloride Mass Flux

The estimated current mass flux of vinyl chloride from ERL through the cross-sectional plane along the western edge of the landfill is 0.017 lbs/year, which is approximately 70% lower than the estimated vinyl chloride mass flux from 2019 and 82% lower than April 2010 (Appendix H). These low total mass and mass flux estimates reflect the decreasing vinyl chloride concentrations observed along the compliance boundary and are anticipated to result in lower downgradient concentrations at the distal end of the plume. The vinyl chloride mass flux estimates/calculation details are included in Appendix H.

4.3 Estimated Attenuation Rates

Well location specific (k_{POINT}) and overall bulk (k_{BULK}) attenuation rates were calculated to further assess vinyl chloride attenuation rates and develop projections of vinyl chloride travel distance based on the initial performance data. Details on attenuation rate calculations and projections are included in Appendix H.

The attenuation rates and the resulting travel distance projections below should be considered approximations based on existing data (at this time) and the stated assumptions (i.e., not definitive estimates). Further long-term monitoring at current vinyl chloride reporting limits and at recently installed wells is necessary to improve confidence in these estimates and refine them as appropriate. Furthermore, downgradient effects of the previously referenced slug of organics observed from 1992-1994 at monitoring well P-17C may influence the calculated attenuation rates (Barr, 2020a).

4.3.1 Well Location Specific Attenuation Rates and Projections

Location-specific vinyl chloride attenuation rates (k_{POINT}) are useful in assessing trends and projecting time until concentrations reach a certain level (e.g., Intervention Limits) at well locations showing decreasing trends. This evaluation was only applied to vinyl chloride in the central and southern portions of the plume (where decreasing vinyl chloride trends are occurring near the compliance boundary and Property Boundary) and not the northern third of the plume (i.e., north of well P-321L) due to the uncertainty stemming from mixed concentration trends.

Using first-order kinetics and k_{POINT} values, projections for when each of these wells may approach Intervention Limits were calculated. The projections range from approximately one year (i.e., 2025 at P-314C and P-323L) to 12 years (i.e., 2036 at P-321L) and are shown in Appendix H (Table H2). Note that the location-specific attenuation rates may be biased low as they do not account for the conversion of precursor compounds (PCE, TCE, and DCE) to vinyl chloride, which is discussed earlier in this report (i.e., the presence of precursor compounds cDCE (and TCE at P-323L) adds a higher degree of uncertainty to the projections for individual wells and the downgradient wells).

4.3.2 Overall Bulk Attenuation Rates and Projections

Overall bulk vinyl chloride attenuation rates (k_{BULK}) from near the source area (P-308L) to the distal well (P-342L) were estimated using trend line analysis methods outlined in MPCA guidance (MPCA, 2006). A primary assumption in applying this method is that the vinyl chloride and other organics have achieved a steady state (i.e., the plume is not expanding). Despite some year-to-year variability in concentrations, it is reasonable to assume a steady-state extent given the long operational history of the facility and non-detect concentrations at distal well P-342L. This assumption is subject to change based on the results of the proposed investigation referenced in Section 4.2.1. The investigation results and continued monitoring at wells along the fringes of the plume will provide further insight into the overall stability of the organics downgradient of ERL. The steady-state assumption was applied to conduct overall vinyl chloride attenuation rate calculations using data from the Summer 2019, 2021, and 2023 monitoring events and the resulting bulk overall vinyl chloride attenuation rate based on vinyl chloride data and total molar concentrations (which incorporate vinyl chloride precursor products) ranged from 0.023 to 0.103/yr (Appendix H). Theoretical projections based on these overall bulk attenuation rates are included in Appendix H.

4.4 Summary

The initial three years of natural attenuation data at ERL provide the following lines of evidence that support the biodegradation of vinyl chloride (and other organics) in groundwater at the ERL.

- Geochemical conditions are conducive to natural attenuation: The dominant reducing environment in the groundwater system downgradient of the landfill appears to be iron/manganese reduction with limited evidence of sulfate reduction in the P-17C/P-308L area. These conditions are favorable for reductive dechlorination near the landfill. Farther downgradient, corresponding with generally lower vinyl chloride mass, groundwater conditions are more amenable to limited attenuation of vinyl chloride via other mechanisms such as aerobic or abiotic degradation processes.
- The vinyl chloride plume has been delineated at the base of the lower outwash: The absence of vinyl chloride (and other organics) and low chloride concentrations (~ 1 mg/L) in groundwater at well P-342L supports the distal extent of vinyl chloride at the base of the lower outwash is defined.

-
- Vinyl chloride and precursor concentrations are predominantly decreasing/stable along the western edge of the landfill: Vinyl chloride concentration trends in wells positions along the western side of the landfill continue to show decreasing or stable concentrations over the majority of the plume with limited exceptions.
 - The estimated mass flux of vinyl chloride from ERL has significantly decreased over recent years: the mass flux of vinyl chloride from the landfill since 2010 indicates a reduction of organics to groundwater (akin to source reduction) or an increase in degradation in groundwater beneath the Pre-Subtitle D portion of the landfill.

5 Initial Protectiveness Evaluation

Considering the water supply well replacement activities identified in the Work Plan have been completed (Section 3.1), no organics have been detected in the residential water supply wells downgradient of ERL (Appendix A), no new water supply wells have been identified in locations that necessitate monitoring or replacement (Appendix A), no groundwater contingencies have been triggered over the last three (and prior) years (Section 2.6), and the distal extent of vinyl chloride is defined at the base of the lower outwash (Section 4.2.1) the groundwater corrective actions are judged to be protective of human health by preventing exposure to organic compounds in water supply wells. As such, aside from continued monitoring per Permit SW-74 and the Work Plan (Barr, 2021) as updated in this report, no additional actions regarding water supply wells are warranted at this time.

Per the Work Plan, MNA monitoring will continue, and a performance evaluation report (5-Year Evaluation) will be prepared as a standalone report after completing additional MNA monitoring data. The 5-Year Evaluation will include updates of evaluations performed in this Initial Performance Evaluation. If appropriate, the report will include proposed alternative compliance criteria that are developed from Site data and refined attenuation rates⁵. The general concept for developing alternative criteria involves back-calculating alternative criteria concentrations at specific wells using the refined attenuation rates⁶. If the performance evaluation demonstrates that the corrective actions are not protective, ERL will provide a schedule and details for designing and implementing supplemental corrective actions described in the Groundwater Corrective Actions Evaluation Report (CAER; Barr, 2020b) to address vinyl chloride in the groundwater.

The five-year protectiveness determination will be based on professional judgment of multiple lines of evidence from the additional data collected over the next two years. As part of this evaluation, organics trends along the downgradient edge of ERL will be considered. If areas where increasing organic concentration trends persist at levels above the demonstrated natural attenuation capacity, ERL will provide a recommendation regarding the need to implement focused corrective actions presented in the CAER (e.g., in-situ injections, groundwater extraction) to address those areas.

⁵ The attenuation rates that alternative criteria will be refined as additional data are collected from the MNA well network; therefore, proposal of alternative criteria may not be appropriate in the first 5-Year Evaluation.

⁶ Examples of calculations that may be used to develop proposed alternative criteria are included in Appendix H.

6 Next Steps

The proposed next steps with planned implementation sequencing are summarized below.

- Continue monitoring for MNA parameters (2024-2026; Table 4 and Table 5) and collect concentration data to establish trends at recently installed wells in the vicinity of the delineated plume (e.g., wells P-338L and P-342L).
- Scope and implement a groundwater investigation in the vicinity of well P-342L to further characterize the nature and geometry of the lower outwash and further evaluate hydrogeologic conditions in the lower outwash. A work plan will be submitted in October 2024 (approximate) with the intent to implement the work plan during the 2024-2025 winter season (assuming access is provided by the landowners and field conditions support the safe completion of the work).
- Install monitoring well P-339L if access is granted by the landowner. If access is granted, the MPCA and others will be notified at least two weeks prior to mobilization.
- Prepare the 5-Year Groundwater Corrective Action Performance Evaluation as described in the work plan. The report will be submitted near the end of the first quarter of 2027.

MNA data collected during the routine groundwater monitoring events will continue to be included in quarterly monitoring reports, summarized in Annual Water Quality Monitoring Reports, and reviewed in the context of historical data and the contingency action triggers in the Work Plan. The annual report summaries will include logs for newly installed wells, trend plots of chlorinated organics concentrations, statistical evaluation of vinyl chloride concentrations, discussion of geochemical conditions, and updates to the MNA monitoring plan for the ensuing year.

7 References

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Tables

Table 1
2023 Groundwater Monitoring Summary
Elk River Landfill
Elk River, Minnesota

Monitoring Point	Unique Well ID ¹	Annual Sampling Frequency in SAP ²	2023 Sampling and Analysis Summary ³	2023 Well Status	Unit Monitored	Well Screen Placement
<u>Monitoring Wells</u>						
P-17C	496278	1x	VOCs (1), Inorganics (1)	In Network (NC), GWCAM	Till/Lower outwash	S
22-OWA	420729	1x	VOCs (1), Inorganics (1)	In Network	Upper outwash	WT
P-22L	801470	1x	VOCs (1), Inorganics (1)	In Network, GWCAM	Lower outwash (bottom)	S
P-29C	496289	3x	VOCs (3), Inorganics (1)	In Network	Lower outwash (bottom)	S
P-29D	496294	3x	VOCs (3), Inorganics (1)	In Network	Bedrock	S
36-OWA	498324	--	Depth to water	WL only	Upper outwash	WT
301-OWA	598567	1x	VOCs (1), Inorganics (1)	In Network	Upper outwash	WT
P-301C	598562	3x	VOCs (3), Inorganics (1)	In Network	Lower outwash	S
P-301L	767989	3x	VOCs (3), Inorganics (1)	In Network	Lower outwash (bottom)	S
302-OWA	598568	1x	VOCs (1), Inorganics (1)	In Network	Upper outwash	WT
P-302C	598563	3x	VOCs (3), Inorganics (1)	In Network, GWCAM	Lower outwash	S
P-303C	598532	1x	VOCs (1), Inorganics (1)	In Network	Upper outwash	S
P-304C	598565	3x	VOCs (3), Inorganics (1)	In Network, GWCAM	Lower outwash	S
P-305C	598566	3x	VOCs (3), Inorganics (1)	In Network	Lower outwash	S
P-308C	621858	1x	VOCs (1), Inorganics (1)	In Network (NC)	Lower outwash	S
P-308L	836661	--	VOCs (2), Inorganics (1)	GWCAM (NC)	Lower outwash	S
P-309C	635420	1x	VOCs (1), Inorganics (1)	In Network (NC)	Lower outwash	S
P-310C	646855	1x	VOCs (1), Inorganics (1)	In Network	Upper outwash	S
P-311C	646854	1x	VOCs (1), Inorganics (1)	In Network	Upper outwash	S
P-311L	801471	3x	VOCs (3), Inorganics (1)	In Network	Lower outwash (bottom)	S
P-311D	650145	3x	VOCs (3), Inorganics (1)	In Network	Bedrock	S
312-OWA	646853	1x	VOCs (1), Inorganics (1)	In Network	Upper outwash	WT
P-313C	969668	3x	VOCs (3), Inorganics (1)	In Network, GWCAM	Lower outwash	S
P-314C	969669	3x	VOCs (3), Inorganics (1)	In Network	Lower outwash	S
315-OWA	696663	1x	VOCs (1), Inorganics (1)	In Network	Upper outwash	WT
P-315L	722063	3x	VOCs (2), Inorganics (1)	In Network	Lower outwash	S
317-OWA	696666	--	Depth to water	WL only	Upper outwash	WT
P-317L	722092	--	Depth to water	WL only	Lower outwash	S
P-320C	737638	3x	VOCs (3), Inorganics (1)	In Network	Lower outwash	S
P-320C2	756593	3x	VOCs (3), Inorganics (1)	In Network	Lower outwash	S
P-320L	737637	3x	VOCs (3), Inorganics (1)	In Network	Lower outwash (bottom)	S
P-321L	767990	3x	VOCs (3), Inorganics (1)	In Network, GWCAM	Lower outwash (bottom)	S
P-322L	767991	3x	VOCs (3), Inorganics (1)	In Network	Lower outwash (bottom)	S
P-323L	786203	3x	VOCs (3), Inorganics (1)	In Network, GWCAM	Lower outwash (bottom)	S
P-324L	786202	3x	VOCs (3), Inorganics (1)	In Network	Lower outwash (bottom)	S
P-325L	804281	3x	VOCs (3), Inorganics (1)	In Network, GWCAM	Lower outwash (bottom)	S
P-326L	804282	3x	VOCs (3), Inorganics (1)	In Network, GWCAM	Lower outwash (bottom)	S

Table 1
2023 Groundwater Monitoring Summary
Elk River Landfill
Elk River, Minnesota

Monitoring Point	Unique Well ID ¹	Annual Sampling Frequency in SAP ²	2023 Sampling and Analysis Summary ³	2023 Well Status	Unit Monitored	Well Screen Placement
P-327L	812996	1x	VOCs (1), Inorganics (1)	In Network, GWCAS	Lower outwash (bottom)	S
P-328L	812994	1x	VOCs (1), Inorganics (1)	In Network, GWCAS	Lower outwash (bottom)	S
P-329L	812995	3x	VOCs (3), Inorganics (1)	In Network, GWCAS	Lower outwash (bottom)	S
P-333L	828060	2x	VOCs (2), Inorganics (1)	In Network, GWCAS	Lower outwash (bottom)	S
P-334L	828061	3x	VOCs (3), Inorganics (1)	In Network, GWCAM	Lower outwash (bottom)	S
P-335L	828062	3x	VOCs (3), Inorganics (1)	In Network, GWCAS	Lower outwash (bottom)	S
336-OWA	853108	1x	VOCs (1), Inorganics (1)	In Network	Upper outwash	WT
337-OWA	853109	1x	VOCs (1), Inorganics (1)	In Network	Upper outwash	WT
P-337L	853110	1x	VOCs (1), Inorganics (1)	In Network	Lower outwash (bottom)	S
P-338L	853139	3x	VOCs (3), Inorganics (1)	In Network, GWCAM	Lower outwash (bottom)	S
P-340L	953140	1x	VOCs (1), Inorganics (1)	In Network, GWCAS	Lower outwash (bottom)	S
P-341L ⁴	877298	1x ⁵	VOCs (2), Inorganics (2)	Baseline, GWCAS	Lower outwash (bottom)	S
P-342L ⁴	871179	2x ⁵	VOCs (2), Inorganics (2)	Baseline, GWCAM	Lower outwash (bottom)	S
401-OWA	683321	1x	VOCs (1), Inorganics (1)	In Network	Upper outwash	WT
402-OWA	683320	--	Depth to water	WL only	Upper outwash	WT
P-403C	683318	2x	VOCs (1), Inorganics (2)	In Network	Upper outwash	S
405-OWA	683316	--	Depth to water	WL only	Upper outwash	WT
406-OWA	683317	--	Depth to water	WL only	Surficial outwash	WT
407-OWA	683315	--	Depth to water	WL only	Surficial outwash	WT
408-OWA	717920	2x	VOCs (1), Inorganics (2)	In Network	Upper outwash	WT
P-694477 ⁶	694477	3x	VOCs (3), Inorganics (1)	In Network	Lower outwash	S
Residential Wells						
22447 Tipton St	813437	1x	VOCs (1), inorganics (1)	per Permit SW-74	--	--
12163 223rd Ave	876409	1x	VOCs (1), inorganics (1)	per Permit SW-74	--	--
12269 223rd St	876410	1x	VOCs (1), inorganics (1)	per Permit SW-74	--	--
12265 223rd Ave ⁷	876411	1x	VOCs (1), inorganics (1)	per Permit SW-74	--	--
12183 223rd Ave	846412	1x	VOCs (1), inorganics (1)	per Permit SW-74	--	--
22272 Quinn St	876413	1x	VOCs (1), inorganics (1)	per Permit SW-74	--	--
22130 Quinn St ⁸	638355	1x	VOCs (1), inorganics (1)	per Permit SW-74	--	--
ERL Shop Well	420558	1x	VOCs (1), inorganics (1)	per Permit SW-74	--	--
Ridges Develop.	626766	1x	VOCs (1), inorganics (1)	per Permit SW-74	--	--
22205 Elk Lake Rd	625475	--	VOCs (1), inorganics (1)	GWCAWP	--	--
22275 Elk Lake Rd	720300	--	VOCs (1), inorganics (1)	GWCAWP	--	--

Table 2
Well Information Index
Elk River Landfill
Elk River, Minnesota

Well I.D.	MN Unique Number	Year Installed	Altered or Sealed	Approx. Depth ⁽¹⁾	Screen Interval (ft MSL)	Top of Casing Elevation (ft MSL)	Const Material
1 OW		1979	S/1988	44		974.32	St
1 OWR	443420	1988	S/1999	33	943 - 953	976.69	St
2 OW		1979	S/1988	30		969.80	St
4 OW	420714	1983	S/1999	35	951 - 956	986.40	PVC
5 OW	420715	1983	S/1987	44		984.50	PVC
5 OWA	420721	1985	S/1987	35		984.20	PVC
5 OWR	443421	1988	S/1996	36	948 - 958	983.85	St
6 OW	420716	1983	S/1988	64		1016.15	PVC
7 OW	420717	1983	S/1985	50		988.60	PVC
8 OW	420718	1983	S/1985	45		985.60	PVC
9 OW	420719	1983	S/1985	30		978.00	PVC
10 OW	420720	1984	S/1999	60	922 - 932	981.99	PVC
11 OWA	420722	1985	S/1997	58	951 - 961	1008.64	PVC
12 OWA	420723	1985	S/1996	41	958 - 968	998.50	PVC
P 12A	420724	1985	S/1996	61	937 - 947	997.94	PVC
13 OWA	420725	1985	S/1999	20	952 - 962	971.82	PVC
15 OWA	420726	1985	S/2012	32	961 - 971	993.08	PVC
16 OWA	420728	1985	S/1999	14	944 - 954	958.31	PVC
P 16A	420727	1985	S/1999	31	927 - 937	958.01	PVC
17 OWA	420730	1985	S/2001	32	950 - 960	982.43	PVC
P 17C	496278	1991	Altered: '01, '08; resurveyed	66	917 - 922	982.62	St
18 OWA	420731	1985	S/1997	32	951 - 961	982.50	PVC
19 OWA	420732	1985	S/1997	33	946 - 956	978.70	PVC
P 19A	420733	1985	S/1997	57	922 - 927	978.63	PVC
20 OWA	420734	1985	S/1991	57	994 - 1004	1051.46	PVC
21 OWA	420735	1985	S/1999	16	937 - 947	952.47	PVC
22 OWA	420729	1985		91	949 - 959	1039.68	PVC
P 22L	801470	2013		197	846 - 856	1043.45	St
23 OWA	433112	1987	S/2001	49	938 - 948	987.02	St
24 OWA	433159	1987	S/1997	26	949 - 959	975.24	St
25 OWA	420741	1987	S/1997	23	948 - 958	970.53	St
26 OWA	420743	1987	S/2007	20	946 - 956	966.16	St
P 26A	420742	1987	S/2007	27	940 - 945	967.01	St
27 OWA	420745	1987	S/1999	18	941 - 951	959.04	St
P 27A	420744	1987	S/1999	33	927 - 932	960.08	St
28 OWA	420746	1987	S/2001	36	949 - 959	985.04	St
29 OWA	420747	1987	S/1999	18	941 - 951	959.03	St
P 29A	420748	1987	S/1999	33	925 - 930	958.34	St
P 29C	496289	1991		108	849 - 854	957.16	St
P 29D	496294	1991		265	692 - 702	957.35	St
30 OWA	433149	1987	S/1999	23	933 - 943	956.05	St
P 30C	496291	1991	S/1999	74	882 - 887	955.04	St
31 OWA	433150	1987	S/1992	50	949 - 959	999.31	St
32 OWA	433147	1987	S/1998	47	944 - 954	991.29	St
33 OWA	433151	1987	S/1998	52	951 - 961	1003.08	St
34 OWA	443422	1988	S/1989	984		983.74	PVC
35 OWA	443424	1988	S/1993	37	945 - 955	982.88	PVC
P 35B	443423	1988	S/1993	51	932 - 937	983.75	PVC
36 OWA	498324	1991		75	946 - 956	1021.61	St
37 OWA	496290	1991	S/2003	58	949 - 959	1007.44	St
38 OWA	496295	1991	S/2003	40	951 - 961	990.61	St
39 OWA	496283	1991	S/2004	26	960 - 970	985.65	St
40 OWA	496282	1991	S/1999	28	927 - 937	955.07	St
P 40B	496292	1991	S/1999	58	898 - 904	956.27	St
41 OWA	496280	1991	S/1999	36	937 - 947	972.95	St
P 41B	496293	1991	S/2001	60	912 - 917	971.69	St
42 OWA	496296	1991	S/1996	89	954 - 964	1043.24	St

Table 2
Well Information Index
Elk River Landfill
Elk River, Minnesota

Well I.D.	MN Unique Number	Year Installed	Altered or Sealed	Approx. Depth ⁽¹⁾	Screen Interval (ft MSL)	Top of Casing Elevation (ft MSL)	Const Material
43 OWA	496279	1991	S/1999	30	944 - 954	973.41	
P 43B	496277	1991	S/1999	72	902 - 907	973.55	St
P 43C	496281	1991	S/1999	287	686 - 696	973.38	St
101 OWA	433160	1987	S/1997	33	944 - 949	977.43	St
102 OWA	433165	1987	S/1997	30	946 - 951	975.73	St
103 OWA	433161	1987	S/1997	58	950 - 955	1008.26	St
104 OWA	433162	1987	S/1996	28	943 - 948	970.74	St
105 OWA	433163	1987	S/1997	58	945 - 950	1002.32	St
106 OWA	433164	1987	S/1997	83	918 - 923	1000.88	St
108 OWA	433166	1987	S/1996	57	946 - 951	1002.72	St
110 OWA	433167	1987	S/1996	88	951 - 956	1038.84	St
201 OWA	443223	1988	S/1999	26	946 - 956	972.27	St
P 201B	443224	1988	S/1999	46	926 - 931	971.96	St
202 OWA	443219	1988	S/1992	86	946 - 956	1031.62	St
203 OWA	443218	1988	S/1992	103	945 - 955	1047.65	St
204 OWA	443221	1988	S/1995	53	945 - 955	998.26	St
205 OWA	443220	1988	S/1994	87	947 - 957	1033.51	St
206 OWA	443217	1988	S/1997	48	947 - 957	994.01	St
207 OWA	443216	1988	S/1999	104	947 - 957	1050.99	St
208 OWA	443215	1988	S/1997	43	953 - 963	996.86	St
209 OWA	443214	1988	S/2012	57	946 - 956	1002.50	St
210 OWA	443211	1988	S/2007	38	943 - 953	981.19	St
P 210B	443212	1988	S/2012	58	923 - 928	981.25	St
211 OWA	443222	1988	S/1999	36	943 - 953	979.03	St
212 OWA	443213	1988	S/1997	70	945 - 955	1014.64	St
213 OWA	443209	1988	S/2012	47	946 - 956	993.35	St
P 213A	443210	1988	S/2007	67	926 - 931	992.20	St
301 OWA	598567	1997		17	950 - 960	966.54	PVC
P 301C	598562	1997		73	895 - 905	967.50	St
P301L	767989	2009		123	847 - 857	970.11	St
302 OWA	598568	1997		17	953 - 963	970.47	PVC
P 302C	598563	1997		72	898 - 908	970.63	St.
303 OWA	598569	1997	S/2012	17	946 - 956	963.71	PVC
P 303C	598532	1997		53	911 - 921	963.77	St.
P 304C	598565	1997		62	898 - 908	959.89	St.
P 305C	598566	1997		80	884 - 894	963.26	St.
306 OWA	621863	1998	S/2004	40	951 - 961	990.88	St.
307 OWA	621862	1998	S/2003	55	951 - 961	1005.59	St.
P 308C	621858	1998	Altered: 2008; resurveyed	77	903 - 913	979.83	St.
P 308L	836661	2019		130	848 - 863	979.94	St.
P 309C	635420	1999		85	883 - 893	967.71	St.
P 310C	646855	2000		42	933 - 948	975.33	St.
P 311C	646854	2000		33	933 - 943	965.54	St.
P 311L	801471	2013		114	852 - 862	965.76	St.
P 311D	650145	2000		253	711 - 779	963.80	St.
312 OWA	646853	2000		70	946 - 956	1016.20	St.
P 313C	969668	2003	reduced: 2004; resurveyed	68	880 - 895	948.15	St.
P 314C	969669	2003		75	877 - 892	952.02	St.
315 OWA	696663	2003		35	937 - 952	972.41	St.
P 315L	722063	2005		100	872 - 882	972.27	St.
316 OWA	696664	2003	S/2015	107	939 - 954	1046.43	St.
P 316L	722093	2005	S/2015	163	884 - 894	1046.82	St.
317 OWA	696666	2003	to be sealed in 2024	73	937 - 952	1009.73	St.
P 317L	722092	2005	to be sealed in 2024	157	852 - 862	1008.65	St.
P 318C	696665	2003	S/2012	57	936 - 946	993.41	St.
P 318L	722091	2005	S/2012	139	853 - 863	991.06	St.
319 OWA	696667	2003	S/2012	72	943 - 953	1014.59	St.

Table 2
Well Information Index
Elk River Landfill
Elk River, Minnesota

Well I.D.	MN Unique Number	Year Installed	Altered or Sealed	Approx. Depth ⁽¹⁾	Screen Interval (ft MSL)	Top of Casing Elevation (ft MSL)	Const Material
P 320C	737638	2006		63	888 - 898	951.19	St.
P 320C2	756593	2007		90	862 - 872	951.21	St.
P 320L	737637	2006		110	851 - 856	951.37	St.
P 321L	767990	2009		118	855 - 865	972.56	St.
P 322L	767991	2009		87	862 - 872	948.75	St.
P 323L	786203	2011		96	872 - 883	967.20	St.
P 324L	786202	2011		103	857 - 865	960.40	St.
P 325L	804281	2014		82	856 - 866	942.11	St.
P 326L	804282	2014		85	854 - 864	942.62	St.
P 327L	812996	2016		119	833 - 848	952.35	St.
P 328L	812994	2016		112	836 - 851	948.20	St.
P 329L	812995	2016		98	850 - 865	947.99	St.
P 333L	828060	2018		116	828 - 843	943.72	St.
P 334L	828061	2018		143	829 - 844	972.22	St.
P 335L	828062	2018		148	848 - 863	995.98	St.
336-OWA	853108	2020		22	942 - 957	963.17	St.
337-OWA	853109	2020		99	932 - 947	1031.70	St.
P-337L	853110	2020		186	846 - 856	1031.68	St.
P-338L	853139	2021		115	98 - 113	961.13	St.
P-340L	953140	2021		105	88 - 103	946.43	St.
P-341L	877298	2023		143	128 - 143	988.58	St.
P-342L	871179	2023		100	85 - 100	947.27	St.
401 OWA	683321	2002		66	945 - 955	1010.97	St.
402 OWA	683320	2002		79	945 - 960	1023.56	St.
P 403C	683318	2002		60	938 - 948	998.46	St.
404 OWA	683319	2002	S/2006	57	944 - 954	1001.12	St.
405 OWA	683316	2002	extended: 2004; resurveyed	41	947 - 957	987.17	St.
406 OWA	683317	2002		15	939 - 944	953.71	St.
407 OWA	683315	2002		40	934 - 944	973.87	St.
408 OWA	717920	2004		42	947 - 957	986.55	PVC
P-694477	694477	2003	Surveyed 2015	145	842 - 846	987.86	St.
T1	643948	2002	extended: 2008; resurveyed	85	896 - 911	980.85	St.
T2	643949	2002	extended: 2008; resurveyed	88	892 - 907	979.85	St.
T3	643950	2002	extended: 2008; resurveyed	91	889 - 904	980.39	St.
T4	673801	2002	extended: 2008; resurveyed	93	887 - 902	980.47	St.
T5	733223	2006		83	883 - 898	965.11	St.
T6	733222	2006		84	882 - 897	964.77	St.

Notes:

PVC - polyvinyl chloride

St - stainless steel & low carbon steel

S - sealed/date of well sealing

MSL - Mean Sea Level

⁽¹⁾ Approx. depth in feet from top of riser to bottom of screen

Table 3
Groundwater Corrective Action Contingency Plan Summary
Elk River Landfill

Scenario	Description	Applicable Wells	Actions	Approximate Timing
1 Organics detection in a water supply well sample	A detection of an organic compound ¹ in a sample from a downgradient water supply well will trigger data review and follow-up sampling ² (to confirm/verify the initial result) and action to protect the health of the well users.	Downgradient monitored water supply wells.	Review the data to assess quality control/quality assurance results (including field and laboratory control sample) and potential of alternate sources ³ .	As soon as feasible (but within two weeks of receiving sample results).
			Notify the owner/resident and MPCA (and others) and coordinate/collect/analyze a confirmation sample.	Within 48 hours of identifying the organics detection. Confirmation sample analysis will be expedited if possible.
			If the detected concentration is above Minnesota drinking water criteria, provide bottled water to the resident until the detection is resolved through confirmation sampling/analysis or addressed by further action.	Within 48 hours of identifying the organics detection.
			If confirmed ⁴ , address the detected organic to prevent exposure to groundwater users ⁵ .	As soon as feasible (after confirmation).
			Evaluate the need for additional or alternate correction action.	To be determined.
2 Organics detection at sentinel well	A first-time detection of an organic compound ^{1,4} at a concentration greater than the IL will trigger rapid notification (i.e., within 48 hours of identification) and resampling unless obvious sampling or laboratory QA/QC issues are evident.	Sentinel monitoring wells: P-327L, P-328L, P-329L, P-333L, P-335L, P-339L (contingent on final location), P-340L, and P-341L .	Notify the MPCA (and others) and coordinate/collect/analyze a verification sample.	Notify within 48 hours of identifying the organics detection above the IL. Verification resample will be conducted as soon as feasible.
			Review the evaluation criteria for nearby water supply wells in context of the detection (see Table 4) and determine if additional water supply well actions are appropriate.	Annual Water Quality Monitoring Report (or separate submittal).
			Review monitoring results from the following three triannual events and determine if additional investigation and/or well installation activities are appropriate.	Subsequent Annual Water Quality Monitoring Report.
			If appropriate, prepare plans for additional investigation activities and/or evaluate the need for additional or alternate corrective action.	To be determined.

Notes:

¹ Attributed to the landfill.

² Sampling and additional actions require permission of the well owner.

³ Common sources of low level organics not attributed to the landfill include sample cross contamination (during sample collection, transport, or analysis), well disinfection byproducts (e.g., new/serviced well disinfection), water pumping/transmission/storage system components, separate sources.

⁴ A confirmed detection is defined as comparable detections for at least two consecutive sampling events that are not attributed to sampling, handling, or laboratory cross contamination.

⁵ May include installation of a point of entry water treatment system, installation of a replacement water supply well, providing a long-term water delivery, or other options/combined approaches as needed.

Table 4
Natural Attenuation Monitoring Plan
Elk River Landfill
Elk River, Minnesota

Relative Position to Source / Plume		Well ID	Natural Attenuation Monitoring Schedule								
			2024			2025			2026		
			Spring ¹	Summer ^{1,2}	Fall ¹	Spring ¹	Summer ^{1,2}	Fall ^{1,2}	Spring ¹	Summer ^{1,2}	Fall ¹
Within Plume	Near Source (Landfill Edge)	P-302C		X	X	X	X	X	X	X	X
		P-17C		X			X			X	
		P-308L		X			X			X	
		P-304C		X	X	X	X	X	X	X	X
	Downgradient (Compliance Boundary)	P-321L		X	X	X	X	X	X	X	X
		P-323L		X	X	X	X	X	X	X	X
		P-313C		X	X	X	X	X	X	X	X
	Mid-Plume (Property Boundary)	P-325L		X	X	X	X	X	X	X	X
		P-326L		X	X	X	X	X	X	X	X
		P-338L		X	X	X	X	X	X	X	X
	Distal Plume	P-334L		X	X	X	X	X	X	X	X
Outside Plume	Downgradient	P-342L		X		X	X		X	X	
	Sentinel	P-339L*		X	X	X	X	X	X	X	X
	Upgradient	P-22L		X			X			X	
	Sidegradient	P-340L		X			X			X	
		P-341L		X			X			X	

Notes:

* To be installed if landowner grant permission.

¹ Samples will be analyzed for List 1 parameters shown on Table 5.

² Samples will be analyzed for List 2 parameters shown on Table 5.

The anticipated schedule is subject to change. The monitoring plan will be reviewed annually as part of Annual Water Quality Monitoring Reports.

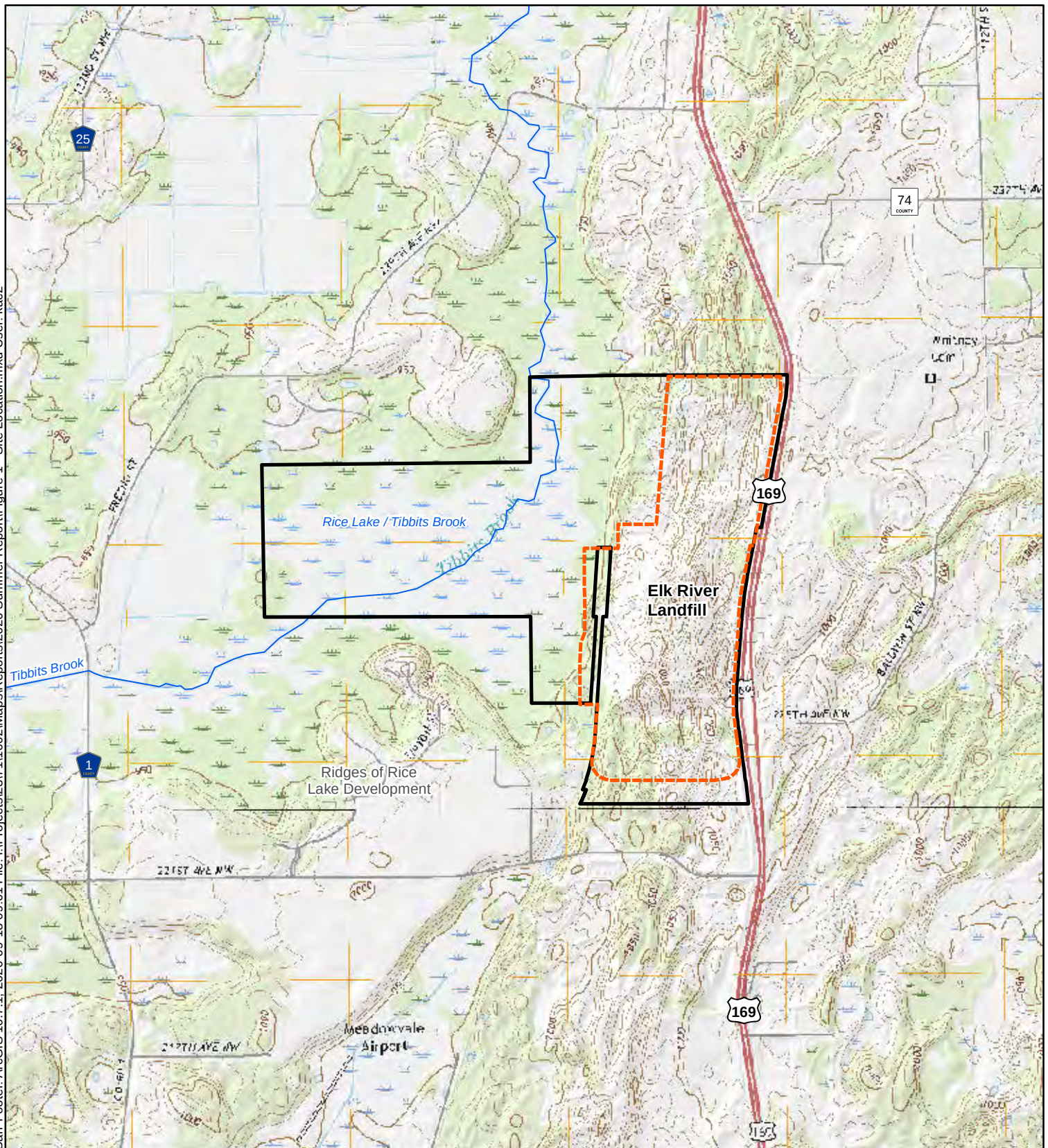
Table 5
Natural Attenuation Monitoring Parameters
Elk River Landfill

Parameter List ¹	Analyte Group	Parameters	Analytical Method
List 1	Organics	Vinyl Chloride (and additional organic compounds included on the EPA Method list)	EPA Method 8260D
	Field Parameters	Conductivity	Field Water Quality Meter Measurement
		Dissolved Oxygen	
		Temperature	
		Oxidation-Reduction Potential	
		pH	
List 2	Natural Attenuation Indicator Parameters	Sulfate	EPA Method 300.0
		Nitrate	EPA Method 300.0
		Chloride	EPA Method 300.0
		Total organic carbon	EPA Method 9060A
		Alkalinity	EPA Method 310.2
		Reduced Iron [Fe (II)]	Field Test Kit Measurement
		Reduced Manganese [Mn (II)]	
		Sulfide	
		Dissolved Oxygen	
		Methane/Ethane/Ethene	AM20 GAX

Notes:

¹ See Table 4 for schedule of analyses.

Figures



-  Property Boundary
-  Groundwater Compliance Boundary

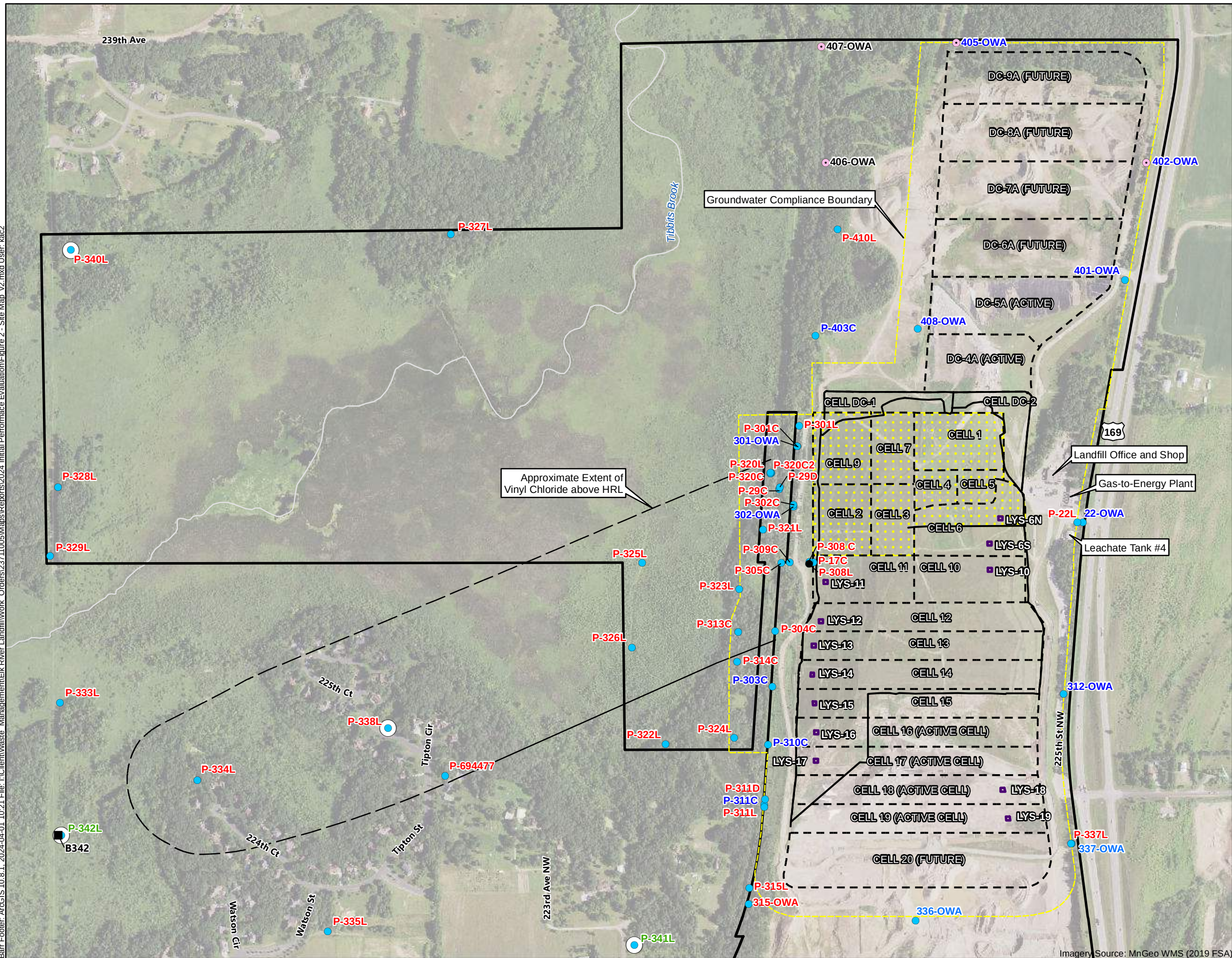


Feet
0 2,000 4,000



Figure 1

SITE LOCATION
Elk River Landfill
Elk River, Minnesota



- Property Boundary
- Pre-Subtitle D Area
- Cell Boundary
- Lysimeter
- Monitoring Well
- Piezometer
- Test Well
- Vertical Groundwater Profile Boring
- Monitoring Wells Completed Following 2021 GWCA Work Plan
- Blue ID indicates well has surface water-based intervention limits
- Red ID indicates well has groundwater-based intervention limits
- Green ID indicates well is currently undergoing baseline monitoring

Notes:
(1) Piezometers 36-OWA (east) and 317-OWA/P-317L (south) are not shown.

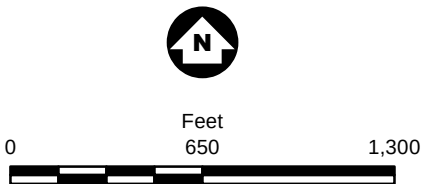
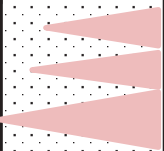
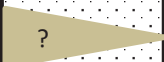
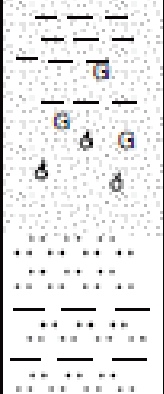
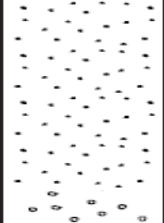
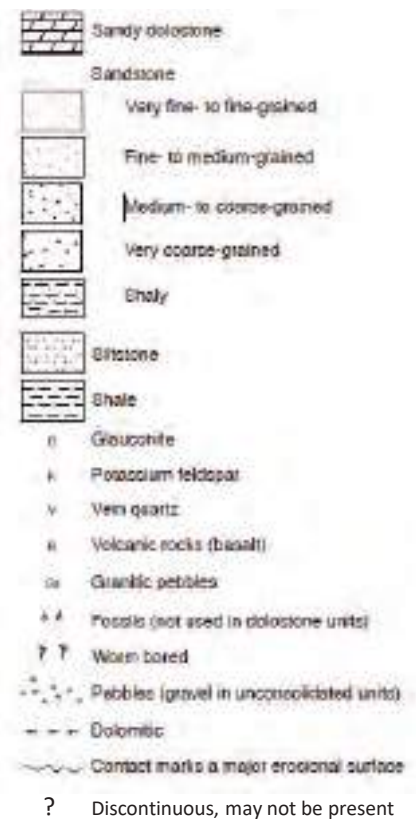


Figure 2
SITE MAP
Elk River Landfill
Elk River, Minnesota



Era	Period	Lithostratigraphy			Lithology	Hydrostratigraphy (Thickness, ft)
Cenozoic	Quaternary	Late Wisconsinan	New Ulm Formation	Yellow-brown to dark gray, sandy loam to loam till and bedded sediments (Riding Mt. provenance)		Upper outwash (Cromwell and/or New Ulm) ($<10 - 130$ ft) Till (Primarily Cromwell) Lower outwash (Cromwell and/or older) ($20 - 60$ ft)
			Cromwell Formation	Red-brown to dark gray, sandy loam tills and bedded sediments (Superior provenance)		
		Pre-Wisconsinan	Lake Henry Formation	Yellow-brown to gray, Silt-rich to loamy tills and bedded sediments		
			St. Francis Formation	Red-brown to gray, loam to sandy loam tills and bedded sediments		
			Older tills	Undifferentiated		
		Paleozoic	Cambrian	Wonewoc Frm.	Siltstone, fine sandstone	
Eau Claire Formation	Very fine-grained, feldspathic sandstone, Siltstone, and shale.				Eau Claire confining unit (~ 80 ft)	
Mt. Simon Sandstone	Medium- to coarse-grained quartz sandstone with interbedded siltstone and very fine sandstone in its upper half to one third.				Mt. Simon aquifer ($\sim 100-190$ ft)	
Precambrian Rocks						Precambrian confining unit



Modified from Berg (2017), Chandler and Mossler (2013); Lusardi (2013); Mossler (1992).

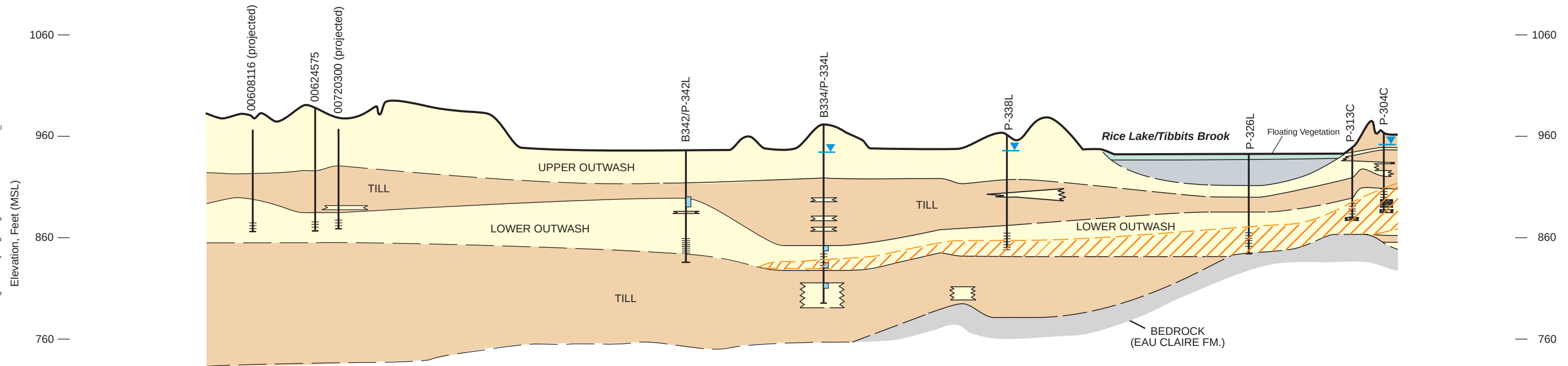
Figure 4

General Hydrostratigraphic Section
Elk River Landfill
Elk River, Minnesota

H'
WEST

H''
EAST

P:\Mpls\23 MN\71\23711005 ERL, GW Network Development\WorkFiles\Corrective Action\Implementation\Monitoring Wells\2023\Cross-sections\Figure 5 - Hydrogeologic Cross Section H'-H''_20240221.ai User: KJN3



EXPLANATION

OUTWASH	Includes the following soil types: SP: Sand with <5% fines; thin/discontinuous gravel lenses rare to common. SM: (Where in contact with SP); Silty sand; silt content approximately 30 to 50%.
TILL	Includes the following soil types: ML: Sandy silt - diamict with approximately 10 to 50% Sand and Gravel; firm to very hard. CL: Clay textured diamict with varying amounts of sand and gravel; firm to hard. SM: (Where bounded by ML or CL); Silty sand; silt content approximately 30 - 50% ML/CL: Silt or clay, <5% sand, massive to thinly bedded
EAU CLAIRE	Eau Claire Formation: Fine-grained sandstone/siltstone with shale partings present locally.

0 750
Approximate Horizontal Scale in Feet
7.5X Vertical Exaggeration

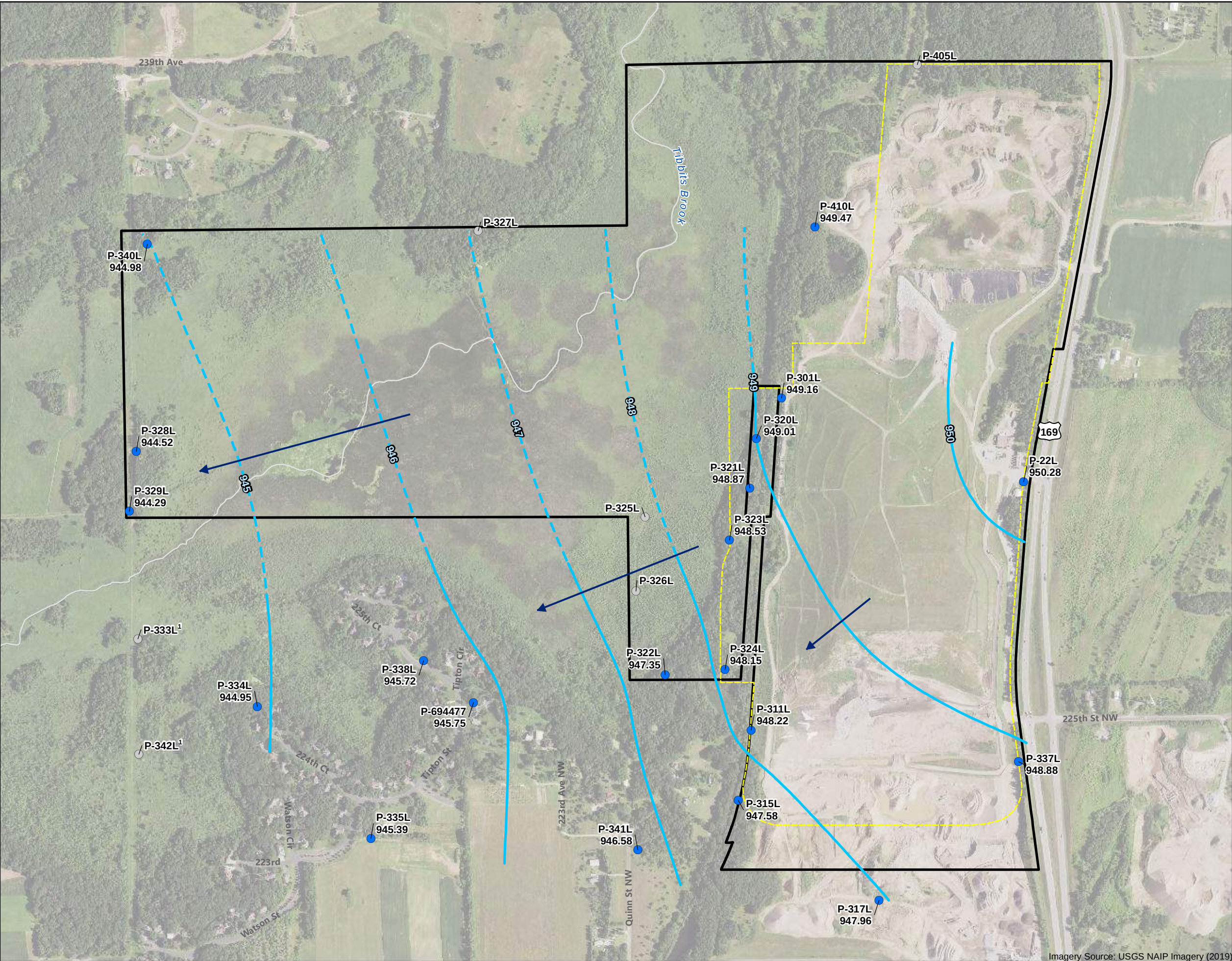
LEGEND

	Ground Surface (Approximate)
	Geologic Contact (Dashed where approximate)
	October 2023 Groundwater Elevation (Measured in deepest nested well shown on figure)
	Existing Well Screen
	Groundwater Sample Locations
	Approximate/Inferred Extent of Vinyl Chloride Above Health Risk Limits



Figure 5

HYDROGEOLOGIC CROSS SECTION H'-H''
Elk River Landfill
Elk River, Minnesota



- Property Boundary
- Groundwater Compliance Boundary
- Lower Outwash Monitoring Well
- Lower Outwash Monitoring Well (Not Used for Groundwater Contours)
- Groundwater Contour (feet MSL)
- Flow Line

Note:
¹ Access to wells P-333L and P-342L is not provided during fall monitoring events.

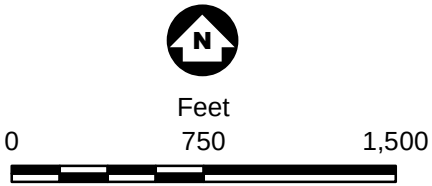
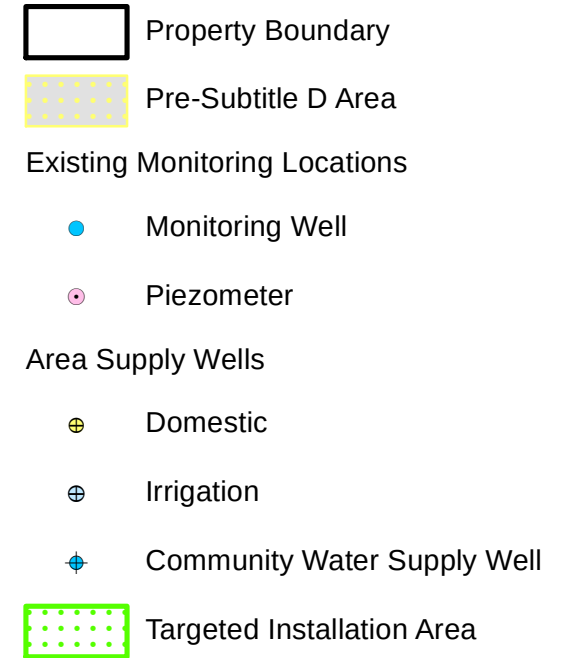
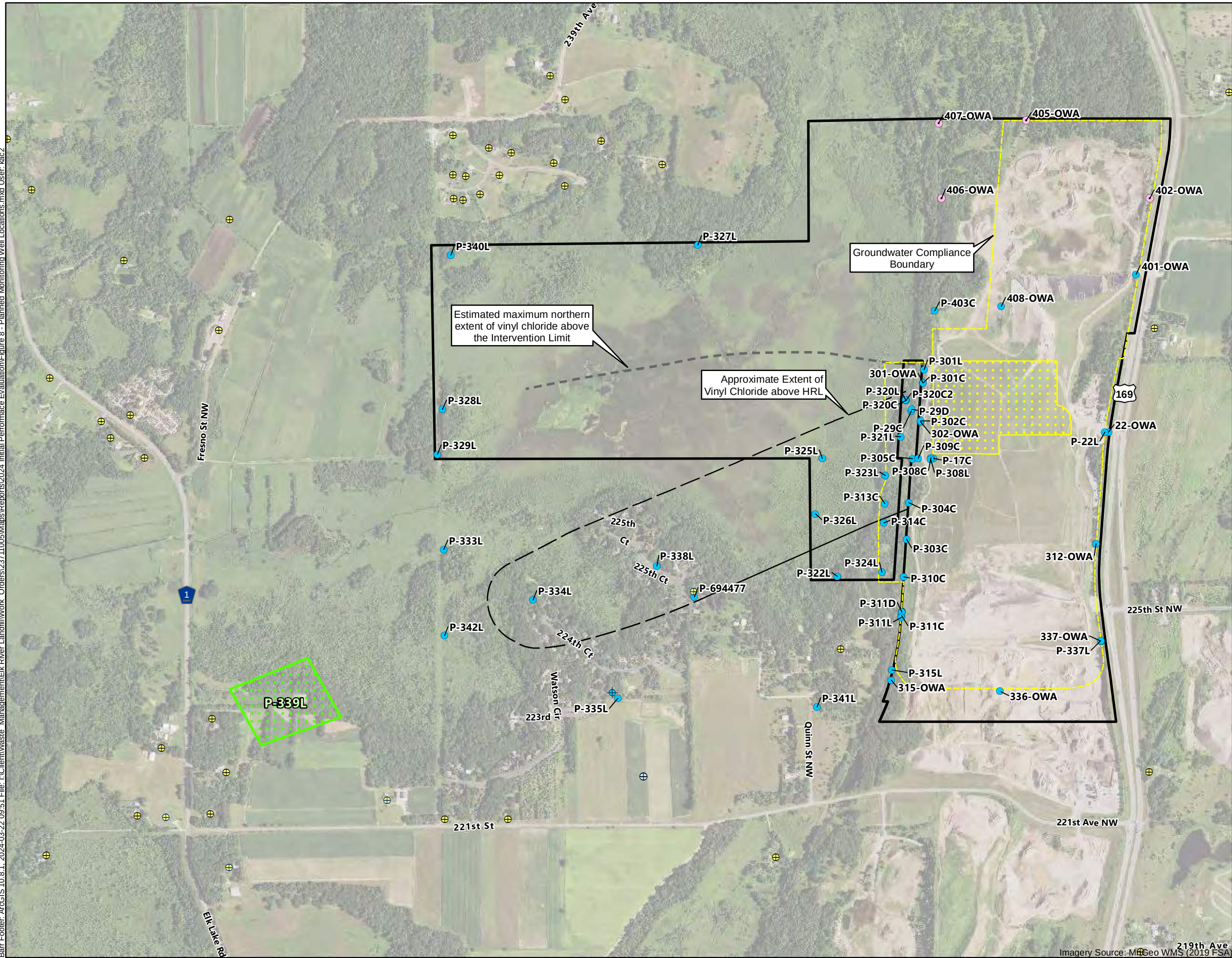


Figure 6
GROUNDWATER ELEVATIONS -
LOWER OUTWASH
October 16, 2023
Elk River Landfill
Elk River, Minnesota



Bar Footer: ArcGIS 10.8.1, 2024-03-22 09:51, File: I:\Client\Waste Management\Elk River Landfill\Work Orders\23711005\Maps\Reports\2024 Initial Performance Evaluation\Figure 8 - Planned Monitoring Well Locations.mxd User: kac2



Note:
1) Targeted installation area is approximate
and subject to access/landowner permissions

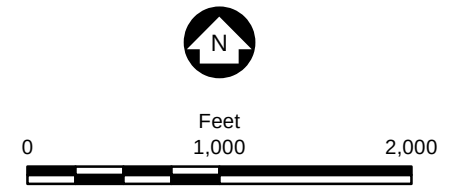


Figure 8
PLANNED MONITORING WELL
LOCATIONS
Elk River Landfill
Elk River, Minnesota



Imagery Source: Microsoft Geo WMS (2019 FSA)

Appendices

Appendix A

Area Water Supply Well Data

Table A1
Residential Well Construction Summary
Elk River Landfill
Elk River, Minnesota

Approximate Distance (feet) and Direction from ERL		MN Unique Number (or MPCA ID)	Address	Years Sampled	Use	Approximate Elevation (feet MSL)	Well Depth (feet bgs)	Base of Casing (feet bgs)	Aquifer	Estimated Completion Interval (feet MSL)
5000'	SW	00416125	12781 221st Ave NW	2015-16, 2020	Domestic	989	135	131	Quaternary	858 - 854
4300'	SW	00439871	12685 221st Ave NW	2015-16, *	Domestic	990	137	133	Quaternary	857 - 853
2800'	SW	00455265	see unique ID# on figure (12210 221st Ave NW)	--	Domestic	957	101	88	Quaternary	869 - 856
8400'	SW	00458929	see unique ID # on figure (22112 Elk Lake Rd)	--	Domestic	951	92	81	Quaternary	870 - 859
1200'	SW	00876413	22272 Quinn St	2022-23	Domestic	995	379	333	Mt. Simon	662 - 616
8000'	SW	1000026209	22017 Elk Lake Rd NW	2016	Domestic	979	170	160	Quaternary	819 - 809
8000'	SW	00608116	22248 Elk Lake Rd	2017, 2021	Domestic	961	94	85	Quaternary	876 - 867
7000'	SW	00625475	22205 Elk Lake Rd	2015-16, 2021-22 *	Domestic	981	113	104	Quaternary	877 - 868
3000'	SW	00626766	Ridges Development	2011-2023	Community	987	325	294	Quaternary	693 - 662
1800'	SW	00876410	12269 223rd Ave NW (St.)	2022-23	Domestic	990	299	255	Mt. Simon	735 - 691
600'	SW	00876409	12163 223rd Ave NW	2022-23	Domestic	985	299	233	Mt. Simon	752 - 686
7400'	SW	00720300	22275 Elk Lake Rd	2017, 2021, 2023 *	Domestic	960	91	82	Quaternary	878 - 869
2000'	SW	00813437	22447 Tipton Ave	2016-2023	Domestic	1000	300	254	Mt. Simon	746 - 700
1500'	SW	00638355*	22130 Quinn St	2011-2023	Domestic	991	105	95	Quaternary	896 - 886
1500'	SW	00876414	22130 Quinn St	2022	Domestic	990	319	293	Quaternary	697 - 671
9400'	SW	00666600	13410 221st Av NW	--	Domestic	952	96	87	Quaternary	865 - 856
1400'	SW	00876411	12265 223rd Ave (formerly listed as 11265 223rd Ave)	2022-23	Domestic	990	296	290	Mt. Simon	700 - 694
1100'	SW	00876412	12183 223rd Ave	2022-23	Domestic	985	310	254	Mt. Simon	731 - 675
8000'	SW	1000022317	13175 221st Ave NW	2016, 2020-21	Domestic	--	--	--	Quat.(assumed)	-- - --
5300'	SW	00535970	12901 221st Ave NW	2016, 2020	Domestic	--	--	--	Quat.(assumed)	-- - --
8500'	SW	--	22106 Elk Lake Rd NW (assumed)	--	Domestic	--	--	--	Quat.(assumed)	-- - --
9200'	W	00169450	22878 Elk Lake Rd	--	Domestic	945	95	91	Quaternary	854 - 850
8400'	W	00450132	22824 Elk Lake Rd	2015	Domestic	961	127	113	Quaternary	848 - 834
7500'	W	00508127	see unique ID# on figure	--	Undefined	948	210	135	Mt. Simon	813 - 738
7500'	W	00562960	see unique ID# on figure (13000 238th Ave NW)	--	Domestic	949	130	123	Quaternary	826 - 819
8200'	W	00606204	22722 Elk Lake Rd	--	Domestic	955	89	84	Quaternary	871 - 866
8700'	W	00617613	22826 Elk Lake Rd	--	Domestic	942	85	80	Quaternary	862 - 857
8700'	W	00636943	22774 Elk Lake Rd	--	Domestic	950	88	84	Quaternary	866 - 862
8500'	W	00798313	23015 1 CR, Elk River	--	Domestic	949	105	95	Quat.(assumed)	854 - 844
9500'	W	00666583	23191 1 CR, Elk River	--	Domestic	950	93	84	Quaternary	866 - 857

Table A1
Residential Well Construction Summary
Elk River Landfill
Elk River, Minnesota

Approximate Distance (feet) and Direction from ERL		MN Unique Number (or MPCA ID)	Address	Years Sampled	Use	Approximate Elevation (feet MSL)	Well Depth (feet bgs)	Base of Casing (feet bgs)	Aquifer	Estimated Completion Interval (feet MSL)
4600'	NW	00525310	1227 239th Ave NW	2011-2020, 2022	Domestic	984	110	105	Quaternary	879 - 874
4200'	NW	00672355	23115 128th St	--	Domestic	948	89	89	Quaternary	859 - 859
5200'	NW	00672356	23255 128th St	--	Domestic	961	89	84	Quaternary	877 - 872
4200'	NW	00676075	23128 128th St	--	Domestic	949	100	91	Quaternary	858 - 849
4500'	NW	00676082	--	--	Domestic	951	93	84	Quaternary	867 - 858
5600'	NW	00676434	23282 128th St NW	--	Domestic	957	210	141	CMTS	816 - 747
5500'	NW	00676922	12876 232nd Ave NW	--	Domestic	951	104	99	Quaternary	852 - 847
5000'	NW	00681344	12821 232nd Ave	--	Domestic	958	90	86	Quaternary	872 - 868
5100'	NW	00703235	12845 232nd Ave	--	Domestic	953	94	90	Quaternary	863 - 859
5000'	NW	00704785	23195 128th St NW	--	Domestic	951	105	95	Quaternary	856 - 846
5300'	NW	00706000	12875 232nd Av NW	--	Domestic	953	105	95	Quaternary	858 - 848
5200'	NW	00706665	12861 232nd Ave	--	Domestic	953	103	99	Quaternary	854 - 850
4850'	NW	00709882	12280 239th Av NW	--	Domestic	963	97	87	Quaternary	876 - 866
3500'	NW	00731676	23105 128th St NW	--	Domestic	958	104	94	Quaternary	864 - 854
5400'	NW	00734477	12818 232nd Av NW	--	Domestic	954	110	100	Quaternary	854 - 844

Notes:

Well construction and elevations from Minnesota Well Index.

-- not available

bgs - below ground surface

MSL - Mean sea level

* Noted as sealed in County Well Index. Residential well at 22130 Quinn St. is included in ERL residential well monitoring network.

+ Requested owner permission to sample in 2020. No response at time of report preparation.

Not included in table: monitoring wells 696665-696667, 770880, 770881; irrigation well 126512; scientific boring 272081; ERL monitoring wells.

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave New		
Date			10/20/2011	10/18/2012	10/15/2013	10/20/2014	4/23/2015	10/23/2015	4/25/2016	10/20/2016	10/18/2017	10/16/2018	10/24/2019	10/15/2020	10/19/2021	9/26/2022	
Unique Well ID# (or MPCA ID)			(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	876411	
Parameter	Units	MDH Human Health-Based Water Guidance Table															
Effective Date		11/13/2023															
Exceedance Key		No Exceed															
Volatile Organic Compounds																	
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50	< 0.50	< 0.500 U	< 0.500 U Q	< 1.00 U	
1,1,2-Trichloroethane	ug/l	3 HRL93	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.75	< 0.75	< 1.0	< 0.750 U	< 0.750 U Q	--	
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,1-Dichloroethylene	ug/l	200 HRL23	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,1-Dichloropropene	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,2,3-Trichlorobenzene	ug/l		< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U C4 Q	< 1.00 U	
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U C4 Q	< 1.00 U	
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.050	< 0.050	< 0.050	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25	< 0.25	< 0.250 U	< 0.250 U Q	< 1.00 U	
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,3-Dichlorobenzene	ug/l		< 5.0	< 5.0	< 5.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,3-Dichloropropane	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50	< 0.25	< 0.500 U	< 0.500 U Q	< 1.00 U	
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
1,4-Dichlorobenzene	ug/l	50 HRL23	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
2,2-Dichloropropane	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U	< 1.00 U Q	< 1.00 U C3	
Acetone	ug/l	3000 HRL23 (1)	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10.0 U	< 10.0 U Q	< 10.0 U	
Allyl chloride	ug/l	30 HRL94	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Benzene	ug/l	2 HRL09 (1)	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50	< 0.50	< 0.500 U	< 0.500 U Q	< 1.00 U	
Bromobenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Bromochloromethane	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Bromoform	ug/l	40 HRL93	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Bromomethane	ug/l	10 HRL93	< 2.0	< 2.0	< 2.0	< 2.0 *	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U	< 1.00 U Q	< 1.00 U C3	
Butylbenzene	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Butylbenzene, sec	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Butylbenzene, tert	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25	< 0.25	< 0.250 U	< 0.250 U Q	< 1.00 U	
Chlorobenzene	ug/l	100 HRL93	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Chlorodibromomethane	ug/l	10 HRL93	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Chloroethane	ug/l	ND RAA16	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Chloroform	ug/l	20 HRL18	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Chloromethane	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Chlorotoluene, o	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Chlorotoluene, p	ug/l		< 4.0	< 4.0	< 4.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Cymene p- (toluene isopropyl p-)	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Dibromomethane (methylene bromide)	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Ethyl benzene	ug/l	40 HRL23	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Ethyl ether	ug/l	200 RAA16 (1)	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.00 U	< 1.00 U Q	< 1.00 U	
Hexachlorobutadiene	ug/l	1 HRL93	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25	< 1.4	< 0.250 U	< 0.250 U C3J4Q	< 1.00 U	
Methyl ethyl ketone (2-butanone)	ug/l	4000 HRL94	< 20	< 20	< 20	< 20	< 10	< 10 ^	< 10	< 10	< 10	< 10 ^	< 10	< 10.0 U	< 10.0 U Q	< 10.0 U C3	
Methyl isobutyl ketone (MIBK)	ug/l	300 HRL94	< 3.0	< 3.0	< 3.0	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.00 U	< 5.00 U Q	< 5.00 U	
Methyl tertiary butyl ether (MTBE)	ug/l	60 RAA13 (1)	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 ^	< 1.00 U	< 1.00 U Q	< 1.00 U	
Methylene chloride	ug/l	5 HRLMCL	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U J4 Q	< 1.00 U	
Naphthalene	ug/l	70 HRL13	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U C3 Q	< 1.00 U	
Propylbenzene	ug/l		< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0								

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave	11265 223rd Ave New	
Date			10/20/2011	10/18/2012	10/15/2013	10/20/2014	4/23/2015	10/23/2015	4/25/2016	10/20/2016	10/18/2017	10/16/2018	10/24/2019	10/15/2020	10/19/2021	9/26/2022
Unique Well ID# (or MPCA ID)			(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	(ZW00214)	ZW00214	ZW00214	ZW00214	ZW00214	ZW00214	876411
Parameter	Units	MDH Human Health-Based Water Guidance Table														
Effective Date		11/13/2023														
Exceedance Key		No Exceed														
Alkalinity, total, as CaCO3	mg/l		197	158	186	206	166	169	--	165	168	166	196	153	170	--
Chemical Oxygen Demand	mg/l		18.1	< 5.0	6.1	< 5.0	--	< 10.0	--	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0 U	< 10.0 U	--
Chloride	mg/l		14.3	13.7	18.6	16.3	17.2	15.5	--	15.4	13	11.8	11.6	8.98	9.53	--
Dissolved oxygen, field	mg/l		--	--	--	--	--	--	0.3	0.6	0.4	0.7	0.8	0.2	0.4	--
Nitrogen, ammonia, as N	mg/l		0.12	0.094	0.055	0.41	--	0.061	--	0.072	0.069	0.072	0.063	< 0.100 U	< 0.100 U	--
Nitrogen, nitrate + nitrite, as N	mg/l		< 0.050	< 0.050	< 0.050	< 0.050	--	< 0.050	--	< 0.050	< 0.050	< 0.050	< 0.050	< 0.100 U	< 0.100 U	--
pH, field	pH units		7.62	7.45	7.60	7.61	7.49	7.94	7.83	7.78	7.76	7.72	7.50	7.42	7.55	--
Redox (oxidation potential), field	mV		--	--	--	--	--	--	-99	-102.0	-50	-20	20	36	-89	--
Solids, total dissolved	mg/l		231	287	277	337	--	248	--	289	288	276	287	275	337	--
Solids, total suspended	mg/l		< 4.0	< 4.0	< 4.0	< 4.0	--	< 4.0	--	< 4.0	< 4.0	< 4.0	< 4.0	< 4.00 U	< 4.00 U	--
Specific conductance @ 25 °C, field	umhos/cm		421	474	452	442	434	422	436	453	448	432	427	412	422	--
Sulfate, as SO4	mg/l		--	--	--	--	48.6	--	--	--	--	--	--	45.7	43.1	--
Temperature, field	deg C		9.7	10.7	9.6	9.4	9.7	11.0	10.0	11.3	9.7	9.6	9.5	9.9	10	--
Turbidity, field	NTU		--	--	--	--	--	--	--	--	1.7	1.1	1.3	1.5	1.3	--
Total Metals																
Calcium	mg/l		--	--	--	--	65.2	63.1	--	58.9	58.1	62.2	58.6	62.6	59.4	--
Lead	ug/l		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/l		--	--	--	--	18.8	18.0	--	18.4	17.3	17.3	16.9	18.0	16.6	--
Manganese	ug/l	100 HRL23	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/l		--	--	--	--	1.5	1.5	--	1.6	1.4	1.5	1.4	1.48	1.09	--
Sodium	mg/l		--	--	--	--	4.3	4.6	--	4.7	4.4	4.1	3.9	4.14	3.93	--

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

[illegible]

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Unique Well ID# (or MPCA ID)			12265 223rd Ave New 11/07/2022 876411	12265 223rd Ave New 10/19/2023 876411	12183 223rd Ave 10/20/2011 ZW00215	12183 223rd Ave 10/18/2012 ZW00215	12183 223rd Ave 10/15/2013 ZW00215	12183 223rd Ave 10/20/2014 ZW00215	12183 223rd Ave 4/23/2015 ZW00215	12183 223rd Ave 10/22/2015 ZW00215	12183 223rd Ave 4/25/2016 ZW00215	12183 223rd Ave 10/20/2016 ZW00215	12183 223rd Ave 10/18/2017 ZW00215	12183 223rd Ave 10/16/2018 ZW00215	12183 223rd Ave 10/24/2019 ZW00215	12183 223rd Ave 10/15/2020 ZW00215
Parameter	Units	MDH Human Health- Based Water Guidance Table														
Effective Date		11/13/2023														
Exceedance Key		No Exceed														
Alkalinity, total, as CaCO3	mg/l		186	189	186	173	195	4030	219	202	--	232	227	214	246	191
Chemical Oxygen Demand	mg/l		< 10.0 U	< 10.0 U	6.4	< 5.0	7.1	5.4 B	--	< 10.0	--	< 10.0	< 10.0	11.8	< 10.0	< 10.0 U
Chloride	mg/l		< 1 U	< 1 U	2.3	3.74	4.33	5.71	6.6	5.71	--	6.04	5.5	5.32	5.8	4.67
Dissolved oxygen, field	mg/l		0.2	0.5	--	--	--	--	--	--	0.3	0.7	0.5	0.5	0.9	0.5
Nitrogen, ammonia, as N	mg/l		0.167	0.154	< 0.050	< 0.050	< 0.050	0.084	--	< 0.020	--	< 0.020	< 0.020	< 0.020	< 0.020	< 0.100 U
Nitrogen, nitrate + nitrite, as N	mg/l		< 0.100 U	< 0.100 U	< 0.050	< 0.050	< 0.050	< 0.050	--	< 0.050	--	< 0.050	< 0.050	< 0.050	< 0.050	< 0.100 U
pH, field	pH units		8.20	7.75	7.54	7.51	7.58	7.45	7.54	7.82	7.65	7.69	7.66	7.63	7.39	7.3
Redox (oxidation potential), field	mV		-131	-69	--	--	--	--	--	--	-98	-124.0	-55	-25	11	-34
Solids, total dissolved	mg/l		194 B	191 B	163	242	222	258	--	233	--	279	285	259	289	262
Solids, total suspended	mg/l		< 4.00 U	4.20	< 4.0	< 4.0	< 4.0	< 4.0	--	< 4.0	--	< 4.0	< 4.0	< 4.0	< 4.0	< 4.00 U
Specific conductance @ 25 °C, field	umhos/cm		341	342	352	395	379	431	432	413	450	502	456	454	452	448
Sulfate, as SO4	mg/l		--	--	--	--	--	--	25.6	--	--	--	--	--	--	32.9
Temperature, field	deg C		9.5	10.6	10.5	10.1	10.2	12.0	9.9	9.9	9.7	11.5	10.8	10.3	10.4	10.8
Turbidity, field	NTU		1.1	--	--	--	--	--	--	--	--	--	2.3	1.8	2.4	2.7
Total Metals																
Calcium	mg/l		48.3	46.9	--	--	--	--	62.3	61.3	--	60.4	58.9	62.7	62.1	63.2
Lead	ug/l		--	< 5.00 U	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/l		14.6	13.4	--	--	--	--	20.1	19.8	--	21.2	20.4	20.9	21.5	22.3
Manganese	ug/l	100 HRL23	--	< 10.0 U	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/l		2.29	1.20	--	--	--	--	1.7	1.7	--	1.8	1.6	1.7	1.6	1.58
Sodium	mg/l		5.63	4.70	--	--	--	--	4.9	5.4	--	5.4	4.9	4.7	4.7	4.80

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			12183 223rd Ave	12183 223rd Ave New	12183 223rd Ave	12183 223rd Ave New	12269 223rd Ave	12269 223rd Ave	12269 223rd Ave	12269 223rd Ave	12269 223rd Ave	12269 223rd Ave	12269 223rd Ave	12269 223rd St	12269 223rd Ave	
Date			10/19/2021	9/29/2022	11/07/2022	10/19/2023	10/20/2011	10/18/2012	10/15/2013	10/22/2014	4/23/2015	12/14/2015	4/25/2016	10/20/2016	10/18/2017	10/16/2018
Unique Well ID# (or MPCA ID)			ZW00215	876412	ZW00215	876412	626780	626780	626780	626780	626780	626780	626780	626780	626780	626780
Parameter	Units	MDH Human Health-Based Water Guidance Table														
Effective Date		11/13/2023														
Exceedance Key		No Exceed														
Volatile Organic Compounds																
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 0.500 U Q	< 1.00 U	< 0.500 U	< 0.500 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50
1,1,2-Trichloroethane	ug/l	3 HRL93	< 0.750 U Q	--	< 0.750 U	< 0.750 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.75	< 0.75
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethylene	ug/l	200 HRL23	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	ug/l		< 1.00 U C4 Q	< 1.00 U C4	< 1.00 U C4	< 1.00 U C3	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 1.00 U C4 Q	< 1.00 U C4	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.050	< 0.050
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 0.250 U Q	< 1.00 U	< 0.250 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 1.00 U Q	< 1.00 U	< 1.00 U	< 0.100 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 5.0	< 5.0	< 5.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 0.500 U Q	< 1.00 U	< 0.500 U	< 0.500 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	ug/l	50 HRL23	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,2-Dichloropropane	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Acetone	ug/l	3000 HRL23 (1)	< 10.0 U Q	< 10.0 U C3	< 10.0 U	< 10.0 U	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 10	< 10
Allyl chloride	ug/l	30 HRL94	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 *	< 1.0
Benzene	ug/l	2 HRL09 (1)	< 0.500 U Q	< 1.00 U	< 0.500 U	< 0.500 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50
Bromobenzene	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromoform	ug/l	40 HRL93	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	ug/l	10 HRL93	< 1.00 U Q	< 1.00 U	< 1.00 U J3	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Butylbenzene	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Butylbenzene, sec	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Butylbenzene, tert	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 0.250 U Q	< 1.00 U	< 0.250 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25
Chlorobenzene	ug/l	100 HRL93	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorodibromomethane	ug/l	10 HRL93	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane	ug/l	ND RAA16	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroform	ug/l	20 HRL18	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorotoluene, o	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorotoluene, p	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 4.0	< 4.0	< 4.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cymene p- (toluene isopropyl p-)	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane (methylene bromide)	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethyl benzene	ug/l	40 HRL23	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethyl ether	ug/l	200 RAA16 (1)	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	ug/l	1 HRL93	< 0.250 U C3J4Q	< 1.00 U	< 0.250 U	< 0.250 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25
Methyl ethyl ketone (2-butanone)	ug/l	4000 HRL94	< 10.0 U Q	< 10.0 U	< 10.0 U	< 10.0 U C3	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 10 ^a	< 10 ^
Methyl isobutyl ketone (MIBK)	ug/l	300 HRL94	< 5.00 U Q	< 5.00 U	< 5.00 U	< 5.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0 ^a	< 5.0
Methyl tertiary butyl ether (MTBE)	ug/l	60 RAA13 (1)	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Methylene chloride	ug/l	5 HRLMCL	< 1.00 U J4 Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	ug/l	70 HRL13	< 1.00 U C3 Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Propylbenzene	ug/l		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	&	

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			12183 223rd Ave	12183 223rd Ave New	12183 223rd Ave	12183 223rd Ave New	12269 223rd Ave	12269 223rd Ave	12269 223rd Ave	12269 223rd Ave	12269 223rd Ave	12269 223rd Ave	12269 223rd Ave	12269 223rd St	12269 223rd Ave	
Date			10/19/2021	9/29/2022	11/07/2022	10/19/2023	10/20/2011	10/18/2012	10/15/2013	10/22/2014	4/23/2015	12/14/2015	4/25/2016	10/20/2016	10/18/2017	10/16/2018
Unique Well ID# (or MPCA ID)			ZW00215	876412	ZW00215	876412	626780	626780	626780	626780	626780	626780	626780	626780	626780	626780
Parameter	Units	MDH Human Health-Based Water Guidance Table														
Effective Date		11/13/2023														
Exceedance Key		No Exceed														
Alkalinity, total, as CaCO3	mg/l		232	--	229	178	240	238	228	254 B	247	270	--	279	294	277
Chemical Oxygen Demand	mg/l		< 10.0 U	--	< 10.0 U	< 10.0 U	5.1	11.7 B	< 5.0	< 5.0	--	< 10.0	--	< 10.0	< 10.0	< 10.0
Chloride	mg/l		5.19	--	5.16	< 1 U	7.9	8.33	10.1	9.69	11.4	12.1	--	11.4	12	11.7
Dissolved oxygen, field	mg/l		0.9	--	0.2	0.3	--	--	--	--	--	--	1.7	2.5	3.5	2.1
Nitrogen, ammonia, as N	mg/l		< 0.100 U	--	< 0.100 U	0.175	< 0.050	< 0.050	< 0.050	< 0.050	--	< 0.020	--	< 0.020	< 0.020 F1	< 0.020
Nitrogen, nitrate + nitrite, as N	mg/l		< 0.100 U	--	< 0.100 U	< 0.100 U	0.98	1.2	1.2	1.3	--	1.4	--	1.4	1.3	1.0
pH, field	pH units		7.68	--	7.60	7.63	7.44	6.90	7.24	7.86	7.41	7.60	7.51	7.52	7.60	7.58
Redox (oxidation potential), field	mV		-89	--	-46	-57	--	--	--	--	--	--	-84	60.0	81	99
Solids, total dissolved	mg/l		262	--	246 B	176 Q	247	297	297	304	--	316	--	349	336	343
Solids, total suspended	mg/l		< 4.00 U	--	< 4.00 U	6.30	< 4.0	< 4.0	< 4.0	< 4.0	--	< 4.0	--	< 4.0	< 4.0	< 4.0
Specific conductance @ 25 °C, field	umhos/cm		463	--	469	331	471	613	487	474	523	566	550	570	567	560
Sulfate, as SO4	mg/l		25.4	--	--	--	--	--	--	20.8	--	--	--	--	--	--
Temperature, field	deg C		11	--	10.1	10	11.0	10.5	10.5	10.2	9.7	10.1	11.0	11.2	11.9	11.5
Turbidity, field	NTU		3	--	1.3	--	--	--	--	--	--	--	--	--	1.8	1.0
Total Metals																
Calcium	mg/l		64.0	--	63.3	46.9	--	--	--	--	78.7	74.3	--	74.9	75.6	80.8
Lead	ug/l		--	--	--	< 5.00 U	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/l		22.5	--	22.1	12.9	--	--	--	--	27.4	26.5	--	27.6	27.4	27.3
Manganese	ug/l	100 HRL23	--	--	--	60.8	--	--	--	--	--	--	--	--	--	--
Potassium	mg/l		1.26	--	1.65	1.35	--	--	--	--	1.5	1.5	--	1.6	1.5	1.5
Sodium	mg/l		4.61	--	4.59	4.50	--	--	--	--	3.2	3.3	--	3.5	3.7	3.4

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			12269 223rd St	12269 223rd St	12269 223RD ST	12269 223rd St New	12269 223rd St New	12269 223rd St New	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St
Date			10/24/2019	10/15/2020	10/19/2021	9/21/2022	11/07/2022	10/19/2023	10/20/2011	10/18/2012	10/15/2013	10/20/2014	4/23/2015	10/22/2015	10/20/2016	10/18/2017	10/16/2018
Unique Well ID# (or MPCA ID)			626780	626780	626780	876410	876410	876410	638355	638355	638355	638355	638355	638355	638355	638355	638355
Parameter	Units	MDH Human Health-Based Water Guidance Table															
Effective Date		11/13/2023															
Exceedance Key		No Exceed															
Volatile Organic Compounds																	
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 0.50	< 0.500 U	< 0.500 U Q	< 1.00 U	< 0.500 U	< 0.500 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50
1,1,2-Trichloroethane	ug/l	3 HRL93	< 1.0	< 0.750 U	< 0.750 U Q	--	< 0.750 U	< 0.750 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.75	< 0.75
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethylene	ug/l	200 HRL23	< 2.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	ug/l		< 5.0	< 1.00 U	< 1.00 U C4 Q	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 5.0	< 1.00 U	< 1.00 U C4 Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 0.050	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 0.050	< 0.050
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 0.25	< 0.250 U	< 0.250 U Q	< 1.00 U	< 0.250 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 0.100 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 5.0	< 5.0	< 5.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 0.25	< 0.500 U	< 0.500 U Q	< 1.00 U	< 0.500 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	ug/l	50 HRL23	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,2-Dichloropropane	ug/l		< 4.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Acetone	ug/l	3000 HRL23 (1)	< 10	< 10.0 U	< 10.0 U Q	< 10.0 U C3	< 10.0 U	< 10.0 U	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 10
Allyl chloride	ug/l	30 HRL94	< 2.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	ug/l	2 HRL09 (1)	< 0.50	< 0.500 U	< 0.500 U Q	< 1.00 U	< 0.500 U	< 0.500 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50
Bromobenzene	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	ug/l		< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromoform	ug/l	40 HRL93	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	ug/l	10 HRL93	< 4.0	< 1.00 U	< 1.00 U Q	< 1.00 U C3	< 1.00 U J3	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0 *	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Butylbenzene	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Butylbenzene, sec	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Butylbenzene, tert	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U C3	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 0.25	< 0.250 U	< 0.250 U Q	< 1.00 U	< 0.250 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25
Chlorobenzene	ug/l	100 HRL93	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorodibromomethane	ug/l	10 HRL93	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane	ug/l	ND RAA16	< 4.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroform	ug/l	20 HRL18	< 3.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	ug/l		< 3.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorotoluene, o	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorotoluene, p	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 4.0	< 4.0	< 4.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cymene p- (toluene isopropyl p-)	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane (methylene bromide)	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 3.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U C3	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.0
Ethyl benzene	ug/l	40 HRL23	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethyl ether	ug/l	200 RAA16 (1)	< 2.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	ug/l	1 HRL93	< 1.4	< 0.250 U	< 0.250 U C3J4Q	< 1.00 U	< 0.250 U	< 0.250 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25
Methyl ethyl ketone (2-butanone)	ug/l	4000 HRL94	< 10	< 10.0 U	< 10.0 U Q	< 10.0 U	< 10.0 U	< 10.0 U C3	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 10 ^
Methyl isobutyl ketone (MIBK)	ug/l	300 HRL94															

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			12269 223rd St	12269 223rd St	12269 223RD ST	12269 223rd St New	12269 223rd St New	12269 223rd St New	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St
Date			10/24/2019	10/15/2020	10/19/2021	9/21/2022	11/07/2022	10/19/2023	10/20/2011	10/18/2012	10/15/2013	10/20/2014	4/23/2015	10/22/2015	10/20/2016	10/18/2017	10/16/2018
Unique Well ID# (or MPCA ID)			626780	626780	626780	876410	876410	876410	638355	638355	638355	638355	638355	638355	638355	638355	638355
Parameter	Units	MDH Human Health- Based Water Guidance Table															
Effective Date		11/13/2023															
Exceedance Key		No Exceed															
Alkalinity, total, as CaCO3	mg/l		312	254	285	--	179	186	238	186	173	4270	196	208	208	218	219
Chemical Oxygen Demand	mg/l		< 10.0	< 10.0 U	< 10.0 U	--	19.4	< 10.0 U	< 5.0	< 5.0	8.3	< 5.0	--	< 10.0	< 10.0	< 10.0	< 10.0
Chloride	mg/l		12.6	12.5	13.2	--	< 1 U	< 1 U	5.8	5.27	6.02	5.83	6.3	6.11	5.9	4.54	4.08
Dissolved oxygen, field	mg/l		2.5	0.7	2.3	--	3.0	0.4	--	--	--	--	--	--	0.4	0.6	0.8
Nitrogen, ammonia, as N	mg/l		< 0.020	< 0.100 U	< 0.100 U	--	0.133	0.241	< 0.050	< 0.050	< 0.050	< 0.050	--	< 0.020	0.038	< 0.020	< 0.020
Nitrogen, nitrate + nitrite, as N	mg/l		0.86	0.814	0.729	--	< 0.100 U	< 0.100 U	< 0.050	< 0.050	< 0.050	< 0.050	--	< 0.050	< 0.050	< 0.050	< 0.050
pH, field	pH units		7.50	7.35	7.5	--	7.74	7.76	7.57	7.71	7.74	7.57	7.34	7.96	7.72	7.74	7.25
Redox (oxidation potential), field	mV		111	86	-35	--	-25	-47	--	--	--	--	--	--	143.0	-35	65
Solids, total dissolved	mg/l		320	348	337	--	179 B	187 B	225	266	254	245	--	214	249	257	271
Solids, total suspended	mg/l		< 4.0	< 4.00 U	< 4.00 U	--	< 4.00 U	< 4.00 U	< 4.0	< 4.0	< 4.0	< 4.0	--	< 4.0	< 4.0	< 4.0	< 4.0
Specific conductance @ 25 °C, field	umhos/cm		555	577	608	--	329	338	438	432	428	459	471	419	424	430	432
Sulfate, as SO4	mg/l		--	21.9	22.4	--	--	--	--	--	--	--	25.6	--	--	--	--
Temperature, field	deg C		11.2	10.9	11.3	--	11.1	11.8	10.0	9.8	9.9	9.9	9.3	9.9	9.9	10.2	10.0
Turbidity, field	NTU		1.3	2.1	2.3	--	3.0	--	--	--	--	--	--	--	--	1.3	1.7
Total Metals																	
Calcium	mg/l		81.8	84.6	82.8	--	45.5	46.7	--	--	--	--	57.7	57.4 4	53.8	52.3	57.3
Lead	ug/l		--	--	--	--	--	< 5.00 U	--	--	--	--	--	--	--	--	--
Magnesium	mg/l		29.0	29.5	28.4	--	13.8	13.5	--	--	--	--	21.2	20.2	20.2	19.6	20.3
Manganese	ug/l	100 HRL23	--	--	--	--	--	< 10.0 U	--	--	--	--	--	--	--	--	--
Potassium	mg/l		1.5	1.53	1.18	--	1.51	1.25	--	--	--	--	1.5	1.5	1.5	1.4	1.5
Sodium	mg/l		3.5	3.72	3.58	--	5.13	4.96	--	--	--	--	3.7	3.8	3.8	3.7	3.5

Table A2
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Initial Performance Evaluation Report
Elk River Landfill

Location			22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St New	22130 Quinn St	22191 Hwy 169	22191 Hwy 169	22191 Hwy 169	22191 Hwy 169	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St
Date			10/24/2019	10/15/2020	10/19/2021	11/07/2022	12/14/2022	10/19/2023	10/20/2011	10/18/2012	10/15/2013	10/21/2014	10/20/2011	10/18/2012	10/15/2013	10/20/2014	4/23/2015	10/22/2015
Unique Well ID# (or MPCA ID)			638355	638355	638355	638355	876414	638355	00437275	00437275	00437275	00437275	527979	527979	527979	527979	527979	527979
Parameter	Units	MDH Human Health-Based Water Guidance Table																
Effective Date		11/13/2023																
Exceedance Key		No Exceed																
Volatile Organic Compounds																		
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 0.50	< 0.500 U	< 0.500 U Q	< 0.500 U	< 1.00 U	< 0.500 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
1,1,2-Trichloroethane	ug/l	3 HRL93	< 1.0	< 0.750 U	< 0.750 U Q	< 0.750 U	< 0.750 U	< 0.750 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
1,1-Dichloroethylene	ug/l	200 HRL23	< 2.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
1,2,3-Trichlorobenzene	ug/l		< 5.0	< 1.00 U	< 1.00 U C4 Q	< 1.00 U C4	< 1.00 U C3	< 1.00 U C3	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 5.0	< 1.00 U	< 1.00 U C4 Q	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 0.050	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 0.25	< 0.250 U	< 0.250 U Q	< 0.250 U	< 1.00 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 0.100 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
1,3-Dichlorobenzene	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 1.0
1,3-Dichloropropane	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 0.25	< 0.500 U	< 0.500 U Q	< 0.500 U	< 1.00 U	< 0.500 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0
1,4-Dichlorobenzene	ug/l	50 HRL23	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
2,2-Dichloropropane	ug/l		< 4.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Acetone	ug/l	3000 HRL23 (1)	< 10	< 10.0 U	< 10.0 U Q	< 10.0 U	< 10.0 U	< 10.0 U	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 10
Allyl chloride	ug/l	30 HRL94	< 2.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0 *	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Benzene	ug/l	2 HRL09 (1)	< 0.50	< 0.500 U	< 0.500 U Q	< 0.500 U	< 1.00 U	< 0.500 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Bromobenzene	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	ug/l		< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromoform	ug/l	40 HRL93	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0
Bromomethane	ug/l	10 HRL93	< 4.0	< 1.00 U	< 1.00 U Q	< 1.00 U J3	< 1.00 U C3	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0 *	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0 *	< 1.0
Butylbenzene	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Butylbenzene, sec	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Butylbenzene, tert	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 0.25	< 0.250 U	< 0.250 U Q	< 0.250 U	< 1.00 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorobenzene	ug/l	100 HRL93	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Chlorodibromomethane	ug/l	10 HRL93	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Chloroethane	ug/l	ND RAA16	< 4.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Chloroform	ug/l	20 HRL18	< 3.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	ug/l		< 3.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorotoluene, o	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorotoluene, p	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 4.0	< 4.0	< 4.0	< 2.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 1.0
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Cymene p- (toluene isopropyl p-)	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Dibromomethane (methylene bromide)	ug/l		< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 3.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U J3	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Ethyl benzene	ug/l	40 HRL23	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0
Ethyl ether	ug/l	200 RAA16 (1)	< 2.0	< 1.00 U	< 1.00 U Q	< 1.00 U												

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St	22130 Quinn St New	22130 Quinn St	22191 Hwy 169	22191 Hwy 169	22191 Hwy 169	22191 Hwy 169	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St
Date			10/24/2019	10/15/2020	10/19/2021	11/07/2022	12/14/2022	10/19/2023	10/20/2011	10/18/2012	10/15/2013	10/21/2014	10/20/2011	10/18/2012	10/15/2013	10/20/2014	4/23/2015	10/22/2015
Unique Well ID# (or MPCA ID)			638355	638355	638355	638355	876414	638355	00437275	00437275	00437275	00437275	527979	527979	527979	527979	527979	527979
Parameter	Units	MDH Human Health-Based Water Guidance Table																
Effective Date		11/13/2023																
Exceedance Key		No Exceed																
Alkalinity, total, as CaCO3	mg/l		239	202	214	219	--	229	201	182	202	206	217	218	190	3960	210	201
Chemical Oxygen Demand	mg/l		< 10.0	< 10.0 U	< 10.0 U	< 10.0 U	--	< 10.0 U	14.9	6.0	< 5.0	7.4	12.7	6.9	< 5.0	< 5.0	--	< 10.0
Chloride	mg/l		4.3	3.97	4.21	3.74	--	4.48	27.8	27.3	30.8	32.3	16.2	15.8	20.4	19.3	22.2	21.6
Dissolved oxygen, field	mg/l		0.3	0.5	1	0.3	--	0.3	--	--	--	--	--	--	--	--	--	--
Nitrogen, ammonia, as N	mg/l		< 0.020	< 0.100 U	< 0.100 U	< 0.100 U	--	< 0.100 U	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050 F1	--	< 0.020
Nitrogen, nitrate + nitrite, as N	mg/l		< 0.050	< 0.100 U	< 0.100 U	< 0.100 U	--	< 0.100 U	< 0.050	< 0.050	< 0.050	< 0.050	1.8	2.1	2.0	2.1	--	2.1
pH, field	pH units		7.08	7.2	7.71	7.44	--	7.7	7.80	7.83	7.82	8.27	7.47	7.20	7.25	7.50	7.37	7.77
Redox (oxidation potential), field	mV		85	95	-50	23	--	-45	--	--	--	--	--	--	--	--	--	--
Solids, total dissolved	mg/l		258	251	253	260 B	--	270 B	259	305	277	321	223	275	250	296	--	238
Solids, total suspended	mg/l		< 4.0	< 4.00 U	< 4.00 U	< 4.00 U	--	< 4.00 U	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	--	< 4.0
Specific conductance @ 25 °C, field	umhos/cm		428	432	450	443	--	451	445	497	490	455	446	496	487	467	482	443
Sulfate, as SO4	mg/l		--	20.3	20.0	--	--	--	--	--	--	--	--	--	--	--	20.1	--
Temperature, field	deg C		10.0	10	11.1	9.9	--	10	9.2	9.4	9.4	9.2	10.6	10.5	10.1	10.2	9.5	10.2
Turbidity, field	NTU		1.2	1.1	1	0.8	--	--	--	--	--	--	--	--	--	--	--	--
Total Metals																		
Calcium	mg/l		58.3	64.6	60.2	59.9	--	62.6	--	--	--	--	--	--	--	--	62.2	61.1
Lead	ug/l		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/l		21.4	23.1	22.5	21.6	--	21.1	--	--	--	--	--	--	--	--	21.5	20.6
Manganese	ug/l	100 HRL23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/l		1.5	1.55	1.16	1.62	--	1.49	--	--	--	--	--	--	--	--	1.3	1.4
Sodium	mg/l		3.6	4.01	3.81	3.84	--	3.67	--	--	--	--	--	--	--	--	2.6	2.8

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St New	22272 Quinn St New	22715 Baldwin	22715 Baldwin	22715 Baldwin	22915 Hwy 169	22915 Hwy 169	22915 Hwy 169	22915 Hwy 169
Date			10/20/2016	10/18/2017	10/16/2018	10/24/2019	10/15/2020	10/19/2021	11/07/2022	12/10/2022	10/19/2023	10/20/2011	10/18/2012	10/21/2014	10/20/2011	10/18/2012	10/15/2013	10/21/2014
Unique Well ID# (or MPCA ID)			527979	527979	527979	527979	527979	527979	527979	876413	876413	(ZW00216)	(ZW00216)	(ZW00216)	545375	545375	545375	545375
Parameter	Units	MDH Human Health-Based Water Guidance Table																
Effective Date		11/13/2023																
Exceedance Key		No Exceed																
Volatile Organic Compounds																		
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 1.0	< 0.50	< 0.50	< 0.50	< 0.500 U	< 0.500 U Q	< 0.500 U	< 1.00 U	< 0.500 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
1,1,2-Trichloroethane	ug/l	3 HRL93	< 1.0	< 0.75	< 0.75	< 1.0	< 0.750 U	< 0.750 U Q	< 0.750 U	< 0.750 U	< 0.750 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
1,1-Dichloroethylene	ug/l	200 HRL23	< 1.0	< 1.0	< 1.0	< 2.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
1,2,3-Trichlorobenzene	ug/l		< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U C4 Q	< 1.00 U C4	< 1.00 U	< 1.00 U C3	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U C4 Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 1.0	< 0.050	< 0.050	< 0.050	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 1.0	< 0.25	< 0.25	< 0.25	< 0.250 U	< 0.250 U Q	< 0.250 U	< 1.00 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 0.100 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
1,3-Dichlorobenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
1,3-Dichloropropane	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 1.0	< 0.50	< 0.50	< 0.25	< 0.500 U	< 0.500 U Q	< 0.500 U	< 1.00 U	< 0.500 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
1,4-Dichlorobenzene	ug/l	50 HRL23	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
2,2-Dichloropropane	ug/l		< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Acetone	ug/l	3000 HRL23 (1)	< 10	< 10	< 10	< 10	< 10.0 U	< 10.0 U Q	< 10.0 U	< 10.0 U	< 10.0 U	< 20	< 20	< 20	< 20	< 20	< 20	< 20
Allyl chloride	ug/l	30 HRL94	< 1.0	< 1.0	< 1.0	< 2.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0 *	< 2.0
Benzene	ug/l	2 HRL09 (1)	< 1.0	< 0.50	< 0.50	< 0.50	< 0.500 U	< 0.500 U Q	< 0.500 U	< 1.00 U	< 0.500 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Bromobenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	ug/l		< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromoform	ug/l	40 HRL93	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0
Bromomethane	ug/l	10 HRL93	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U	< 1.00 U Q	< 1.00 U J3	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Butylbenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Butylbenzene, sec	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Butylbenzene, tert	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 1.0	< 0.25	< 0.25	< 0.25	< 0.250 U	< 0.250 U Q	< 0.250 U	< 1.00 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorobenzene	ug/l	100 HRL93	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chlorodibromomethane	ug/l	10 HRL93	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chloroethane	ug/l	ND RAA16	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chloroform	ug/l	20 HRL18	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	ug/l		< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorotoluene, o	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorotoluene, p	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 4.0	< 4.0	< 2.0	< 4.0	< 4.0	< 4.0	< 2.0
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Cymene p- (toluene isopropyl p-)	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dibromomethane (methylene bromide)	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Ethyl benzene	ug/l	40 HRL23	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Ethyl ether	ug/l	200 RAA16 (1)	< 1.0	< 1.0 ^	< 1.0	< 2.0	<											

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St	22272 Quinn St New	22272 Quinn St New	22715 Baldwin	22715 Baldwin	22715 Baldwin	22915 Hwy 169	22915 Hwy 169	22915 Hwy 169	22915 Hwy 169
Date			10/20/2016	10/18/2017	10/16/2018	10/24/2019	10/15/2020	10/19/2021	11/07/2022	12/10/2022	10/19/2023	10/20/2011	10/18/2012	10/21/2014	10/20/2011	10/18/2012	10/15/2013	10/21/2014
Unique Well ID# (or MPCA ID)			527979	527979	527979	527979	527979	527979	527979	876413	876413	(ZW00216)	(ZW00216)	(ZW00216)	545375	545375	545375	545375
Parameter	Units	MDH Human Health-Based Water Guidance Table																
Effective Date		11/13/2023																
Exceedance Key		No Exceed																
Alkalinity, total, as CaCO3	mg/l		195	207	209	266	229	244	241	--	182	265	216	233	247	188	213	206
Chemical Oxygen Demand	mg/l		< 10.0	< 10.0	15.1	< 10.0	< 10.0 U	< 10.0 U	< 10.0 U	--	91.4	12.7	< 5.0	< 5.0	13.0	< 5.0	< 5.0	< 5.0
Chloride	mg/l		21.9	23.5	23.9	27.3	31.3	30.6	30.4	--	< 1 U	12.5	10.9	12.7	28.4	24.3	28.9	27.1
Dissolved oxygen, field	mg/l		1.9	1.4	1.5	0.9	0.3	0.8	0.4	--	0.2	--	--	--	--	--	--	--
Nitrogen, ammonia, as N	mg/l		< 0.020	< 0.020	< 0.020	< 0.020	< 0.100 U	< 0.100 U	< 0.100 U	--	0.203	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Nitrogen, nitrate + nitrite, as N	mg/l		2.1	2.0	2.0	1.6	1.03	0.878	1.36	--	< 0.100 U	9.6	9.6	9.8	0.19	0.49	0.81	0.93
pH, field	pH units		7.60	7.63	7.58	7.60	7.5	7.47	7.42	--	7.6	7.60	8.09	7.73	7.67	7.96	7.92	7.67
Redox (oxidation potential), field	mV		130.0	25	80	99	101	-90	89	--	-58	--	--	--	--	--	--	--
Solids, total dissolved	mg/l		259	314	308	290	323	324	328 B	--	175 Q	316	347	316	256	302	294	330
Solids, total suspended	mg/l		< 4.0	< 4.0	< 4.0	< 4.0	< 4.00 U	< 4.00 U	< 4.00 U	--	< 4.00 U	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Specific conductance @ 25 °C, field	umhos/cm		479	482	497	520	555	590	578	--	330	562	566	495	472	518	503	479
Sulfate, as SO4	mg/l		--	--	--	--	22.0	24.3	--	--	--	--	--	--	--	--	--	--
Temperature, field	deg C		10.6	10.7	10.6	10.4	10.3	10.6	10.3	--	10.3	11.0	9.6	9.3	10.6	10.6	9.6	9.8
Turbidity, field	NTU		--	1.4	1.0	0.8	1.0	1.4	0.8	--	--	--	--	--	--	--	--	--
Total Metals																		
Calcium	mg/l		58.9	60.2	70.2	71.2	84.6	75.8	81.1	--	46.1 V	--	--	--	--	--	--	--
Lead	ug/l		--	--	--	--	--	--	--	--	< 5.00 U	--	--	--	--	--	--	--
Magnesium	mg/l		21.8	21.3	23.2	24.7	28.9	26.1	26.9	--	13.4	--	--	--	--	--	--	--
Manganese	ug/l	100 HRL23	--	--	--	--	--	--	--	--	< 10.0 U	--	--	--	--	--	--	--
Potassium	mg/l		1.5	1.3	1.5	1.4	1.53	1.09	1.67	--	1.25	--	--	--	--	--	--	--
Sodium	mg/l		2.9	2.8	3.0	3.1	4.05	3.18	3.49	--	4.85	--	--	--	--	--	--	--

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			22915 Hwy 169	22915 Hwy 169	22915 Hwy 169	23385 Hwy 169	23385 Hwy 169	23385 Hwy 169	23385 Hwy 169	ERL Shop Well	ERL Shop Well	ERL Shop Well	ERL Shop Well	ERL Shop Well	ERL Shop Well	ERL Shop Well	ERL Shop Well	ERL Shop Well	
Date			10/23/2015	10/16/2018	10/19/2021	10/20/2011	10/18/2012	10/15/2013	10/21/2014	10/20/2011	10/18/2012	10/15/2013	10/20/2014	10/23/2015	10/20/2016	10/18/2017	10/16/2018	10/24/2019	10/15/2020
Unique Well ID# (or MPCA ID)			545375	545375	545375	00531397	00531397	00531397	00531397	420558	420558	420558	420558	420558	420558	420558	420558	420558	420558
Parameter	Units	MDH Human Health-Based Water Guidance Table																	
Effective Date		11/13/2023																	
Exceedance Key		No Exceed																	
Volatile Organic Compounds																			
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 1.0	< 1.0	< 1.00 U J4	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 1.0	< 0.50	< 0.500 U C3	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 0.50	< 0.50	< 0.50	< 0.500 U
1,1,2-Trichloroethane	ug/l	3 HRL93	< 1.0	< 0.75	< 0.750 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.75	< 0.75	< 1.0	< 0.750 U
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,1-Dichloroethylene	ug/l	200 HRL23	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.00 U
1,1-Dichloropropene	ug/l		< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,2,3-Trichlorobenzene	ug/l		< 1.0	< 1.0	< 1.00 U J3	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 1.0	< 1.0	< 1.00 U C3	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 1.0	< 1.0	< 1.00 U J3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 1.0	< 0.050	< 1.00 U C3	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 0.050	< 0.050	< 0.050	< 1.00 U
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 1.0	< 0.25	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25	< 0.25	< 0.250 U
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,3-Dichlorobenzene	ug/l		< 1.0	< 1.0	< 1.00 U	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,3-Dichloropropane	ug/l		< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 1.0	< 0.50	< 0.500 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50	< 0.25	< 0.500 U
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 1.0	< 1.0	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U
1,4-Dichlorobenzene	ug/l	50 HRL23	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
2,2-Dichloropropane	ug/l		< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U
Acetone	ug/l	3000 HRL23 (1)	< 10 ^	< 10	< 10.0 U	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 10.0 U J4	
Allyl chloride	ug/l	30 HRL94	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0 *	< 2.0	< 2.0	< 2.0	< 2.0 *	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.00 U
Benzene	ug/l	2 HRL09 (1)	< 1.0	< 0.50	< 0.500 U J4	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 0.50	< 0.50	< 0.50	< 0.500 U
Bromobenzene	ug/l		< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Bromochloromethane	ug/l		< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.0	< 1.0	< 1.00 U J4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Bromoform	ug/l	40 HRL93	< 1.0	< 1.0	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U
Bromomethane	ug/l	10 HRL93	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0 *	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U
Butylbenzene	ug/l		< 1.0	< 1.0	< 1.00 U C3 J3	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Butylbenzene, sec	ug/l		< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Butylbenzene, tert	ug/l		< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 1.0	< 0.25	< 0.250 U J4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25	< 0.25	< 0.250 U	
Chlorobenzene	ug/l	100 HRL93	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Chlorodibromomethane	ug/l	10 HRL93	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U
Chloroethane	ug/l	ND RAA16	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U
Chloroform	ug/l	20 HRL18	< 1.0	< 1.0	< 1.00 U J4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U
Chloromethane	ug/l		< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U
Chlorotoluene, o	ug/l		< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Chlorotoluene, p	ug/l		< 1.0	< 1.0	< 1.00 U	< 4.0	< 4.0	< 4.0	< 2.0	< 4.0	< 4.0	< 4.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Cymene p- (toluene isopropyl p-)	ug/l		< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Dibromomethane (methylene bromide)	ug/l		< 1.0	< 1.0	< 1.00 U J4	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Ethyl benzene	ug/l	40 HRL23	< 1.0	< 1.0	< 1.00 U	< 2.0	< 2.												

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			22915 Hwy 169	22915 Hwy 169	22915 Hwy 169	23385 Hwy 169	23385 Hwy 169	23385 Hwy 169	23385 Hwy 169	ERL Shop Well	ERL Shop Well	ERL Shop Well	ERL Shop Well	ERL Shop Well	ERL Shop Well	ERL Shop Well	ERL Shop Well	ERL Shop Well	
Date			10/23/2015	10/16/2018	10/19/2021	10/20/2011	10/18/2012	10/15/2013	10/21/2014	10/20/2011	10/18/2012	10/15/2013	10/20/2014	10/23/2015	10/20/2016	10/18/2017	10/16/2018	10/24/2019	10/15/2020
Unique Well ID# (or MPCA ID)			545375	545375	545375	00531397	00531397	00531397	00531397	420558	420558	420558	420558	420558	420558	420558	420558	420558	420558
Parameter	Units	MDH Human Health-Based Water Guidance Table																	
Effective Date		11/13/2023																	
Exceedance Key		No Exceed																	
Alkalinity, total, as CaCO3	mg/l		206	205	223	217	196	170	165	214	149	148	3520	174	167	175	177	216	166
Chemical Oxygen Demand	mg/l		11.6	10.5	< 11.7 U	6.7	< 5.0	< 5.0	5.8	< 5.0	< 5.0	< 5.0	< 5.0	< 10.0 F1	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0 U
Chloride	mg/l		30.7	30.2	27.9	< 1.0	< 1	< 1	< 1 F1	< 1.0	< 1	< 1	< 1	< 0.5	< 0.5	< 0.5	< 0.5	< 1.0	< 1 U
Dissolved oxygen, field	mg/l		--	0.6	0.5	--	--	--	--	--	--	--	--	--	0.8	0.6	0.5	1.5	1.8
Nitrogen, ammonia, as N	mg/l		< 0.020	< 0.020	< 0.100 U	0.076	0.13	0.10	0.16	0.18	0.14	0.099	0.15 F1	0.13	0.13	0.13	0.13	0.15	< 0.100 U
Nitrogen, nitrate + nitrite, as N	mg/l		0.84	0.34	0.595	< 0.050	< 0.050	< 0.050	< 0.050 F1	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.100 U
pH, field	pH units		7.92	7.62	7.67	8.17	8.26	8.19	8.04	7.70	7.20	7.18	7.59	8.13	7.97	7.93	7.83	7.60	7.63
Redox (oxidation potential), field	mV		--	80	-155	--	--	--	--	--	--	--	--	--	-200.0	-180	-101	-39	-54
Solids, total dissolved	mg/l		265	318	292	159	183	169	190	157	184	158	179	164	194	202	184	165	186
Solids, total suspended	mg/l		< 4.0	< 4.0	< 4.00 U	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	4.70
Specific conductance @ 25 °C, field	umhos/cm		450	532	550	318	347	350	330	307	418	409	356	325	328	326	326	327	327
Sulfate, as SO4	mg/l		--	--	29.8	--	--	--	--	--	--	--	--	--	--	--	--	--	< 5.00 U
Temperature, field	deg C		9.4	9.4	10.3	9.5	9.8	10.1	9.5	10.0	10.2	10.0	11.8	11.4	11.3	11.0	10.8	11.0	11.1
Turbidity, field	NTU		--	4.7	5.3	--	--	--	--	--	--	--	--	--	--	1.7	0.9	1.4	1.9
Total Metals																			
Calcium	mg/l		73.6	71.3	74.2	--	--	--	--	--	--	--	--	43.7	40.6	41.7	44.5	42.0	45.3
Lead	ug/l		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/l		25.0	24.4	25.1	--	--	--	--	--	--	--	--	13.7	13.7	13.7	13.7	13.5	14.7
Manganese	ug/l	100 HRL23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/l		1.7	1.7	3.07	--	--	--	--	--	--	--	--	1.4	1.4	1.4	1.4	1.4	1.44
Sodium	mg/l		3.2	3.1	3.87	--	--	--	--	--	--	--	--	6.4	6.4	6.5	6.1	6.0	6.79

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			ERL Shop Well	ERL Shop Well	ERL Shop Well	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.
Date			10/19/2021	11/07/2022	10/19/2023	10/20/2011	10/18/2012	10/15/2013	10/20/2014	4/23/2015	10/23/2015	10/20/2016	10/18/2017	10/16/2018	10/24/2019	10/15/2020	10/19/2021
Unique Well ID# (or MPCA ID)			420558	420558	420558	626766	626766	626766	626766	626766	626766	626766	626766	626766	626766	626766	626766
Parameter	Units	MDH Human Health-Based Water Guidance Table															
Effective Date		11/13/2023															
Exceedance Key		No Exceed															
Volatile Organic Compounds																	
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 1.00 U J4	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U J4
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 0.500 U C3	< 0.500 U	< 0.500 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50	< 0.50	< 0.500 U	< 0.500 U C3
1,1,2-Trichloroethane	ug/l	3 HRL93	< 0.750 U	< 0.750 U	< 0.750 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.75	< 0.75	< 1.0	< 0.750 U	< 0.750 U
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
1,1-Dichloroethylene	ug/l	200 HRL23	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.00 U	< 1.00 U
1,1-Dichloropropene	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
1,2,3-Trichlorobenzene	ug/l		< 1.00 U J3	< 1.00 U C4	< 1.00 U C3	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 1.00 U C3	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U C3
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 1.00 U J3	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 1.00 U C3	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.050	< 0.050	< 1.00 U	< 1.00 U C3
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 0.250 U	< 0.250 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25	< 0.25	< 0.250 U	< 0.250 U
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 1.00 U	< 1.00 U	< 0.100 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
1,3-Dichlorobenzene	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 5.0	< 5.0	< 5.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
1,3-Dichloropropane	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 0.500 U	< 0.500 U	< 0.500 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50	< 0.25	< 0.500 U	< 0.500 U
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
1,4-Dichlorobenzene	ug/l	50 HRL23	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
2,2-Dichloropropane	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U	< 1.00 U
Acetone	ug/l	3000 HRL23 (1)	< 10.0 U	< 10.0 U	< 10.0 U	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 10	< 10	< 10.0 U J4	< 10.0 U
Allyl chloride	ug/l	30 HRL94	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0 *	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.00 U
Benzene	ug/l	2 HRL09 (1)	< 0.500 U J4	< 0.500 U	< 0.500 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50	< 0.50	< 0.500 U	< 0.500 U J4
Bromobenzene	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
Bromochloromethane	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U J4
Bromoform	ug/l	40 HRL93	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U
Bromomethane	ug/l	10 HRL93	< 1.00 U	< 1.00 U J3	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0 *	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U
Butylbenzene	ug/l		< 1.00 U C3 J3	< 1.00 U	< 1.00 U C3	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U C3 J3
Butylbenzene, sec	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
Butylbenzene, tert	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 0.250 U J4	< 0.250 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25	< 0.25	< 0.250 U	< 0.250 U J4
Chlorobenzene	ug/l	100 HRL93	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
Chlorodibromomethane	ug/l	10 HRL93	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U
Chloroethane	ug/l	ND RAA16	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U	< 1.00 U
Chloroform	ug/l	20 HRL18	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U	< 1.00 U J4
Chloromethane	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U	< 1.00 U
Chlorotoluene, o	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
Chlorotoluene, p	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 4.0	< 4.0	< 4.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
Cymene p- (toluene isopropyl p-)	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
Dibromomethane (methylene bromide)	ug/l		< 1.00 U J4	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U J4
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 1.00 U	< 1.00 U	< 1.00 U C3	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U	< 1.00 U
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
Ethyl benzene	ug/l	40 HRL23	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U
Ethyl ether	ug/l	200 RAA16 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0 ^	< 1.0	< 2.0	< 1.00 U	< 1.00 U
Hexachlorobutadiene	ug/l	1 HRL93	< 0.250 U C3 J3	< 0.250 U	< 0.250 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25	< 1.4	< 0.250 U	< 0.250 U C3 J3
Methyl ethyl ketone (2-butanone)	ug/l	4000 HRL94	< 10.0 U	< 10.0 U	< 10.0 U C3	< 20	< 20	< 20	< 20	< 10	< 10	< 10	< 10	< 10 ^	< 10	< 10.0 U	< 10.0 U
Methyl isobutyl ketone (MIBK)	ug/l	300 HRL94	< 5.00 U	< 5.00 U	< 5.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 5.0	< 5						

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			ERL Shop Well	ERL Shop Well	ERL Shop Well	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.	Ridges Develop.
Date			10/19/2021	11/07/2022	10/19/2023	10/20/2011	10/18/2012	10/15/2013	10/20/2014	4/23/2015	10/23/2015	10/20/2016	10/18/2017	10/16/2018	10/24/2019	10/15/2020	10/19/2021
Unique Well ID# (or MPCA ID)			420558	420558	420558	626766	626766	626766	626766	626766	626766	626766	626766	626766	626766	626766	626766
Parameter	Units	MDH Human Health- Based Water Guidance Table															
Effective Date		11/13/2023															
Exceedance Key		No Exceed															
Alkalinity, total, as CaCO3	mg/l		173	173	181	202	176	182	3890	172	185	183	187	182	225	173	185
Chemical Oxygen Demand	mg/l		< 10.0 U	< 10.0 U	209	10.8	< 5.0	< 5.0	6.1 B	--	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0 U	< 10.0 U
Chloride	mg/l		< 1 U	< 1 U	< 1 U	< 1.0	< 1	< 1	< 1	< 1.0	< 0.5	< 0.5	< 0.5	< 0.5	< 1.0	< 1 U	< 1 U
Dissolved oxygen, field	mg/l		0.5	0.3	0.9	--	--	--	--	--	--	6.9	2.9	3.0	3.5	4.0	5.2
Nitrogen, ammonia, as N	mg/l		0.151	0.116	0.117	0.27	0.23	0.18	0.51	--	0.18	0.23	0.23	0.80	0.24	0.207	0.269
Nitrogen, nitrate + nitrite, as N	mg/l		< 0.100 U	< 0.100 U	< 0.100 U	< 0.050	< 0.050	< 0.050	< 0.050 F1	--	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.100 U	< 0.100 U
pH, field	pH units		8	7.7	8.1	7.82	8.25	8.19	7.58	7.53	7.97	7.87	7.80	7.58	7.48	7.5	7.78
Redox (oxidation potential), field	mV		-185	-63	-41	--	--	--	--	--	--	-10.0	25	36	58	71	-15
Solids, total dissolved	mg/l		176	178 B	184 Q	196	202	191	209	--	168	207	232	185	210	200	190
Solids, total suspended	mg/l		< 4.00 U	< 4.00 U	8.40	< 4.0	< 4.0	< 4.0	< 4.0	--	< 4.0	< 4.0	< 4.0	< 4.0	5.6	< 4.00 U	< 4.00 U
Specific conductance @ 25 °C, field	umhos/cm		337	321	325	326	350	352	344	342	319	348	344	366	352	358	360
Sulfate, as SO4	mg/l		< 5.00 U	--	--	--	--	--	--	< 4.0	--	--	--	--	--	< 5.00 U	< 5.00 U
Temperature, field	deg C		11.3	11.1	14.9	10.2	10.0	10.0	9.9	9.4	10.0	10.2	10.5	9.9	9.6	10.9	12
Turbidity, field	NTU		1.5	2.0	--	--	--	--	--	--	--	--	3.0	2.5	5.2	5.8	5
Total Metals																	
Calcium	mg/l		42.1	41.3	44.5	--	--	--	--	46.4	45.7 4	44.0	46.8	47.9	45.2	49.2	46.3
Lead	ug/l		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/l		13.7	13.2	12.9	--	--	--	--	14.9	14.3	15.1	15.4	14.8	14.5	15.9	14.3
Manganese	ug/l	100 HRL23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/l		1.14	1.45	1.33	--	--	--	--	1.2	1.2	1.3	1.3	1.2	1.2	1.22	< 1.00 U
Sodium	mg/l		6.41	6.64 O1	6.08	--	--	--	--	5.4	5.7	6.0	6.2	5.6	5.4	6.08	5.60 O1

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Unique Well ID# (or MPCA ID)			Ridges Develop. 11/07/2022 626766	Ridges Develop. 10/19/2023 626766	12781 221st Ave NW 5/29/2015 416125	12781 221st Ave NW 10/23/2015 416125	12781 221st Ave NW 11/07/2016 416125	12781 221st Ave NW 10/15/2020 416125	22205 Elk Lake Rd 5/29/2015 625475	22205 Elk Lake Rd 10/23/2015 625475	22205 Elk Lake Rd 11/07/2016 625475	22205 Elk Lake Rd 10/19/2021 625475	22205 Elk Lake Rd 11/07/2022 625475	22205 Elk Lake Rd 10/19/2023 625475	22275 Elk Lake Rd NW 4/10/2017 720300
Parameter	Units	MDH Human Health-Based Water Guidance Table													
Effective Date		11/13/2023													
Exceedance Key		No Exceed													
Volatile Organic Compounds															
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.0
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 0.500 U	< 0.500 U	< 1.0	< 1.0	< 1.0	< 0.500 U	< 1.0	< 1.0	< 1.0	< 0.500 U C3	< 0.500 U	< 0.500 U	< 0.50
1,1,2-Trichloroethane	ug/l	3 HRL93	< 0.750 U	< 0.750 U	< 1.0	< 1.0	< 1.0	< 0.750 U	< 1.0	< 1.0	< 1.0	< 0.750 U	< 0.750 U	< 0.750 U	< 0.75
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,1-Dichloroethylene	ug/l	200 HRL23	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,1-Dichloropropene	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,2,3-Trichlorobenzene	ug/l		< 1.00 U C4	< 1.00 U C3	< 1.0	< 1.0	< 1.0 ^	< 1.00 U	< 1.0	< 1.0	< 1.0 ^	< 1.00 U J3	< 1.00 U C4	< 1.00 U	< 1.0
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.0
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.0
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U C3	< 1.00 U	< 1.00 U	< 0.050
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 0.250 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 0.250 U	< 1.0	< 1.0	< 1.0	< 0.250 U	< 0.250 U	< 0.250 U	< 0.25
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 1.00 U	< 0.100 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 0.100 U	< 1.0
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,3-Dichlorobenzene	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,3-Dichloropropane	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 0.500 U	< 0.500 U	< 1.0	< 1.0	< 1.0	< 0.500 U	< 1.0	< 1.0	< 1.0	< 0.500 U	< 0.500 U	< 0.500 U	< 0.50
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
1,4-Dichlorobenzene	ug/l	50 HRL23	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
2,2-Dichloropropane	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0 ^	< 1.00 U	< 1.0	< 1.0	< 1.0 ^	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Acetone	ug/l	3000 HRL23 (1)	< 10.0 U	< 10.0 U	< 10	< 10	< 10	< 10.0 U J4	< 10	< 10	< 10	< 10.0 U	< 10.0 U	< 10.0 U	< 10
Allyl chloride	ug/l	30 HRL94	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Benzene	ug/l	2 HRL09 (1)	< 0.500 U	< 0.500 U	< 1.0	< 1.0	< 1.0	< 0.500 U	< 1.0	< 1.0	< 1.0	< 0.500 U J4	< 0.500 U	< 0.500 U	< 0.50
Bromobenzene	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Bromochloromethane	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.0
Bromoform	ug/l	40 HRL93	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Bromomethane	ug/l	10 HRL93	< 1.00 U J3	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.0
Butylbenzene	ug/l		< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U C3 J3	< 1.00 U	< 1.00 U	< 1.0
Butylbenzene, sec	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Butylbenzene, tert	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 0.250 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 0.250 U	< 1.0	< 1.0	< 1.0	< 0.250 U J4	< 0.250 U	< 0.250 U	< 0.25
Chlorobenzene	ug/l	100 HRL93	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Chlorodibromomethane	ug/l	10 HRL93	< 1.00 U	< 1.00 U	< 1.0 ^	< 1.0	< 1.0	< 1.00 U	< 1.0 ^	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Chloroethane	ug/l	ND RAA16	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0 *
Chloroform	ug/l	20 HRL18	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.0
Chloromethane	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Chlorotoluene, o	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Chlorotoluene, p	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Cymene p- (toluene isopropyl p-)	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Dibromomethane (methylene bromide)	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.0
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.0
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 1.00 U	< 1.00 U	< 1.0	< 1.0 ^	< 1.0	< 1.00 U	< 1.0	< 1.0 ^	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Ethyl benzene	ug/l	40 HRL23	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Ethyl ether	ug/l	200 RAA16 (1)	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Hexachlorobutadiene	ug/l	1 HRL93	< 0.250 U	< 0.250 U	< 1.0	< 1.0	< 1.0 ^	< 0.250 U	< 1.0	< 1.0	< 1.0 ^	< 0.250 U C3 J3	< 0.250 U	< 0.250 U	< 0.25
Methyl ethyl ketone (2-butanone)	ug/l	4000 HRL94	< 10.0 U	< 10.0 U C3	< 10	< 10 ^	< 10	< 10.0 U	< 10	< 10 ^	< 10	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10
Methyl isobutyl ketone (MIBK)	ug/l	300 HRL94	< 5.00 U	< 5.00 U	< 5.0	< 5.0	< 5.0	< 5.00 U	< 5.0	< 5.0	< 5.0	< 5.00 U	< 5.00 U	< 5.00 U	< 5.0
Methyl tertiary butyl ether (MTBE)	ug/l	60 RAA13 (1)	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Methylene chloride	ug/l	5 HRLMCL	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Naphthalene	ug/l	70 HRL13	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U C3 J3	< 1.00 U	< 1.00 U	< 1.0
Propylbenzene	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Styrene	ug/l		< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Tetrachloroethylene	ug/l	4 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0
Tetrahydrofuran	ug/l	600 HRL18	< 5.00 U	< 5.00 U J3</											

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Unique Well ID# (or MPCA ID)			Ridges Develop. 11/07/2022 626766	Ridges Develop. 10/19/2023 626766	12781 221st Ave NW 5/29/2015 416125	12781 221st Ave NW 10/23/2015 416125	12781 221st Ave NW 11/07/2016 416125	12781 221st Ave NW 10/15/2020 416125	22205 Elk Lake Rd 5/29/2015 625475	22205 Elk Lake Rd 10/23/2015 625475	22205 Elk Lake Rd 11/07/2016 625475	22205 Elk Lake Rd 10/19/2021 625475	22205 Elk Lake Rd 11/07/2022 625475	22205 Elk Lake Rd 10/19/2023 625475	22275 Elk Lake Rd NW 4/10/2017 720300
Parameter	Units	MDH Human Health- Based Water Guidance Table													
Effective Date		11/13/2023													
Exceedance Key		No Exceed													
Alkalinity, total, as CaCO3	mg/l		184	189	171	165	172	153	154	139	147	159	148	153	--
Chemical Oxygen Demand	mg/l		< 10.0 U	< 10.0 U	--	< 10.0	< 10.0	< 10.0 U	--	< 10.0	< 10.0	< 10.0 U	< 10.0 U	14.2	--
Chloride	mg/l		< 1 U	< 1 U	2.0	2.38	5.09	5.27	14.7	14.4	15.5	16.5	16.7	16.9	--
Dissolved oxygen, field	mg/l		3.5	4.9	--	--	0.2	0.2	--	--	0.2	0.5	0.2	0.5	1.5
Nitrogen, ammonia, as N	mg/l		0.217	0.225	--	0.098	0.091 F1	< 0.100 U	--	0.15	0.17	0.217	0.148	0.175	--
Nitrogen, nitrate + nitrite, as N	mg/l		< 0.100 U	< 0.100 U	--	< 0.050	< 0.050	< 0.100 U	--	< 0.050	< 0.050	< 0.100 U	< 0.100 U	< 0.100 U	--
pH, field	pH units		7.68	7.47	7.88	8.26	7.81	7.45	7.87	8.13	7.81	7.85	7.8	7.85	8.24
Redox (oxidation potential), field	mV		49	-25	--	--	-148.0	-8	--	--	-83.0	-190	-37	-35	-20.0
Solids, total dissolved	mg/l		188 B	197 B	--	169	227	226 J3	--	248	283	2910	280 B	309 B	--
Solids, total suspended	mg/l		< 4.00 U	< 4.00 U	--	< 4.0	< 4.0	< 4.00 U	--	< 4.0	< 4.0	< 4.00 U	19.8	< 4.00 U	--
Specific conductance @ 25 °C, field	umhos/cm		338	399	379	309	384	387	431	387	435	459	444	454	397
Sulfate, as SO4	mg/l		--	--	24.6	--	--	37.6	49.8	--	--	61.4	--	--	--
Temperature, field	deg C		8.6	10.8	9.7	10.0	10.0	10	9.7	9.9	9.8	10.7	12.9	10.2	9.3
Turbidity, field	NTU		5.0	--	--	--	--	1.9	--	--	--	2.5	1.5	--	--
Total Metals															
Calcium	mg/l		45.9	48.7	48.7	45.4	49.2	54.1	59.5	61.9	59.9 4	64.6	66.0	64.2	--
Lead	ug/l		--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/l		14.7	13.8	14.3	14.2	15.5	17.2	14.7	15.0	14.9	15.7	16.4	14.4	--
Manganese	ug/l	100 HRL23	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/l		1.25	1.16	1.6	1.5	1.7	1.64	1.3	1.4	1.4	1.06	1.40	1.28	--
Sodium	mg/l		5.97	5.58	9.3	6.8	7.2	7.40	3.3	3.8	3.8	4.16	3.87	3.45	--

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			22275 Elk Lake Rd NW	22275 Elk Lake Rd NW	22275 Elk Lake Rd NW	12685 221st Ave NW	12685 221st Ave NW	12685 221st Ave NW	12901 221st Ave NW	12901 221st Ave NW	12901 221st Ave NW	13175 221st Ave NW	13175 221st Ave NW	13175 221st Ave NW
Date			10/18/2017	10/19/2021	10/19/2023	5/29/2015	10/23/2015	11/07/2016	7/07/2016	10/21/2016	10/15/2020	7/07/2016	10/21/2016	10/15/2020
Unique Well ID# (or MPCA ID)			720300	720300	720300	00439871	00439871	00439871	535970	535970	535970	1000022317	1000022317	1000022317
Parameter	Units	MDH Human Health-Based Water Guidance Table												
Effective Date		11/13/2023												
Exceedance Key		No Exceed												
Volatile Organic Compounds														
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 1.0	< 1.00 U J4	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 0.50	< 0.500 U C3	< 0.500 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.500 U	< 1.0	< 1.0	< 0.500 U
1,1,2-Trichloroethane	ug/l	3 HRL93	< 0.75	< 0.750 U	< 0.750 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.750 U	< 1.0	< 1.0	< 0.750 U
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,1-Dichloroethylene	ug/l	200 HRL23	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,1-Dichloropropene	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,2,3-Trichlorobenzene	ug/l		< 1.0	< 1.00 U J3	< 1.00 U	< 1.0	< 1.0	< 1.0 ^	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 1.0	< 1.00 U C3	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 1.0	< 1.00 U J3	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 0.050	< 1.00 U C3	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 0.25	< 0.250 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.250 U	< 1.0	< 1.0	< 0.250 U
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 1.0	< 1.00 U	< 0.100 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,3-Dichlorobenzene	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,3-Dichloropropane	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 0.50	< 0.500 U	< 0.500 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.500 U	< 1.0	< 1.0	< 0.500 U
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
1,4-Dichlorobenzene	ug/l	50 HRL23	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
2,2-Dichloropropane	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0 ^	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Acetone	ug/l	3000 HRL23 (1)	< 10	< 10.0 U	< 10.0 U	< 10	< 10	< 10	< 10	< 10	< 10.0 U J4	< 10	< 10	< 10.0 U J4
Allyl chloride	ug/l	30 HRL94	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Benzene	ug/l	2 HRL09 (1)	< 0.50	< 0.500 U J4	< 0.500 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.500 U	< 1.0	< 1.0	< 0.500 U
Bromobenzene	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Bromochloromethane	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.0	< 1.00 U J4	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Bromoform	ug/l	40 HRL93	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Bromomethane	ug/l	10 HRL93	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Butylbenzene	ug/l		< 1.0	< 1.00 U C3 J3	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Butylbenzene, sec	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Butylbenzene, tert	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 0.25	< 0.250 U J4	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.250 U	< 1.0	< 1.0	< 0.250 U
Chlorobenzene	ug/l	100 HRL93	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Chlorodibromomethane	ug/l	10 HRL93	< 1.0	< 1.00 U	< 1.00 U	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Chloroethane	ug/l	ND RAA16	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Chloroform	ug/l	20 HRL18	< 1.0	< 1.00 U J4	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Chloromethane	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Chlorotoluene, o	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Chlorotoluene, p	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Cymene p- (toluene isopropyl p-)	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Dibromomethane (methylene bromide)	ug/l		< 1.0	< 1.00 U J4	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 1.0	< 1.00 U	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Ethyl benzene	ug/l	40 HRL23	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Ethyl ether	ug/l	200 RAA16 (1)	< 1.0 ^	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Hexachlorobutadiene	ug/l	1 HRL93	< 0.25	< 0.250 U C3 J3	< 0.250 U	< 1.0	< 1.0	< 1.0 ^	< 1.0	< 1.0	< 0.250 U	< 1.0	< 1.0	< 0.250 U
Methyl ethyl ketone (2-butanone)	ug/l	4000 HRL94	< 10	< 10.0 U	< 10.0 U C3	< 10	< 10 ^	< 10	< 10	< 10	< 10.0 U	< 10	< 10	< 10.0 U
Methyl isobutyl ketone (MIBK)	ug/l	300 HRL94	< 5.0 ^	< 5.00 U	< 5.00 U	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.00 U	< 5.0	< 5.0	< 5.00 U
Methyl tertiary butyl ether (MTBE)	ug/l	60 RAA13 (1)	< 1.0 ^	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Methylene chloride	ug/l	5 HRLMCL	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Naphthalene	ug/l	70 HRL13	< 1.0	< 1.00 U C3 J3	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Propylbenzene	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Styrene	ug/l		< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Tetrachloroethylene	ug/l	4 HRL23 (1)	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Tetrahydrofuran	ug/l	600 HRL18	< 5.0 ^	< 5.00 U	< 5.00 U J3 J4	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.00 U	< 5.0	< 5.0	< 5.00 U
Toluene	ug/l	70 HRL23	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Trichloroethylene (TCE)	ug/l	0.4 HRL15 (1)	< 0.10	< 0.100 U J4	< 0.100 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.100 U	< 1.0	< 1.0	< 0.100 U
Trichlorofluoromethane (Freon-11)	ug/l	2000 HRL93	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0 ^	< 1.0 ^	< 1.0	< 1.0	< 1.00 U	< 1.0	< 1.0	< 1.00 U
Trichlorotrifluoroethane (Freon 113)	ug/l	200000 HRL93	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0 ^	< 1.0	< 1.0	&			

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			22275 Elk Lake Rd NW	22275 Elk Lake Rd NW	22275 Elk Lake Rd NW	12685 221st Ave NW	12685 221st Ave NW	12685 221st Ave NW	12901 221st Ave NW	12901 221st Ave NW	12901 221st Ave NW	13175 221st Ave NW	13175 221st Ave NW	13175 221st Ave NW
Date			10/18/2017	10/19/2021	10/19/2023	5/29/2015	10/23/2015	11/07/2016	7/07/2016	10/21/2016	10/15/2020	7/07/2016	10/21/2016	10/15/2020
Unique Well ID# (or MPCA ID)			720300	720300	720300	00439871	00439871	00439871	535970	535970	535970	1000022317	1000022317	1000022317
Parameter	Units	MDH Human Health-Based Water Guidance Table												
Effective Date		11/13/2023												
Exceedance Key		No Exceed												
Alkalinity, total, as CaCO3	mg/l		193	196	198	153	152 4	152	172	170	158	164	161	151
Chemical Oxygen Demand	mg/l		< 10.0	< 10.0 U	< 10.0 U	--	< 10.0	< 10.0	--	117	< 10.0 U	--	< 10.0	< 10.0 U
Chloride	mg/l		3.66	3.99	4.8	15.9	17.3	17.3	3.2	1.74	5.18	19.2	21.8	20.1
Dissolved oxygen, field	mg/l		0.5	0.5	0.3	--	--	0.2	0.8	0.2	0.3	0.6	0.3	0.3
Nitrogen, ammonia, as N	mg/l		0.34	0.380	0.349	--	0.035	< 0.020	--	0.086	< 0.100 U	--	0.054	< 0.100 U
Nitrogen, nitrate + nitrite, as N	mg/l		< 0.050	< 0.100 U	< 0.100 U	--	< 0.050	< 0.050	--	< 0.050	< 0.100 U	--	< 0.050	< 0.100 U
pH, field	pH units		7.99	8.09	7.98	7.94	8.19	7.50	7.95	8.03	7.42	7.93	7.93	7.42
Redox (oxidation potential), field	mV		20	-180	-49	--	--	-89.0	-103.0	-144.0	14	-79.0	-142.0	13
Solids, total dissolved	mg/l		262	236	243 B	--	232	281	--	191	227	--	285	306
Solids, total suspended	mg/l		< 4.0	< 4.00 U	< 4.00 U	--	< 4.0	5.2	--	< 4.0	< 4.00 U	--	< 4.0	< 4.00 U
Specific conductance @ 25 °C, field	umhos/cm		396	399	398	460	403	435	380	357	379	420	451	473
Sulfate, as SO4	mg/l		--	20.6	--	51.0	--	--	21.9	--	26.2	59.1	--	56.6
Temperature, field	deg C		9.6	9.8	10.3	11.0	12.0	11.8	10.4	10.9	10.1	10.9	10.5	10.7
Turbidity, field	NTU		2.6	1.5	--	--	--	--	--	--	1.3	--	--	1.5
Total Metals														
Calcium	mg/l		50.6	53.3	57.6	59.4	60.1	57.2	45.8	43.1	53.7 V	65.0	67.9	74.4
Lead	ug/l		--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/l		16.7	17.1	16.5	16.4	15.9	15.7	14.9	15.0	17.4	14.6	16.2	16.8
Manganese	ug/l	100 HRL23	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/l		1.6	1.27	1.61	1.2	1.3	1.3	1.5	1.4	1.43	1.4	1.5	1.39
Sodium	mg/l		4.8	4.90	4.91	3.3	3.5	3.7	5.8	6.2	6.35	3.3	3.4	3.66

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			13175 221ST Ave NW	22017 Elk Lake Rd NW	22017 Elk Lake Rd NW	22248 Elk Lake Rd	22248 Elk Lake Rd	22248 ELK LAKE RD	22447 Tipton St. New	22447 Tipton St. New	22447 Tipton St. New	22447 Tipton St. New	22447 Tipton St. New	22447 Tipton St. New
Date			10/19/2021	7/07/2016	10/21/2016	4/10/2017	10/18/2017	10/19/2021	10/23/2015	4/25/2016	10/21/2016	10/18/2017	10/16/2018	10/24/2019
Unique Well ID# (or MPCA ID)			1000022317	1000026209	1000026209	608116	608116	608116	813437	813437	813437	813437	813437	813437
Parameter	Units	MDH Human Health-Based Water Guidance Table												
Effective Date		11/13/2023												
Exceedance Key		No Exceed												
Volatile Organic Compounds														
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 1.00 U J4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 0.500 U C3	< 1.0	< 1.0	< 0.50	< 0.50	< 0.500 U Q	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50	< 0.50
1,1,2-Trichloroethane	ug/l	3 HRL93	< 0.750 U	< 1.0	< 1.0	< 0.75	< 0.75	< 0.750 U Q	< 1.0	< 1.0	< 1.0	< 0.75	< 0.75	< 1.0
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethylene	ug/l	200 HRL23	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0
1,1-Dichloropropene	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	ug/l		< 1.00 U J3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U C4 Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 1.00 U C3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 1.00 U J3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U C4 Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 1.00 U C3	< 1.0	< 1.0	< 0.050	< 0.050	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 0.050	< 0.050	< 0.050
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 0.250 U	< 1.0	< 1.0	< 0.25	< 0.25	< 0.250 U Q	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25	< 0.25
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 0.500 U	< 1.0	< 1.0	< 0.50	< 0.50	< 0.500 U Q	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50	< 0.25
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0
1,4-Dichlorobenzene	ug/l	50 HRL23	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,2-Dichloropropane	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0
Acetone	ug/l	3000 HRL23 (1)	< 10.0 U	< 10	< 10	< 10	< 10	< 10.0 U Q	< 10	< 10	< 10	< 10	< 10	< 10
Allyl chloride	ug/l	30 HRL94	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0
Benzene	ug/l	2 HRL09 (1)	< 0.500 U J4	< 1.0	< 1.0	< 0.50	< 0.50	< 0.500 U Q	< 1.0	< 1.0	< 1.0	< 0.50	< 0.50	< 0.50
Bromobenzene	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.00 U J4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromoform	ug/l	40 HRL93	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0
Bromomethane	ug/l	10 HRL93	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0
Butylbenzene	ug/l		< 1.00 U C3 J3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Butylbenzene, sec	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Butylbenzene, tert	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 0.250 U J4	< 1.0	< 1.0	< 0.25	< 0.25	< 0.250 U Q	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25	< 0.25
Chlorobenzene	ug/l	100 HRL93	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorodibromomethane	ug/l	10 HRL93	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0
Chloroethane	ug/l	ND RAA16	< 1.00 U	< 1.0	< 1.0	< 1.0 *	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0
Chloroform	ug/l	20 HRL18	< 1.00 U J4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 3.0
Chloromethane	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 3.0
Chlorotoluene, o	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorotoluene, p	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cymene p- (toluene isopropyl p-)	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromomethane (methylene bromide)	ug/l		< 1.00 U J4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 3.0
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethyl benzene	ug/l	40 HRL23	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethyl ether	ug/l	200 RAA16 (1)	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0 ^	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0 ^	< 1.0	< 2.0
Hexachlorobutadiene	ug/l	1 HRL93	< 0.250 U C3 J3	< 1.0	< 1.0	< 0.25	< 0.25	< 0.250 U C3J4Q	< 1.0	< 1.0	< 1.0	< 0.25	< 0.25	< 1.4
Methyl ethyl ketone (2-butanone)	ug/l	4000 HRL94	< 10.0 U	< 10	< 10	< 10	< 10	< 10.0 U Q	< 10 ^	< 10	< 10	< 10	< 10 ^	< 10
Methyl isobutyl ketone (MIBK)	ug/l	300 HRL94	< 5.00 U	< 5.0	< 5.0	< 5.0	< 5.0 ^	< 5.00 U Q	< 5.0	< 5.0	< 5.0	< 5.0 ^	< 5.0	< 10
Methyl tertiary butyl ether (MTBE)	ug/l	60 RAA13 (1)	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0 ^	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0 ^	< 1.0	< 1.0 ^
Methylene chloride	ug/l	5 HRLMCL	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U J4 Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0
Naphthalene	ug/l	70 HRL13	< 1.00 U C3 J3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U C3 Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0
Propylbenzene	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	ug/l		< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethylene	ug/l	4 HRL23 (1)	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrahydrofuran	ug/l	600 HRL18	< 5.00 U	< 5.0	< 5.0	< 5.0 *	< 5.0 ^	< 5.00 U Q	< 5.0	< 5.0	< 5.0	< 5.0 ^	< 5.0	< 10
Toluene	ug/l	70 HRL23	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethylene (TCE)	ug/l	0.4 HRL15 (1)	< 0.100 U J4	< 1.0	< 1.0	< 0.10	< 0.10	< 0.100 U Q	< 1.0	< 1.0	< 1.0	< 0.10	< 0.10	< 0.10
Trichlorofluoromethane (Freon-11)	ug/l	2000 HRL93	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0 ^	< 1.0	< 1.0	< 1.0	< 1.0	< 4.0
Trichlorotrifluoroethane (Freon 113)	ug/l	200000 HRL93	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U Q	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0
Vinyl chloride	ug/l	0.2 HRL18 (1)	< 0.0500 U	< 0.0040	< 0.050	< 0.050	< 0.050	< 0.0500 U Q	< 0.10	< 0.050	< 0.050</			

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			13175 221ST Ave NW	22017 Elk Lake Rd NW	22017 Elk Lake Rd NW	22248 Elk Lake Rd	22248 Elk Lake Rd	22248 ELK LAKE RD	22447 Tipton St. New	22447 Tipton St. New	22447 Tipton St. New	22447 Tipton St. New	22447 Tipton St. New	22447 Tipton St. New
Date			10/19/2021	7/07/2016	10/21/2016	4/10/2017	10/18/2017	10/19/2021	10/23/2015	4/25/2016	10/21/2016	10/18/2017	10/16/2018	10/24/2019
Unique Well ID# (or MPCA ID)			1000022317	1000026209	1000026209	608116	608116	608116	813437	813437	813437	813437	813437	813437
Parameter	Units	MDH Human Health-Based Water Guidance Table												
Effective Date		11/13/2023												
Exceedance Key		No Exceed												
Alkalinity, total, as CaCO3	mg/l		178	174	176	--	178	173	172	--	168	175	181	217
Chemical Oxygen Demand	mg/l		< 10.0 U	--	< 10.0	--	< 10.0	< 10.0 U	< 10.0	--	< 10.0	< 10.0	< 10.0	< 10.0
Chloride	mg/l		21.2	2.8	3.21	--	6.01	6.12	0.527	--	< 0.5	< 0.5	< 0.5	< 1.0
Dissolved oxygen, field	mg/l		0.9	0.6	0.4	1.2	0.7	0.6	--	0.4	0.6	0.3	0.6	0.7
Nitrogen, ammonia, as N	mg/l		< 0.100 U	--	0.030	--	0.55	0.543	0.17	--	0.22 F1	0.23	0.23 F1	0.23
Nitrogen, nitrate + nitrite, as N	mg/l		< 0.100 U J5	--	< 0.050	--	< 0.050	< 0.100 U	< 0.050	--	< 0.050	< 0.050	< 0.050	< 0.050
pH, field	pH units		7.74	7.91	7.97	8.19	7.94	7.87	8.02	7.89	7.98	7.93	7.82	7.55
Redox (oxidation potential), field	mV		-97	-102.0	-145.0	-15.0	-20	-99	--	-173	-210.0	-100	-129	-20
Solids, total dissolved	mg/l		319	--	232	--	260	354	130	--	174	194	194	161
Solids, total suspended	mg/l		< 4.00 U	--	8.0	--	< 4.0	< 4.00 U	< 4.0	--	< 4.0	< 4.0	< 4.0	< 4.0
Specific conductance @ 25 °C, field	umhos/cm		489	386	381	405	405	411	333	337	328	327	328	325
Sulfate, as SO4	mg/l		59.6	24.7	--	--	--	42.7	--	--	--	--	--	--
Temperature, field	deg C		10.5	9.9	9.9	9.1	10.2	9.9	10.0	9.2	9.5	9.6	9.8	10.0
Turbidity, field	NTU		1.6	--	--	--	7.0	1	--	--	--	2.5	2.0	2.2
Total Metals														
Calcium	mg/l		77.1	53.4	54.2	--	52.1	57.7	43.0	--	40.2	40.5	45.6	43.2
Lead	ug/l		--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/l		16.6	11.5	12.6	--	15.5	16.6	13.4	--	13.6	13.2	13.9	13.8
Manganese	ug/l	100 HRL23	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/l		1.95	1.1	1.1	--	1.7	1.33	1.5	--	1.6	1.4	1.5	1.4
Sodium	mg/l		3.84	3.3	3.4	--	4.5	4.81	5.9	--	5.9	5.7	5.7	5.5

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			22447 Tipton St. New	22447 Tipton St. New	22447 Tipton St. New	22447 Tipton St. New	12275 239th Ave	12275 239th Ave	12275 239th Ave	12163 223rd Ave	12163 223rd Ave	12163 223rd Ave	12163 223rd Ave	12163 223rd Ave	12163 223rd Ave	12163 223rd Ave
Date			10/15/2020	10/19/2021	11/07/2022	10/19/2023	10/24/2019	10/15/2020	11/07/2022	10/20/2011	10/18/2012	10/15/2013	10/20/2014	4/23/2015	10/23/2015	4/25/2016
Unique Well ID# (or MPCA ID)			813437	813437	813437	813437	525310	525310	525310	655131	655131	655131	655131	655131	655131	655131
Parameter	Units	MDH Human Health-Based Water Guidance Table														
Effective Date		11/13/2023														
Exceedance Key		No Exceed														
Volatile Organic Compounds																
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 0.500 U	< 0.500 U C3	< 0.500 U	< 0.500 U	< 0.50	< 0.500 U	< 0.500 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
1,1,2-Trichloroethane	ug/l	3 HRL93	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 1.0	< 0.750 U	< 0.750 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethylene	ug/l	200 HRL23	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	ug/l		< 1.00 U	< 1.00 U J3	< 1.00 U C4	< 1.00 U	< 5.0	< 1.00 U	< 1.00 U C4	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 5.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 0.050	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.25	< 0.250 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 5.0	< 5.0	< 5.0	< 5.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.25	< 0.500 U	< 0.500 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.0	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	ug/l	50 HRL23	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
2,2-Dichloropropane	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 4.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Acetone	ug/l	3000 HRL23 (1)	< 10.0 U J4	< 10.0 U	< 10.0 U	< 10.0 U	< 10	< 10.0 U	< 10.0 U	< 20	< 20	< 20	< 20	< 10	< 10 ^	< 10
Allyl chloride	ug/l	30 HRL94	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0 *	< 2.0	< 1.0	< 1.0	< 1.0
Benzene	ug/l	2 HRL09 (1)	< 0.500 U	< 0.500 U J4	< 0.500 U	< 0.500 U	< 0.50	< 0.500 U	< 0.500 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Bromobenzene	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromochloromethane	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromoform	ug/l	40 HRL93	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.0	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0
Bromomethane	ug/l	10 HRL93	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 4.0	< 1.00 U	< 1.00 U J3	< 2.0	< 2.0	< 2.0	< 2.0 *	< 1.0	< 1.0	< 1.0
Butylbenzene	ug/l		< 1.00 U	< 1.00 U C3 J3	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Butylbenzene, sec	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Butylbenzene, tert	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 0.250 U	< 0.250 U J4	< 0.250 U	< 0.250 U	< 0.25	< 0.250 U	< 0.250 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorobenzene	ug/l	100 HRL93	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Chlorodibromomethane	ug/l	10 HRL93	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^	< 1.0	< 1.0
Chloroethane	ug/l	ND RAA16	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 4.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Chloroform	ug/l	20 HRL18	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 3.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloromethane	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorotoluene, o	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorotoluene, p	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 4.0	< 4.0	< 4.0	< 4.0	< 1.0	< 1.0	< 1.0
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Cymene p- (toluene isopropyl p-)	ug/l		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Dibromomethane (methylene bromide)	ug/l		< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 3.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0 ^	< 1.0	< 1.0
Ethyl benzene	ug/l	40 HRL23	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Ethyl ether	ug/l	200 RAA16 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 2.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	ug/l	1 HRL93	< 0.250 U	< 0.250 U C3 J3	< 0.250 U	< 0.250 U	< 1.4	< 0.250 U	< 0.250 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0
Methyl ethyl ketone (2-butanone)	ug/l	4000 HRL94	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10	< 10.0 U	< 10.0 U	< 20	< 20	< 20	< 20	< 10	< 10 ^	< 10
Methyl isobutyl ketone (MIBK)	ug/l	300 HRL94	< 5.00 U	< 5.00 U	< 5.00 U	< 5.00 U	< 10	< 5.00 U	< 5.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 5.0	< 5.0	< 5.0
Methyl tertiary butyl ether (MTBE)	ug/l	60 RAA13 (1)	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.0 ^	< 1.00 U	< 1.00 U	< 3.0	< 3.0	< 3.0	< 3.0	< 1.0	< 1.0	< 1.0
Methylene chloride	ug/l	5 HRLMCL	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 5.0	< 1.00 U	< 1.00 U	< 2.0	< 2.0	< 2.0	< 2.0	< 1		

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			22447 Tipton St. New	22447 Tipton St. New	22447 Tipton St. New	22447 Tipton St. New	12275 239th Ave	12275 239th Ave	12275 239th Ave	12163 223rd Ave	12163 223rd Ave	12163 223rd Ave	12163 223rd Ave	12163 223rd Ave	12163 223rd Ave	12163 223rd Ave
Date			10/15/2020	10/19/2021	11/07/2022	10/19/2023	10/24/2019	10/15/2020	11/07/2022	10/20/2011	10/18/2012	10/15/2013	10/20/2014	4/23/2015	10/23/2015	4/25/2016
Unique Well ID# (or MPCA ID)			813437	813437	813437	813437	525310	525310	525310	655131	655131	655131	655131	655131	655131	655131
Parameter	Units	MDH Human Health-Based Water Guidance Table														
Effective Date		11/13/2023														
Exceedance Key		No Exceed														
Alkalinity, total, as CaCO3	mg/l		165	180	177	177	275	216	228	271	265	297	7120	270	283.4	--
Chemical Oxygen Demand	mg/l		< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0	< 10.0 U	< 10.0 U	10.8	5.0	< 5.0	< 5.0	--	< 10.0	--
Chloride	mg/l		< 1 U	< 1 U	< 1 U	< 1 U	22.0	23.4	24.5	10.7	10.1	10.7	10.1	12.1	11.3	--
Dissolved oxygen, field	mg/l		0.2	0.4	0.3	0.2	0.4	0.2	0.2	--	--	--	--	--	--	0.9
Nitrogen, ammonia, as N	mg/l		0.205	0.257	0.202	0.220	0.12	< 0.100 U	< 0.100 U	< 0.050	< 0.050	< 0.050	0.098	--	< 0.020	--
Nitrogen, nitrate + nitrite, as N	mg/l		< 0.100 U	< 0.100 U	< 0.100 U	< 0.100 U	< 0.050	< 0.100 U	< 0.100 U	1.8	1.9	1.4	1.3	--	1.2	--
pH, field	pH units		7.5	7.97	7.64	7.69	7.65	7.59	7.75	7.48	7.52	7.60	7.47	7.44	7.78	7.59
Redox (oxidation potential), field	mV		-55	-99	-85	-61	101	93	-11	--	--	--	--	--	--	-85
Solids, total dissolved	mg/l		180	170	180 B	181 J3	314	353	340 B	272	337	329	336	--	315	--
Solids, total suspended	mg/l		< 4.00 U	< 4.00 U	< 4.00 U	8.53	< 4.0	< 4.00 U	< 4.00 U	< 4.0	< 4.0	< 4.0	< 4.0	--	< 4.0	--
Specific conductance @ 25 °C, field	umhos/cm		325	341	326	332	512	533	530	516	573	555	530	537	517	544
Sulfate, as SO4	mg/l		< 5.00 U	< 5.00 U	--	--	--	29.7	--	--	--	--	--	22.3	--	--
Temperature, field	deg C		2.2	10	10.6	9.8	9.7	9.9	8.7	9.3	9.5	9.6	9.4	9.6	9.0	9.0
Turbidity, field	NTU		1.9	1.5	1.3	--	1.5	1.5	1.7	--	--	--	--	--	--	--
Total Metals																
Calcium	mg/l		46.8	42.1	43.5	43.2	65.6	73.9	68.8	--	--	--	--	79.1	78.5	--
Lead	ug/l		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/l		15.1	13.5	13.3	12.3	26.8	30.0	26.9	--	--	--	--	27.9	27.3	--
Manganese	ug/l	100 HRL23	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/l		1.54	1.10	1.54	1.36	1.6	1.67	1.70	--	--	--	--	1.5	1.6	--
Sodium	mg/l		6.23	5.70	5.88	5.39	4.1	4.55	4.41	--	--	--	--	3.0	3.3	--

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Unique Well ID# (or MPCA ID)			12163 223rd Ave 10/20/2016 655131	12163 223rd Ave 10/18/2017 655131	12163 223rd Ave 10/16/2018 655131	12163 223rd Ave 10/24/2019 655131	12163 223rd Ave 7/06/2020 655131	12163 223rd Ave 10/15/2020 655131	12163 223rd Ave 7/14/2021 655131	12163 223rd Ave 10/19/2021 655131	12163 223rd Ave New 6/16/2022 876409	12163 223rd Ave New 11/07/2022 876409	12163 223rd Ave New 10/19/2023 876409	12163 223rd Ave New 12/04/2023 876409	11661 225th Ave 10/20/2011 ZW00217	11661 225th Ave 10/18/2012 ZW00217
Parameter	Units	MDH Human Health- Based Water Guidance Table														
Effective Date		11/13/2023														
Exceedance Key		No Exceed														
Volatile Organic Compounds																
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 1.0	< 0.50	< 0.50	< 0.50	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U Q	< 1.00 U	< 0.500 U	< 0.500 U	--	< 2.0	< 2.0
1,1,2-Trichloroethane	ug/l	3 HRL93	< 1.0	< 0.75	< 0.75	< 1.0	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U Q	--	< 0.750 U	< 0.750 U	--	< 1.0	< 1.0
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
1,1-Dichloroethylene	ug/l	200 HRL23	< 1.0	< 1.0	< 1.0	< 2.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	--	< 1.0	< 1.0
1,1-Dichloropropene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
1,2,3-Trichlorobenzene	ug/l		< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4 Q	< 1.00 U C4 J4	< 1.00 U C4	< 1.00 U C3	--	< 3.0	< 3.0
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4 Q	< 1.00 U C4	< 1.00 U	< 1.00 U C3	--	< 1.0	< 1.0
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 1.0	< 0.050	< 0.050	< 0.050	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 3.0	< 3.0
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.0	< 1.0
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 1.0	< 0.25	< 0.25	< 0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U Q	< 1.00 U	< 0.250 U	< 0.250 U	--	< 1.0	< 1.0
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 0.100 U	--	< 2.0	< 2.0
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.0	< 1.0
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U C3	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
1,3-Dichlorobenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 5.0	< 5.0
1,3-Dichloropropane	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 1.0	< 0.50	< 0.50	< 0.25	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U Q	< 1.00 U	< 0.500 U	< 0.500 U	--	< 1.0	< 1.0
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 3.0	< 3.0
1,4-Dichlorobenzene	ug/l	50 HRL23	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
2,2-Dichloropropane	ug/l		< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Acetone	ug/l	3000 HRL23 (1)	< 10	< 10	< 10	< 10	< 10.0 U	< 10.0 U	< 10.0 U J4	< 10.0 U Q	< 10.0 U C5	< 10.0 U	< 10.0 U	--	< 20	< 20
Allyl chloride	ug/l	30 HRL94	< 1.0	< 1.0	< 1.0	< 2.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Benzene	ug/l	2 HRL09 (1)	< 1.0	< 0.50	< 0.50	< 0.50	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U Q	< 1.00 U	< 0.500 U	< 0.500 U	--	< 2.0	< 2.0
Bromobenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.0	< 1.0
Bromochloromethane	ug/l		< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.0	< 1.0
Bromoform	ug/l	40 HRL93	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 3.0	< 3.0
Bromomethane	ug/l	10 HRL93	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U C3	< 1.00 U J3	< 1.00 U	--	< 2.0	< 2.0
Butylbenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	--	< 2.0	< 2.0
Butylbenzene, sec	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Butylbenzene, tert	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 1.0	< 0.25	< 0.25	< 0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U Q	< 1.00 U	< 0.250 U	< 0.250 U	--	< 1.0	< 1.0
Chlorobenzene	ug/l	100 HRL93	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Chlorodibromomethane	ug/l	10 HRL93	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Chloroethane	ug/l	ND RAA16	< 1.0	< 1.0	< 1.0	< 4.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Chloroform	ug/l	20 HRL18	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.0	< 1.0
Chloromethane	ug/l		< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.0	< 1.0
Chlorotoluene, o	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.0	< 1.0
Chlorotoluene, p	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U C3	< 1.00 U	< 1.00 U	--	< 4.0	< 4.0
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Cymene p- (toluene isopropyl p-)	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Dibromomethane (methylene bromide)	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 1.0	< 1.0	< 1.0	< 3.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U C3	--	< 2.0	< 2.0
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Ethyl benzene	ug/l	40 HRL23	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Ethyl ether	ug/l	200 RAA16 (1)	< 1.0	< 1.0	< 1.0	< 2.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Hexachlorobutadiene	ug/l	1 HRL93	< 1.0	< 0.25	< 0.25	< 1.4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U C3J4Q	< 1.00 U	< 0.250 U	< 0.250 U	--	< 2.0	< 2.0
Methyl ethyl ketone (2-butanone)	ug/l	4000 HRL94	< 10	< 10	< 10 ^	< 10	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U Q	< 10.0 U	< 10.0 U	< 10.0 U C3	--	< 20	< 20
Methyl isobutyl ketone (MIBK)	ug/l	300 HRL94	< 5.0	< 5.0	< 5.0	< 10	< 5.00 U	< 5.00 U	< 5.00 U	< 5.00 U Q	< 5.00 U	< 5.00 U	< 5.00 U	--	< 3.0	< 3.0
Methyl tertiary butyl ether (MTBE)	ug/l	60 RAA13 (1)	< 1.0	< 1.0	< 1.0	< 1.0 ^	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 3.0	< 3.0
Methylene chloride	ug/l	5 HRLMCL	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4 Q	< 1.00 U	< 1.00 U	< 1.00 U	--	< 2.0	< 2.0
Naphthalene	ug/l	70 HRL13	< 1.0	< 1.0	< 1.0	< 5.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3 Q	< 1.00 U C3	< 1.00 U	< 1.00 U C3	--	< 3.0	< 3.0
Propylbenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0</										

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Unique Well ID# (or MPCA ID)			12163 223rd Ave 10/20/2016 655131	12163 223rd Ave 10/18/2017 655131	12163 223rd Ave 10/16/2018 655131	12163 223rd Ave 10/24/2019 655131	12163 223rd Ave 7/06/2020 655131	12163 223rd Ave 10/15/2020 655131	12163 223rd Ave 7/14/2021 655131	12163 223rd Ave 10/19/2021 655131	12163 223rd Ave New 6/16/2022 876409	12163 223rd Ave New 11/07/2022 876409	12163 223rd Ave New 10/19/2023 876409	12163 223rd Ave New 12/04/2023 876409	11661 225th Ave 10/20/2011 ZW00217	11661 225th Ave 10/18/2012 ZW00217
Parameter	Units	MDH Human Health- Based Water Guidance Table														
Effective Date		11/13/2023														
Exceedance Key		No Exceed														
Alkalinity, total, as CaCO3	mg/l		287	307	319	350	--	298	--	307	--	184	189	--	195	144
Chemical Oxygen Demand	mg/l		< 10.0	< 10.0	< 10.0	< 10.0	--	< 10.0 U	--	< 10.0 U	--	< 10.0 U	< 10.0 U	--	14.6	5.0
Chloride	mg/l		14.1	16.3	15.5	18.3	--	18	--	16.8	--	< 1 U	< 1 U	--	< 1.0	< 1
Dissolved oxygen, field	mg/l		1.2	0.7	1.0	1.1	1.5	0.3	3	0.8	--	0.9	0.4	--	--	--
Nitrogen, ammonia, as N	mg/l		< 0.020	< 0.020	< 0.020	< 0.020	--	< 0.100 U	--	< 0.100 U	--	< 0.100 U	< 0.100 U	--	0.27	0.23
Nitrogen, nitrate + nitrite, as N	mg/l		1.5	1.4	1.2	1.3	--	1.51	--	1.27	--	< 0.100 U	< 0.100 U	--	< 0.050	< 0.050
pH, field	pH units		7.58	7.56	7.55	7.42	7.2	7.3	6.81	7.5	--	7.80	7.64	7.75	7.99	7.98
Redox (oxidation potential), field	mV		138.0	68	99	87	145	113	130	-35	--	-55	-55	--	--	--
Solids, total dissolved	mg/l		358	372	375	390	--	390	--	374	--	189 Q	206 Q	--	171	197
Solids, total suspended	mg/l		< 4.0	< 4.0	< 4.0	< 4.0	--	< 4.00 U	--	< 4.00 U	--	< 4.00 U	< 4.00 U	--	< 4.0	< 4.0
Specific conductance @ 25 °C, field	umhos/cm		599	628	621	639	655	651	642	684	--	340	341	360	318	346
Sulfate, as SO4	mg/l		--	--	--	--	--	21.8	--	21.3	--	--	--	--	--	--
Temperature, field	deg C		9.2	9.3	9.8	9.4	10	9.4	9.8	9.7	--	10.0	10.3	10.5	9.6	9.8
Turbidity, field	NTU		--	--	0.8	1.5	2.6	1.0	0.9	0.8	--	1.5	--	--	--	--
Total Metals																
Calcium	mg/l		79.4	83.9	93.1	90.6	--	99.2	--	93.6	--	< 1.00 U	< 1.00 U	--	--	--
Lead	ug/l		--	--	--	--	--	--	--	--	--	--	--	< 5.00 U	--	--
Magnesium	mg/l		29.5	30.8	31.9	31.9	--	34.7	--	31.5	--	< 1.00 U	< 1.00 U	--	--	--
Manganese	ug/l	100 HRL23	--	--	--	--	--	--	--	--	--	--	--	< 10.0 U	--	--
Potassium	mg/l		1.6	1.6	1.8	1.6	--	1.65	--	1.29	--	< 1.00 U	< 1.00 U	--	--	--
Sodium	mg/l		3.6	3.7	3.7	3.7	--	4.21	--	3.89	--	86.3	83.3	--	--	--

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location			11661 225th Ave	11661 225th Ave	11661 225th Ave	11661 225th Ave	11661 225th Ave
Date			10/15/2013	10/21/2014	10/23/2015	10/16/2018	10/19/2021
Unique Well ID# (or MPCA ID)			ZW00217	ZW00217	ZW00217	ZW00217	ZW00217
Parameter	Units	MDH Human Health-Based Water Guidance Table					
Effective Date		11/13/2023					
Exceedance Key		No Exceed					
Volatile Organic Compounds							
1,1,1,2-Tetrachloroethane	ug/l	70 HRL93	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
1,1,1-Trichloroethane	ug/l	5000 HRL18 (1)	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U J4
1,1,2,2-Tetrachloroethane	ug/l	2 HRL94	< 2.0	< 2.0	< 1.0	< 0.50	< 0.500 U C3
1,1,2-Trichloroethane	ug/l	3 HRL93	< 1.0	< 1.0	< 1.0	< 0.75	< 0.750 U
1,1-Dichloroethane	ug/l	80 RAA16 (1)	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
1,1-Dichloroethylene	ug/l	200 HRL23	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,1-Dichloropropene	ug/l		< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
1,2,3-Trichlorobenzene	ug/l		< 3.0	< 3.0	< 1.0	< 1.0	< 1.00 U J3
1,2,3-Trichloropropane	ug/l	0.003 HRL13 (1)	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U C3
1,2,4-Trichlorobenzene	ug/l	4 HRL13 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U J3
1,2,4-Trimethylbenzene	ug/l	30 HRL23	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,2-Dibromo-3-chloropropane (DBCP)	ug/l		< 3.0	< 3.0	< 1.0	< 0.050	< 1.00 U C3
1,2-Dibromoethane (EDB)	ug/l	0.03 HRL23 (1)	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
1,2-Dichlorobenzene	ug/l	600 HRL93	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,2-Dichloroethane	ug/l	1 HRL13 (1)	< 1.0	< 1.0	< 1.0	< 0.25	< 0.250 U
1,2-Dichloroethylene, cis	ug/l	6 HRL18 (1)	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
1,2-Dichloroethylene, trans	ug/l	9 HRL23 (1)	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
1,2-Dichloropropane	ug/l	3 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
1,3,5-Trimethylbenzene	ug/l	30 HRL23 (1)	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
1,3-Dichlorobenzene	ug/l		< 5.0	< 5.0	< 1.0	< 1.0	< 1.00 U
1,3-Dichloropropane	ug/l		< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
1,3-Dichloropropene, cis	ug/l	2 DCP HRL94	< 1.0	< 1.0	< 1.0	< 0.50	< 0.500 U
1,3-Dichloropropene, trans	ug/l	2 DCP HRL94	< 3.0	< 3.0	< 1.0	< 1.0	< 1.00 U
1,4-Dichlorobenzene	ug/l	50 HRL23	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
2,2-Dichloropropane	ug/l		< 2.0	< 2.0	< 1.0	< 1.0 ^	< 1.00 U
Acetone	ug/l	3000 HRL23 (1)	< 20	< 20	< 10	< 10	< 10.0 U
Allyl chloride	ug/l	30 HRL94	< 2.0 *	< 2.0	< 1.0	< 1.0	< 1.00 U
Benzene	ug/l	2 HRL09 (1)	< 2.0	< 2.0	< 1.0	< 0.50	< 0.500 U J4
Bromobenzene	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Bromochloromethane	ug/l		< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Bromodichloromethane	ug/l	3 HRL23 (1)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U J4
Bromoform	ug/l	40 HRL93	< 3.0	< 3.0	< 1.0	< 1.0	< 1.00 U
Bromomethane	ug/l	10 HRL93	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Butylbenzene	ug/l		< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U C3 J3
Butylbenzene, sec	ug/l		< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Butylbenzene, tert	ug/l		< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Carbon tetrachloride	ug/l	1 HRL13 (1)	< 1.0	< 1.0	< 1.0	< 0.25	< 0.250 U J4
Chlorobenzene	ug/l	100 HRL93	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Chlorodibromomethane	ug/l	10 HRL93	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Chloroethane	ug/l	ND RAA16	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Chloroform	ug/l	20 HRL18	< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U J4
Chloromethane	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Chlorotoluene, o	ug/l		< 1.0	< 1.0	< 1.0	< 1.0	< 1.00 U
Chlorotoluene, p	ug/l		< 4.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Cumene (isopropyl benzene)	ug/l	300 HRL93	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Cymene p- (toluene isopropyl p-)	ug/l		< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Dibromomethane (methylene bromide)	ug/l		< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U J4
Dichlorodifluoromethane (Freon-12)	ug/l	500 RAA17 (1)	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Dichlorofluoromethane (Freon-21)	ug/l	20 RAA17	< 2.0	< 2.0	< 1.0 ^	< 1.0	< 1.00 U
Ethyl benzene	ug/l	40 HRL23	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Ethyl ether	ug/l	200 RAA16 (1)	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Hexachlorobutadiene	ug/l	1 HRL93	< 2.0	< 2.0	< 1.0	< 0.25	< 0.250 U C3 J3
Methyl ethyl ketone (2-butanone)	ug/l	4000 HRL94	< 20	< 20	< 10 ^	< 10 ^	< 10.0 U
Methyl isobutyl ketone (MIBK)	ug/l	300 HRL94	< 3.0	< 3.0	< 5.0	< 5.0	< 5.00 U
Methyl tertiary butyl ether (MTBE)	ug/l	60 RAA13 (1)	< 3.0	< 3.0	< 1.0	< 1.0 ^	< 1.00 U
Methylene chloride	ug/l	5 HRLMCL	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Naphthalene	ug/l	70 HRL13	< 3.0	< 3.0	< 1.0	< 1.0	< 1.00 U C3 J3
Propylbenzene	ug/l		< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Styrene	ug/l		< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Tetrachloroethylene	ug/l	4 HRL23 (1)	< 1.0 *	< 1.0	< 1.0	< 1.0	< 1.00 U
Tetrahydrofuran	ug/l	600 HRL18	< 5.0	< 5.0	< 5.0	< 5.0	< 5.00 U
Toluene	ug/l	70 HRL23	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Trichloroethylene (TCE)	ug/l	0.4 HRL15 (1)	< 1.0	< 1.0	< 1.0	< 0.10	< 0.100 U J4
Trichlorofluoromethane (Freon-11)	ug/l	2000 HRL93	< 1.0	< 1.0 ^	< 1.0 ^	< 1.0	< 1.00 U
Trichlorotrifluoroethane (Freon 113)	ug/l	200000 HRL93	< 2.0	< 2.0	< 1.0	< 1.0	< 1.00 U
Vinyl chloride	ug/l	0.2 HRL18 (1)	< 1.0	< 1.0	< 0.10	< 0.050	< 0.0500 U
Xylene, total	ug/l	300 XYL HRL23 (1)	< 2.0	< 2.0	< 2.0	< 2.0	< 2.00 U
General Parameters							

Table A2
Residential Water Supply Well Data (2011-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Unique Well ID# (or MPCA ID)			11661 225th Ave 10/15/2013 ZW00217	11661 225th Ave 10/21/2014 ZW00217	11661 225th Ave 10/23/2015 ZW00217	11661 225th Ave 10/16/2018 ZW00217	11661 225th Ave 10/19/2021 ZW00217
Parameter	Units	MDH Human Health- Based Water Guidance Table					
Effective Date		11/13/2023					
Exceedance Key		No Exceed					
Alkalinity, total, as CaCO3	mg/l		185	207	176	173	185
Chemical Oxygen Demand	mg/l		< 5.0	< 5.0	< 10.0 F1	< 10.0	< 11.7 U
Chloride	mg/l		< 1	< 1	0.748	1.19	1.03
Dissolved oxygen, field	mg/l		--	--	--	0.6	0.6
Nitrogen, ammonia, as N	mg/l		0.17	0.27	0.19	0.21	0.241
Nitrogen, nitrate + nitrite, as N	mg/l		< 0.050	< 0.050	< 0.050	< 0.050	< 0.100 U
pH, field	pH units		8.00	7.94	8.40	7.98	8.09
Redox (oxidation potential), field	mV		--	--	--	-73	-195
Solids, total dissolved	mg/l		179	173	170	177	303
Solids, total suspended	mg/l		< 4.0	< 4.0	< 4.0	< 4.0	< 4.00 U
Specific conductance @ 25 °C, field	umhos/cm		340	325	316	333	348
Sulfate, as SO4	mg/l		--	--	--	--	5.84
Temperature, field	deg C		9.6	10.5	9.4	9.7	10.3
Turbidity, field	NTU		--	--	--	0.8	1.1
Total Metals							
Calcium	mg/l		--	--	39.0	40.6	41.6
Lead	ug/l		--	--	--	--	--
Magnesium	mg/l		--	--	15.1	15.3	16.3
Manganese	ug/l	100 HRL23	--	--	--	--	--
Potassium	mg/l		--	--	1.5	1.5	2.17
Sodium	mg/l		--	--	8.3	8.2	8.67

Data Footnotes and Qualifiers

Barr Standard Footnotes and Qualifiers

--	Not analyzed/Not available.
*	Estimated value, QA/QC criteria not met.
U	The analyte was analyzed for, but was not detected.

Laboratory Qualifiers

*	LCS or LCSD is outside acceptance limits.
^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA, DLCK or MRL standard: Instrument related QC is outside acceptance limits.
4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.
B	Compound was found in the blank and sample.
F1	MS and/or MSD Recovery is outside acceptance limits.
C3	The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.
C4	The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Data is likely to show a low bias concerning the result.
C5	The reported concentration is an estimate. The continuing calibration standard associated with this data responded high. Data is likely to show a high bias concerning the result.
J3	The associated batch QC was outside the established quality control range for precision.
J4	The associated batch QC was outside the established quality control range for accuracy.
O1	The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.
Q	Sample was prepared and/or analyzed past holding time as defined in the method. Concentrations should be considered minimum values.
V	The sample concentration is too high to evaluate accurate spike recoveries.

MDH Human Health-Based Water Guidance Table

(1)	Value is representative of the lowest exposure duration published in the Minnesota Department of Health Human Health Advisory Table.
DCP	Value shown is 1,3-dichloropropene in the MDH criterion, however, the laboratory reports cis and trans isomers individually.
HBV20	Health Based Value 2020.
HBV22	Health Based Value 2022.
HRL09	Health Risk Limit 2009
HRL13	Health Risk Limit 2013.
HRL15	Health Risk Limit 2015
HRL18	Health Risk Limit 2018.
HRL23	Health Risk Limit 2023.
HRL93	Health Risk Limit 1993.
HRL94	Health Risk Limit 1994.
HRLMCL	Health Risk Limit; Maximum Contaminant Level.
ND	Not derived due to insufficient information.
RAA13	Risk Assessment Advice 2013
RAA16	Risk Assessment Advice 2016
RAA17	Risk Assessment Advice 2017.
XYL	Value shown is for the sum of the mixed o,m and p Xylene isomers.

Appendix B

Residential Replacement Well Information

Technical Memorandum

To: File
From: Jim Eidem P.G. and Kevin McGilp
Subject: 2021 – 2022 Residential Well Replacements
Date: March 1, 2024
Project: Elk River Landfill, Groundwater Corrective Action Work Plan Implementation

This technical memorandum describes the residential water supply well replacements completed as part of the Elk River Landfill (ERL) Groundwater Corrective Action Work Plan (Work Plan; Barr, 2021) implementation. The work included replacing six residential wells located southwest of the ERL (Figure 1) with deeper wells (completed in confined bedrock or confined sand at the base of a bedrock valley) to increase the protectiveness of the groundwater corrective action activities¹. The Work Plan was reviewed and approved by the Minnesota Pollution Control Agency (MPCA) and the well replacement work was conducted by a well contractor licensed by the State of Minnesota.

1 Well Installation

Following MPCA approval of the Work Plan, ERL representatives met with the well owners to discuss rationale for replacement, property access agreements, and general scope and timing for completing the well replacement work. Upon owner agreement for well replacement and after the property access agreements were in place, representatives of ERL, Barr Engineering Co. (Barr), and Able Well, Inc. (Able), a Minnesota licensed water supply well contractor, coordinated site visits to identify and stake locations for replacement well installations for owner approval.

Prior to the start of well installation, Able coordinated public utilities clearance and spoke with the owners regarding any private underground utility lines that they were aware of. The final locations of the replacement wells were determined by drill rig access, setback distances meeting Minnesota Department of Health (MDH) requirements from existing utilities, and owner approval. The residential well replacements were completed by Able using mud rotary drilling techniques between June, 2022 and January, 2023. The wells were constructed in conformance with Minnesota Rules Chapter 4725 (Well Code) and were constructed with either a cased/open hole configuration or a cased/screened configuration depending on if bedrock was encountered and/or the competency of the bedrock to maintain an open borehole. Each replacement well was fully cased and grouted through the lower outwash and unconsolidated geologic material into the bedrock (Eau Claire Formation or Mount Simon Sandstone) or to the depth of the screened interval, as applicable. Well construction documentation is

¹ Four wells were replaced per the Work Plan. The two southernmost wells, 22272 Quinn St and 22130 Quinn St, were replaced voluntarily by the ERL.

included in Attachment A and summarized in Table 1. The well construction logs were used to update geologic cross sections for ERL and are shown on Figure 2 and Figure 3.

Upon completion of well construction, the wells were developed by over pumping by air lifting. Well development continued until the wells produced clear water generally free of sediments.

2 Replacement Well Sampling and Analysis

Groundwater quality samples were collected at the end of the well development process prior to connection to the residence. Samples for volatile organic compound (VOC) analysis were collected by Barr and submitted to the laboratory for analysis per the Work Plan. No VOCs were detected in the samples collected from the six replacement wells (Attachment B).

Groundwater samples from newly constructed water supply wells (as required by the Well Code) for analysis of bacteriological (coliform bacteria), nitrate-nitrogen, and arsenic were collected and submitted to the laboratory by Able. No coliform bacteria were detected in samples from any of the new wells. Nitrate-nitrogen and arsenic results for samples from the new wells were either not detected or were below the Environmental Protection Agency (EPA) maximum contaminant levels (MCLs).

3 New Well Service Connection

The replacement water supply wells were connected to each residence by Able. New submersible pumps sized for the depth of the well and water use based on communications with the owner were installed with new drop pipe and pump electrical cables.

The connection of the replacement water supply wells to the residences consisted of trenching between the new well and the old well and splicing the new water supply line into the existing water supply line into the residence at the old well. Where splicing at the old well was not feasible, such as at 12183 223rd St. NW., the new supply line was spliced into the old supply line where it entered the residence.

Water treatment systems are present at each residence. For several of the new well installations, ERL coordinated with a water treatment vendor (Aquarius Home Services), for the installation of water treatment systems (or inspection/upgrade of existing systems). The new water treatment systems were designed, installed, and adjusted for the water hardness content by the water treatment vendor.

Based on recommendations in the MDH owner's guide to wells information brochure (MDH, 2023), samples were collected from the kitchen faucet for analysis of lead and manganese in the Fall of 2023 except for the well installed at 22130 Quinn St. NW., which had not yet been connected to the residence. The results of the lead and manganese analysis were reported as not detected or below the applicable MCLs.

4 Old Well Sealing Activities

Decommissioning of the former water supply wells (except 22130 Quinn St. NW.) was completed by Able after the replacement wells had been placed into service. In addition, an unused well located on the 12163

223rd St. NW. parcel was also decommissioned. Decommissioning of the old wells was completed in conformance with the Well Code and generally included removal of the existing submersible pump and drop pipe and permanently sealing the well by pressure grouting through a tremie pipe from the bottom of the well up to within a few feet of the ground surface. The wells were then cut off below the ground surface. Well sealing documentation is included in Attachment C.

5 References

Barr Engineering Co. (Barr), 2021. Groundwater Corrective Action Work Plan, Elk River Landfill (SW 74), Elk River, Minnesota, prepared for Elk River Landfill, Inc., March, 2021.

Minnesota Department of Health (MDH), 2023. Owners Guide to Wells, information brochure,
<https://www.health.state.mn.us/wellguide>

Attachments

- Table 1 – Well Construction Detail Summary
- Figure 1 – Residential Well Replacement Locations
- Figure 2 – Geologic Cross Section R'-R''
- Figure 3 – Geologic Cross Section – T'-T''
- Attachment A - Well Construction Records
- Attachment B - Laboratory Reports
- Attachment C - Well Sealing Records

Attachments

Table 1
Well Construction Detail Summary
Elk River Landfill
Elk River, Minnesota

Address	Replacement Well				Initial Organics Sample Results	Notes
	Unique ID No.	Date Installed	Casing Depth (feet bgs)	Total Depth (feet bgs)		
12163 223 rd Ave.	876409	6/16/2022	233	299	ND	Proposed in Corrective Action Work Plan (Barr, 2021)
12269 223 rd Ave.	876410	9/22/2022	255	299	ND	
12265 223 rd Ave.	876411	9/26/2022	290	296	ND	
12183 223 rd Ave.	876412	9/29/2022	254	310	ND	
22272 Quinn St.	876413	12/10/2022	333	379	ND	Voluntarily installed by ERL
22130 Quinn St.	876414	12/14/2022	293	319	ND	

Notes:

bgs - below ground surface

ND - no organics detected

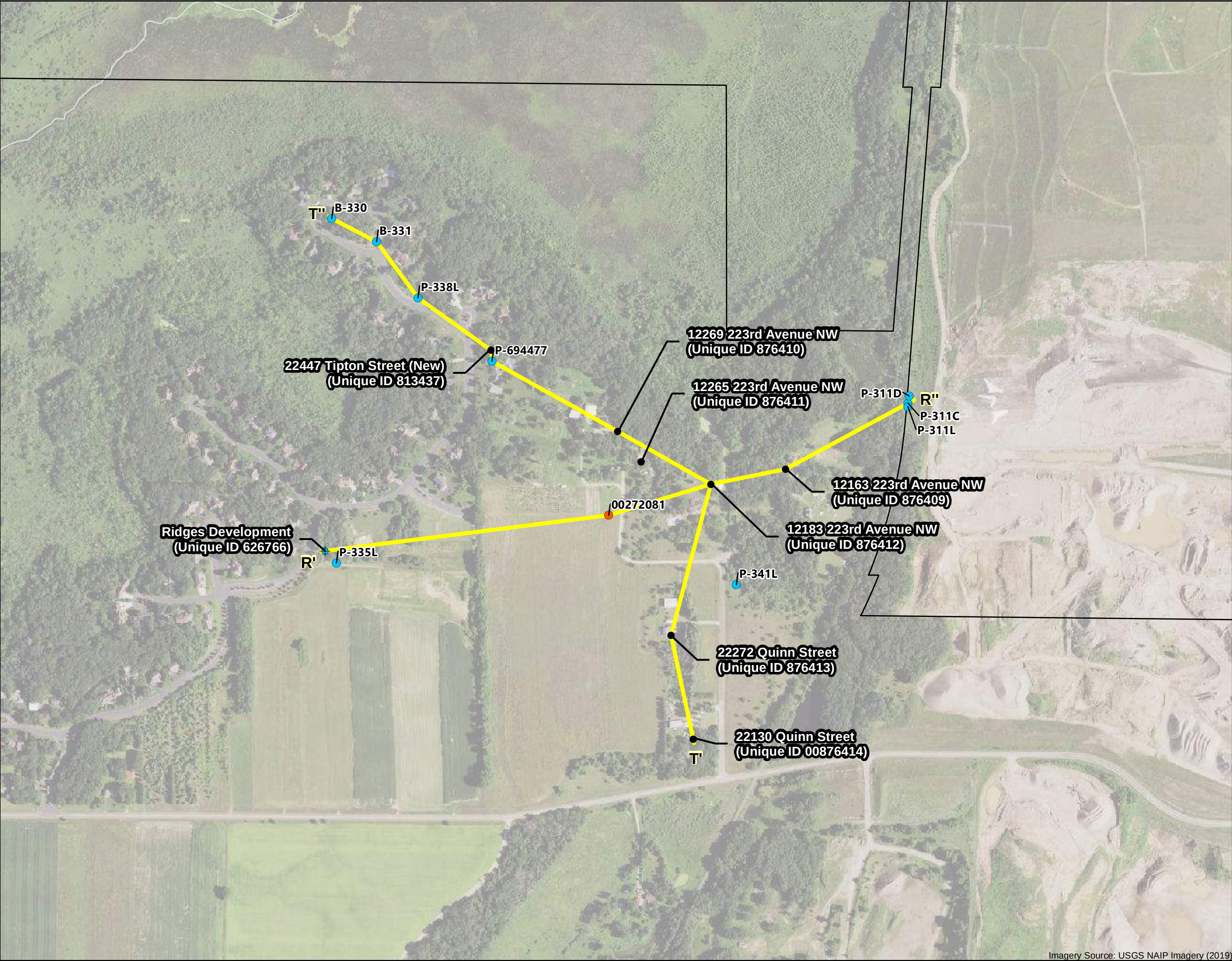
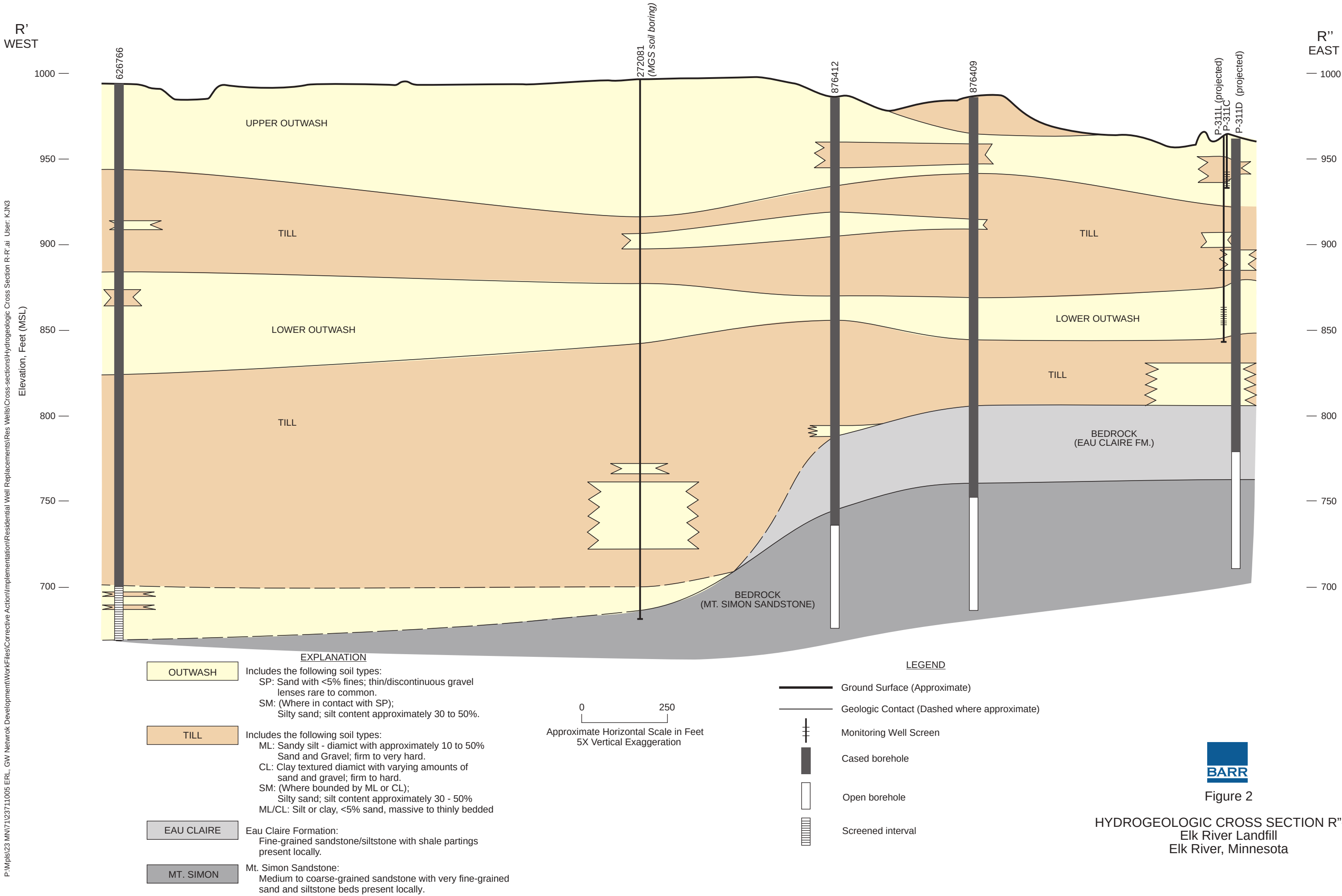
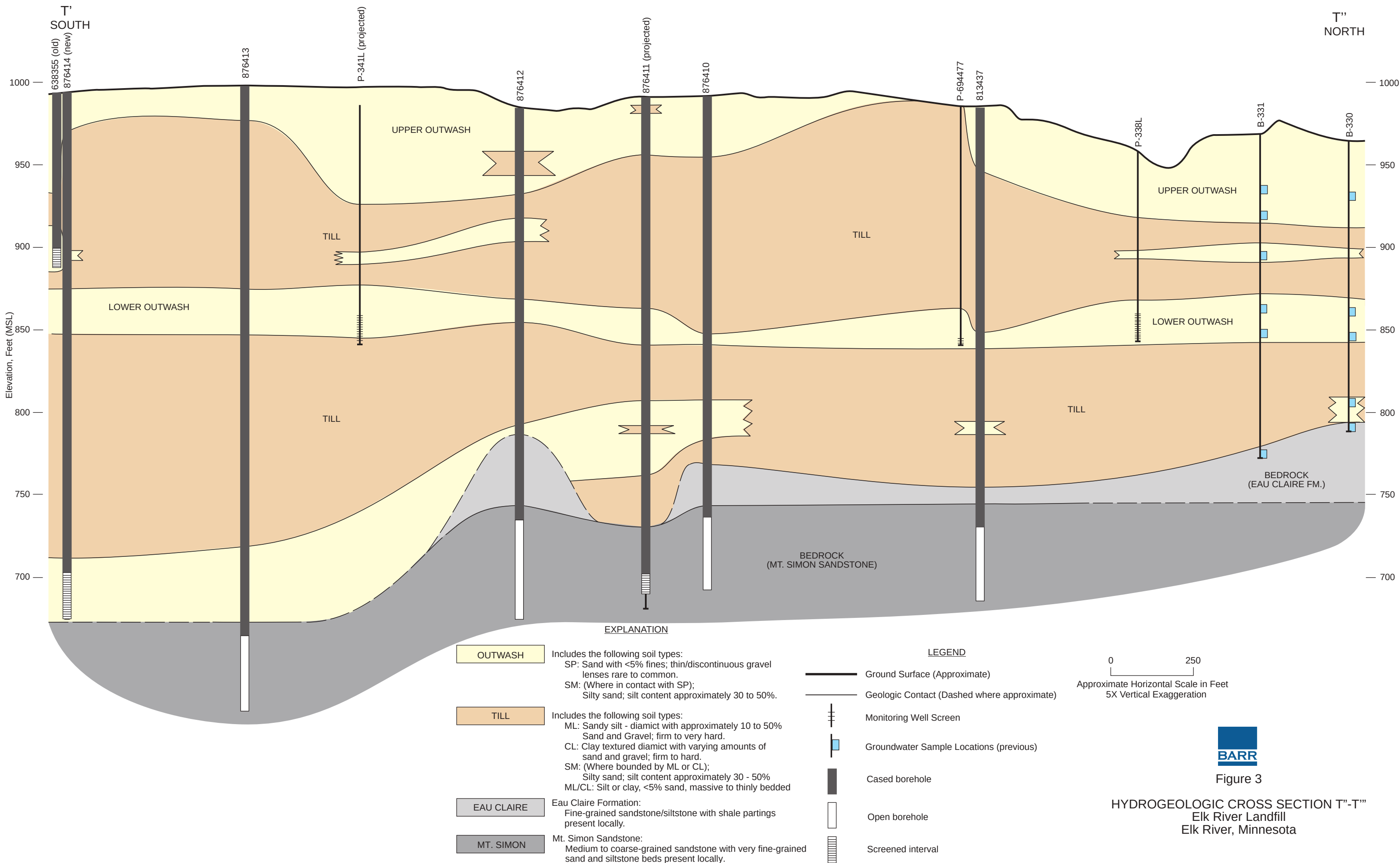


Figure 1
HYDROGEOLOGIC CROSS
SECTION LOCATIONS
Elk River Landfill
Elk River, Minnesota



P:\Mpls\23 MN\1\123711005 ERL, GW Network Development\WorkFiles\Corrective Action\Implementation\Residential Well Replacements\Res Wells\Cross-sections\Hydrogeologic Cross Section R-R'.ai User: KJN3





WELL OR BORING LOCATION

County Name

Sherburne

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING CONSTRUCTION RECORD

Minnesota Statutes, chapter 1031

MINNESOTA UNIQUE WELL
AND BORING NO.

876412

Township Name
Elk RiverTownship No.
33Range No.
26Section No.
4Fraction (sm. → lg.)
SE NW SEWELL/BORING DEPTH (completed)
310

DATE WORK COMPLETED

12-5-22

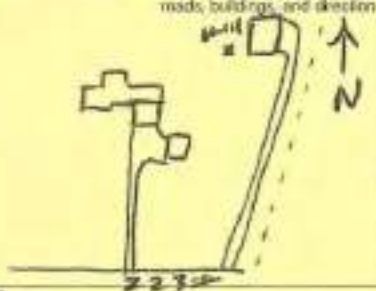
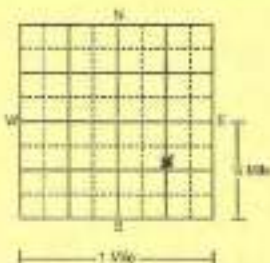
GPS LOCATION — decimal degrees (to four decimal places).

Latitude _____ Longitude _____

House Number, Street Name, City, and ZIP Code of Well Location

12183 223rd Ave. NW, Elk River 55330

Show exact location of well/boring in section grid with "X."

Sketch map of well/boring location.
Showing property lines,
roads, buildings, and direction

PROPERTY OWNER'S NAME/COMPANY NAME

Curt Collow

Property owner's mailing address if different than well location address indicated above.

WELL OWNER'S NAME/COMPANY NAME

Well/boring owner's mailing address if different than property owner's address indicated above.

DRILLING METHOD

☐ Cable Tool
☐ Auger
☒ Rotary
☐ Other

DRILLING FLUID

Super Gel

WELL HYDROFRACTURED? ☐ Yes ☒ No

From _____ ft. To _____ ft.

USE

☒ Domestic
☐ Noncommunity PWS
☐ Community PWS
☐ Elevator
☐ Monitoring
☐ Irrigation
☐ Dowelcoring
☐ Heating/Cooling
☐ Industry/Commercial
☐ Remedial

CASING MATERIAL

☒ Steel
☐ Plastic
☐ Drive Shoe? ☒ Yes ☐ No
☒ Threaded ☐ Welded

HOLE DIAM.

CASING

Diameter Weight Specifications

4 in. To 254 ft. 11 lbs./ft. ASTM-A93 8 in. To 254 ft.

in. To _____ ft. _____ lbs./ft. _____

in. To _____ ft. _____ lbs./ft. _____

SCREEN

Make _____

Type _____

Slot/Gauge _____

Set between _____ ft. and _____ ft. FITTINGS

OPEN HOLE

From 254 ft. To 310 ft.

STATIC WATER LEVEL

45 ft. ☒ Below ☐ Above land surfaceDate measured 9-30-22 Dry hole ☐ Yes ☒ No

PUMPING LEVEL (below land surface)

ft. after 4 hrs. pumping 75 g.p.m.

WELLHEAD COMPLETION

☒ Wellhead manufacturer Aqua Seal Model 74-1
☐ Casing protection
☐ At-grade ☐ Well House ☐ Hand Pump

GROUT INFORMATION (specify bentonite, cement-sand, neat-cement, concrete, cuttings, or other)

Material Neat Cement 0 to 254 ft. 50 ☐ Yes ☒ No

Material _____ From _____ To _____ ft. _____ ☐ Yes ☐ No

Material _____ From _____ To _____ ft. _____ ☐ Yes ☐ No

Driven casing seal From _____ To _____ ft. _____ ☐ Yes ☐ No

NEAREST KNOWN SOURCE OF CONTAMINATION

Well is 80 feet E direction from Drained field

Will dislodge upon completion? ☐ Yes ☐ No

PUMP

☐ Not installed Date installed 12-5-22

Manufacturer's name Goulds

Model Number 18LS10 HP 1 Vols 230

Length of drop pipe 100 ft. Capacity 18 g.p.m.

Type: ☒ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet

ABANDONED WELLS

Does property have any, but in use and not sealed wells? ☐ Yes ☒ No

VARIANCE

Was a variance granted from the MDH for this well? ☐ Yes ☒ No

WELL CONTRACTOR CERTIFICATION

This well was drilled under my supervision and in accordance with Minnesota Rules, chapter 4725. The information contained in this report is true to the best of my knowledge.

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Sand	Brown	Soft	0	5
Sand + Gravel	Brown	Soft	5	26
Sandy Clay + Gravel	Tan	Med	26	41
Sand + Gravel	Tan	Soft	41	52
Clay	Gray	Med	52	67
Sand	Tan	Soft	67	72
Clay	Gray	Med	72	74
Sand	Tan	Soft	74	81
Clay w/ gravel	Brown	Med	81	116
Sand + Gravel	Brown	Soft	116	130
Clay w/ gravel	Orange/Brown	Med	130	161
Clay w/ gravel	Gray	Med	161	192
Sand	Brown	Soft	192	198
Shale + Sandstone	Green/Tan	M-H	198	241
Sandstone	White/Yellow	M-M	241	310

Use a second sheet, if needed.

REMARKS, ELEVATION, SOURCE OF DATA, etc.

Able Well, Inc.

1377

Licensee Business Name

Lic. or Reg. No.

Certified Representative Signature

Certified Rep. No.

Date

Scott Thompson

Name of Driller

IMPORTANT-FILE WITH PROPERTY
PAPERS-WELL OWNER COPY

876412

WELL OR BORING LOCATION

County Name SherburneMINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING CONSTRUCTION RECORD
Minnesota Statutes, Chapter 102CMINNESOTA UNIQUE WELL
AND BORING NO.

876411

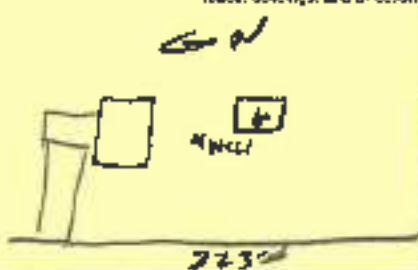
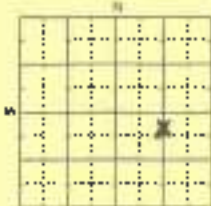
Township Name Elk River Township No. 33 Range No. 26 Section No. 4 Fractional Section NE NW SEWELL BORING DEPTH (feet) 300DATE WORK COMPLETED 10-21-22GPS LOCATION (decimal degrees to four decimal places)
Latitude _____ Longitude _____

House Number, Street Name, City and ZIP Code of Well Location

12265 223rd Ave NW, Elk River 55330

Show exact location of well/boring on a sketch grid with "X".

Sketch map of well/boring location showing property lines, roads, buildings, and direction



PROPERTY OWNER'S NAME/COMPANY NAME

Jean Klatke
Property Owner's mailing address if different than property address indicated above

WELL OWNER'S NAME/COMPANY NAME

Well/boring owner's mailing address if different than property owner's address indicated above

DRILLING METHOD

☐ Cable Tool
☐ Auger
☐ Other

☐ Driven
☒ Rotary

☐ Dual Rotary
☐ Percussion

DRILLING FLUID

Super GelWELL HYDROFRACTURED? Yes Yes

USE

☐ Domestic
☐ Nonpotable PWS
☐ Commercial PWS
☐ Irrigation
☐ Fluvial

☐ Working
☐ Injection
☐ Drilling
☐ Fluvial

☐ Mining/Quarrying
☐ Industrial/Commercial
☐ Refractory

CASING MATERIAL

☐ Steel
☐ Plastic

☐ Drive Sheet
☐ Threaded
☐ Welded

WELL LID

CASING

Casing

Casing

Casing

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NEAREST KNOWN SOURCE OF CONTAMINATION

Well is 55 feet W direction from Sanctuary typeWell disinfected upon completion? ☒ Yes ☐ No

PUMP

Not installed Date installed 10-21-22Manufacturer's name GouldsModel Number 101507 HP 3/4 Volts 230Length of drop pipe 80 ft Capacity 10 gpmType ☒ Submersible ☐ S Turbine ☐ Percussive ☐ Jet

ABANDONED WELLS

Does property have any not in use and not sealed wells? ☐ Yes ☒ No

VARIANCE

Has a var been granted from the MDA for this well? ☐ Yes ☒ No

WELL CONSTRUCTION OF HOLE LOCATION

This well was drilled under my supervision and in accordance with Minnesota Rules, chapter 4725.

The information contained in this report is true to the best of my knowledge.

GEOLOGICAL MATERIALS	COLOR	HARDNESS (X MATERIAL)	FROM	TO
Sand + Gravel	Brown	Soft	0	5
Clay w/ gravel	Brown	Soft	5	10
Sand + Gravel	Brown	Soft	10	35
Clay	Tan	Med	35	61
Sand	Tan	Soft	61	63
Clay	Gray	Med	63	69
Gravel	Tan	Soft	69	72
Clay	Gray	Med	72	79
Gravel	White	Soft	79	81
Clay w/ gravel	Brown	Med	81	95
Sandy clay	Brown	Soft	95	111
Clay w/ gravel	Brown	Med	111	129
Sand	Tan	Soft	129	150
Clay w/ gravel	Brown	Med	150	189
Sand	White	Soft	189	199
Clay	Gray	Med	199	204
Sand	Mixed	Soft	204	229
Sandy clay	Brown	Med	229	260
Sand/rock	White	Med	260	310

REMARKS: ELEVATION SOURCE OF DATA, etc.

IMPORTANT: FILE WITH PROPERTY
PAPERS: WELL OWNER COPY

876411

Able Well, Inc.

Licensee Business Name

1377

Lic. or Reg. No.

Scott Thompson

Signature

972

Lic. or Reg. No.

10-21-22

Date

Name of Owner

WELL OR BORING LOCATION
County Name Stearns

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING CONSTRUCTION RECORD
Minnesota Statutes, Chapter 103A

ANNEXED TO MINN. WELLS
AND BORING ACT

876410

Township Name Elk River Township No. 33 Range No. 26 Section No. 4 Fractional Part NW 1/4

WELL/BORING DEPTH (complete)
299

DATE WORK COMPLETED

10-21-22

GPS LOCATION — decimal degrees (to four decimal places)
Latitude _____ Longitude _____

Project Number, Street Name, City, and ZIP Code of Well Location

1269 223rd Ave NW, Elk River, 55330

Show exact location of well/boring on section grid with "X"

Show map of well/boring location
Showing property lines,
roads, buildings, and direction



new well
old well

PROPERTY OWNER'S NAME (COMPANY NAME)

Doug Hipsley

Property Owner's mailing address (if different from well location address) (include zip code)

WELL OWNER'S NAME (COMPANY NAME)

Well/boring owner's mailing address (if different from property owner's address) (include zip code)

DRILLING METHOD

☐ Cable Tool
☐ Auger
☐ Core

☐ Driven
☒ Rotary

☐ Dual Rotary
☐ Percussion

DRILLING FLUID

Super Gel

WATER HYDRATED HEMIHYDRATE ☐ Yes ☒ No

USE

☐ Domestic
☐ Municipal/Utility PWS
☐ Commercial PWS
☐ Industrial

☐ Mining
☐ Irrigation
☐ Dewatering

☐ Heating/Cooling
☐ Industrial/Commercial
☐ Domestic

CASING MATERIAL

☒ Steel
☐ Plastic

Drill Stem? ☒ Yes ☐ No
Hydratation ☐ Yes ☒ No

INCHES DOWN

8 in. to 255

4 in. to 299

CASING

4

in. to 255

11

in. to 255

ASTM-A53

8 in. to 255

SCREEN

None

OPEN HOLE

255 in. to 299 in.

Static Water Level

52

ft. below ground surface

DATE MEASURED

9-21-22

Dry hole ☐ Yes ☒ No

PLUMBING LEVEL (below land surface)

3

ft. plumb

60

WELHEAD CONSTRUCTION

☒ Class A concrete construction

Aggr Seal

Under 7425-1

Casing protector

☐ Air-grade ☐ Well Head ☐ Hard Plug

GROUT INFORMATION (specify Bentonite, cement-sand, neat cement, concrete, etc. (type or other))

Material Neat Cement

0 to 255

48

Yds

Material Neat Cement

0 to 255

48

Yds

Material Neat Cement

0 to 255

48

Yds

Material Neat Cement

0 to 255

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Yds

Material Neat Cement

0 to 255

48

Yds

Use a second paper, if needed

REMARKS, ELEVATION, SOURCE OF DATA, etc.

IMPORTANT: FILE WITH PROPERTY

PATENT: WELL OWNER COPY

876410

Abt. Well, Inc.

1377

Licensee Business Name

Let. or Reg. No.

Scott Thompson

972

10-25-22

Certified Representative Signature

Certified Reg. No.

Date

Scott Thompson

Name of Title

HE 0125-15 (Rev. 8/17)

WELL OR BORING LOCATION

County Name

Sherburne

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING CONSTRUCTION RECORD
Minnesota Statutes, chapter 103BMINNESOTA UNIQUE WELL
AND BORING NO.

876414

Township Name
Eik RiverTownship No.
33Range No.
26Section No.
4Fraction (in. → 16 ft.)
SE SW SE

WELL/BORING DEPTH (completed)

319

DATE WORK COMPLETED

12-14-22

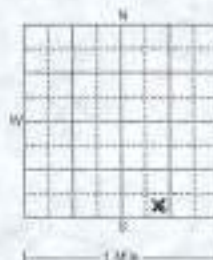
GPS LOCATION — decimal degrees (to four decimal places).

Latitude _____ Longitude _____

House Number, Street Name, City, and ZIP Code of Well Location

22130 Quian St. NW, Eik River 55330

Show exact location of well/boring in section grid with "X".

Sketch map of well/boring location
Showing property lines,
roads, buildings, and direction.

PROPERTY OWNER'S NAME/COMPANY NAME

R. Mattson

Property owner's mailing address if different than well location address indicated above.

DRILLING METHOD

☐ Cable Tool
☐ Auger
☒ Other

☐ Driven
☒ Rotary

☐ Dual Rotary
☐ Rotasonic

DRILLING FLUID

Super Gel

WELL HYDROFRACTURED? ☐ Yes ☒ No

From _____ ft. To _____ ft.

USE

☒ Domestic
☐ Noncommunity PWS
☐ Community PWS
☐ Elevator

☐ Monitoring
☐ Irrigation
☐ Dewatering

☐ Heating/Cooling
☐ Industry/Commercial
☐ Remedial

CASING MATERIAL

☒ Steel
☐ Plastic
Drive Shoe? ☒ Yes ☐ No
☒ Threaded ☐ Welded

HOLE DIA.

CASING Diameter

4

Weight

Specifications

In. To 293

ft. 11

ft./ft.

ASTM-A53

8 In. To 293

In. To

ft.

ft./ft.

In. To

In. To

ft.

ft./ft.

In. To

SCREEN

yes

Make

Johnson

Type

SS

Slot/Gauge

12 slot

Set between

293

ft. and

319

ft.

Fittings

Kparker + leader

ft.

STATIC WATER LEVEL

45

ft. ☒ Below ☐ Above land surface

Date measured

12-14-22

Dry hole ☐ Yes ☒ No

PUMPING LEVEL (below land surface)

ft. after

2

hrs. pumping

40

g.p.m.

WELLHEAD COMPLETION

☒ Pile/casing manufacturer

Agnes Seal

Model

T4-1

☐ Casing protection

☒ 12 in. above grade

☐ At-grade ☐ Well House ☐ Hand Pump

DROUT INFORMATION (specify bentonite, cement-sand, sand-cement, concrete, cuttings, or other)

Material

Neat Cement

0

To 293

ft.

54

ft.

ft.

ft.

ft.

ft.

ft.

ft.

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ft.

NEAREST KNOWN SOURCE OF CONTAMINATION

Well is

95

feet

N

direction from

Septic

type

Well completed upon completion? ☒ Yes ☐ No

Tank

PUMP

☐ Not installed ☐ Date installed

Manufacturer's name

Goulds

Model Number

10C507

HP

3/4

Volts

230

Length of drop pipe

100

ft.

Capacity

12

g.p.m.

Type ☒ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet

ABANDONED WELLS

Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

VARIANCE

Was a variance granted from the MDH for this well? ☐ Yes ☒ No

TMA

WELL CONTRACTOR CERTIFICATION

This well was drilled under my supervision and in accordance with Minnesota Rules, chapter 4725. The information contained in this report is true to the best of my knowledge.

Able Well, Inc

1377

Licenser Business Name

Lic. or Reg. No.

Scott Thompson

972

12-15-22

Certified Representative Signature

Certified Rep. No.

Date

Name of Driller

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Sand - Some Gravel	Tan	Soft	0	24
Sandy Clay	Brown	Soft	24	57
Clay/Gravel	Brown	Med	57	65
Clay w/Gravel	Gray	Med	65	82
Clay w/Gravel	Brown	Med	82	96
Sand	Tan	Soft	96	102
Clay w/Gravel	Brown	Med	102	119
Sand	Tan	Soft	119	139
Boulder	Black/White	Hard	139	141
Sand	Tan	Soft	141	146
Clay	Gray	Med	146	214
Clay w/Gravel	Brown	Med	214	282
Sand	Gray	Soft	282	319

REMARKS, ELEVATION, SOURCE OF DATA, etc.

MINN. DEPT. OF HEALTH COPY

876414

WELL OR BORING LOCATION					MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING CONSTRUCTION RECORD Minnesota Statutes, chapter 103B		MINNESOTA UNIQUE WELL AND BORING NO. 876413																																																													
County Name <u>Sherburne</u>					Township Name <u>Elk River</u>		Township No. <u>33</u>																																																													
Range No. <u>26</u>					Section No. <u>4</u>		Fraction (nm. → to) <u>NE SW SE</u>																																																													
WELL/BORING DEPTH (completed) <u>379</u>					DATE WORK COMPLETED <u>12-10-22</u>																																																															
GPS LOCATION — decimal degrees (to four decimal places) Latitude _____ Longitude _____					DRILLING METHOD ☐ Cable Tool ☐ Driven ☐ Dual Rotary ☐ Auger ☒ Rotary ☐ Rotasonic ☐ Other _____																																																															
House Number, Street Name, City, and ZIP Code of Well Location <u>22272 Quinn St. NW, Elk River 55330</u>					DRILLING FLUID <u>Super bcl</u>																																																															
Show exact location of well/boring in section grid with "X".					WELL HYDROFRACTURED? ☐ Yes ☒ No From _____ ft. To _____ ft.																																																															
Sketch map of well/boring location, showing property lines, roads, buildings, and direction. 					USE ☒ Domestic ☐ Misting ☐ Heating/Cooling ☐ Noncommunity PWS ☐ Irrigation ☐ Industry/Commercial ☐ Community PWS ☐ Demolition ☐ Remedial ☐ Elevator ☐ _____																																																															
CASING MATERIAL ☒ Steel ☐ Plastic					Drive Shaft? ☒ Yes ☐ No ☒ Threaded ☐ Welded																																																															
CASING DIAMETER <u>4</u> in. To <u>333</u> ft.					WEIGHT <u>11</u> lbs./ft.																																																															
SPECIFICATIONS <u>ASTM-A53</u>					HOLE DIAM. <u>8</u> in. To <u>333</u> ft.																																																															
PROPERTY OWNER'S NAME/COMPANY NAME <u>Paul Hipps</u>					PROPERTY OWNER'S MAILING ADDRESS (if different than well location address indicated above)																																																															
SCREEN Make _____ Type _____ Slot/Gauge _____ Length _____ Set between _____ ft. and _____ ft.					OPEN HOLE From <u>333</u> ft. To <u>379</u> ft.																																																															
STATIC WATER LEVEL <u>50</u> ft. ☒ Below ☐ Above land surface					Date measured <u>12-10-22</u> Dry hole ☐ Yes ☒ No																																																															
WELL OWNER'S NAME/COMPANY NAME					PUMPING LEVEL (below land surface) ft. after <u>2</u> hrs. pumping <u>50</u> g.p.m.																																																															
WELLBORE OWNER'S MAILING ADDRESS (if different than property owner's address indicated above)					WELLHEAD COMPLETION ☒ Wellhead/adaptor manufacturer <u>Agnes Seal</u> Model <u>T4-1</u> ☐ Casing protector ☒ 2 in. above grade ☐ At-grade ☐ Well House ☐ Hand Pump																																																															
GROUT INFORMATION (specify bentonite, cement-sand, neat-cement, concrete, outcrops, or other) Material <u>Neat Cement</u> From <u>0</u> To <u>333</u> ft. ☐ Yes ☒ No Material _____ From _____ To _____ ft. ☐ Yes ☐ No Material _____ From _____ To _____ ft. ☐ Yes ☐ No Driven casing seal From _____ To _____ ft. ☐ Yes ☐ No					NEAREST KNOWN SOURCE OF CONTAMINATION Well is <u>75</u> feet <u>E</u> direction from <u>Drain field</u> type _____ Well disinfected upon completion? ☒ Yes ☐ No																																																															
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>GEOLOGICAL MATERIALS</th> <th>COLOR</th> <th>HARDNESS OF MATERIAL</th> <th>FROM</th> <th>TO</th> </tr> </thead> <tbody> <tr> <td>Sand</td> <td>Brown</td> <td>Soft</td> <td>0</td> <td>8</td> </tr> <tr> <td>Clay</td> <td>Brown</td> <td>Soft</td> <td>8</td> <td>11</td> </tr> <tr> <td>Sand</td> <td>Brown</td> <td>Soft</td> <td>11</td> <td>21</td> </tr> <tr> <td>Sandy Clay</td> <td>Brown</td> <td>Soft</td> <td>21</td> <td>50</td> </tr> <tr> <td>Clay w/gravel</td> <td>Gray</td> <td>med</td> <td>50</td> <td>99</td> </tr> <tr> <td>Clay w/gravel</td> <td>Brown</td> <td>med</td> <td>99</td> <td>123</td> </tr> <tr> <td>Sand + gravel</td> <td>Tan</td> <td>Soft</td> <td>123</td> <td>151</td> </tr> <tr> <td>Clay</td> <td>Gray</td> <td>med</td> <td>151</td> <td>224</td> </tr> <tr> <td>Clay w/gravel</td> <td>Brown</td> <td>med</td> <td>224</td> <td>279</td> </tr> <tr> <td>Sand + gravel</td> <td>Gray</td> <td>Soft</td> <td>279</td> <td>325</td> </tr> <tr> <td>Sand/rock</td> <td>Orange + pink</td> <td>Hard</td> <td>325</td> <td>379</td> </tr> </tbody> </table>					GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO	Sand	Brown	Soft	0	8	Clay	Brown	Soft	8	11	Sand	Brown	Soft	11	21	Sandy Clay	Brown	Soft	21	50	Clay w/gravel	Gray	med	50	99	Clay w/gravel	Brown	med	99	123	Sand + gravel	Tan	Soft	123	151	Clay	Gray	med	151	224	Clay w/gravel	Brown	med	224	279	Sand + gravel	Gray	Soft	279	325	Sand/rock	Orange + pink	Hard	325	379	PUMP ☐ Not installed Date installed <u>1-26-23</u> Manufacturer's name <u>Goulds</u> Model Number <u>18C310</u> HP <u>1</u> Volts <u>230</u> Length of drop pipe <u>100</u> ft. Capacity <u>18</u> g.p.m. Type ☒ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet			
GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO																																																																
Sand	Brown	Soft	0	8																																																																
Clay	Brown	Soft	8	11																																																																
Sand	Brown	Soft	11	21																																																																
Sandy Clay	Brown	Soft	21	50																																																																
Clay w/gravel	Gray	med	50	99																																																																
Clay w/gravel	Brown	med	99	123																																																																
Sand + gravel	Tan	Soft	123	151																																																																
Clay	Gray	med	151	224																																																																
Clay w/gravel	Brown	med	224	279																																																																
Sand + gravel	Gray	Soft	279	325																																																																
Sand/rock	Orange + pink	Hard	325	379																																																																
REMARKS, ELEVATION, SOURCE OF DATA, etc. <u>Clay w/gravel</u> <u>Brown</u> <u>med</u> <u>224</u> <u>279</u> <u>Sand + gravel</u> <u>Gray</u> <u>Soft</u> <u>279</u> <u>325</u> <u>Sand/rock</u> <u>Orange + pink</u> <u>Hard</u> <u>325</u> <u>379</u>					ABANDONED WELLS Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No VARIANCE Was a variance granted from the MDH for this well? ☐ Yes ☒ No																																																															
WELL CONTRACTOR CERTIFICATION This well was drilled under my supervision and in accordance with Minnesota Rules, chapter 4725. The information contained in this report is true to the best of my knowledge.					WELL CONTRACTOR <u>Able Well, Inc.</u> License Business Name <u>1377</u> Lic. or Reg. No. <u>Scott Thompson</u> Certified Representative Signature <u>972</u> <u>12-15-22</u> Date <u>Scott Thompson</u>																																																															
IMPORTANT: FILE WITH PROPERTY PAPERS—WELL OWNER COPY					876413																																																															



ANALYTICAL REPORT

June 24, 2022

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Elk River Landfill

Sample Delivery Group: L1506115
Samples Received: 06/17/2022
Project Number: 200
Description: Residential Well Replacement
Site: MN02
Report To: Andrea Nord
4300 MarketPoint Drive Suite 200
Minneapolis, MN 55435

Entire Report Reviewed By:

Stacy Kennedy
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.

Pace Analytical National

12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

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¹ Cp
² Tc
³ Ss
⁴ Cn
⁵ Sr
⁶ Qc
⁷ Gl
⁸ Al
⁹ Sc

SAMPLE SUMMARY

#876409 L1506115-01 GW

Collected by
KM

Collected date/time
06/16/22 12:00

Received date/time
06/17/22 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1883931	1	06/23/22 12:25	06/23/22 12:25	ADM	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1885068	1	06/24/22 12:51	06/24/22 12:51	JHH	Mt. Juliet, TN

TRIP BLANK L1506115-02 GW

Collected by
KM

Collected date/time
06/16/22 00:00

Received date/time
06/17/22 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1883931	1	06/23/22 12:06	06/23/22 12:06	ADM	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1885068	1	06/24/22 12:31	06/24/22 12:31	JHH	Mt. Juliet, TN

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

CASE NARRATIVE

Unless qualified or notated within the narrative below, all sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



Stacy Kennedy
Project Manager

Project Comments

The requested project specific reporting limits may be less than laboratory standard quantitation limits (PQL) but will be greater than or equal to the laboratory method detection limits (MDL). It is noted that results reported below lab standard quantitation limits (PQLs) may result in false positive/false negative values that may require additional laboratory quality assurance review, if requested. Routine laboratory procedures do not initiate a data review process for detections below the laboratory's PQL unless requested by the client.

Sample Delivery Group (SDG) Narrative

Analyzed from headspace vial.

Batch	Method	Lab Sample ID
WG1885068	8260D	L1506115-02

Volatile Organic Compounds (GC/MS) by Method 8260D

The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Data is likely to show a low bias concerning the result.

Batch	Lab Sample ID	Analytes
WG1883931	L1506115-01	1,2,3-Trichlorobenzene and 1,2,4-Trichlorobenzene

The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.

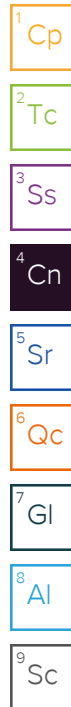
Batch	Lab Sample ID	Analytes
WG1883931	L1506115-01	1,3,5-Trimethylbenzene, 4-Chlorotoluene, Bromomethane, Naphthalene and n-Propylbenzene
WG1883931	L1506115-02	1,3,5-Trimethylbenzene, 4-Chlorotoluene, Bromomethane, Naphthalene and n-Propylbenzene

The reported concentration is an estimate. The continuing calibration standard associated with this data responded high. Data is likely to show a high bias concerning the result.

Batch	Lab Sample ID	Analytes
WG1883931	L1506115-01	Acetone

The associated batch QC was below the established quality control range for accuracy.

Batch	Lab Sample ID	Analytes
WG1883931	(LCS) R3807136-1, L1506115-01	1,2,3-Trichlorobenzene



#876409

SAMPLE RESULTS - 01

Collected date/time: 06/16/22 12:00

L1506115

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
1,1,1,2-Tetrachloroethane	ND		1.00	1	06/23/2022 12:25	WG1883931
1,1,1-Trichloroethane	ND		1.00	1	06/23/2022 12:25	WG1883931
1,1,2,2-Tetrachloroethane	ND		1.00	1	06/23/2022 12:25	WG1883931
1,1-Dichloroethane	ND		1.00	1	06/23/2022 12:25	WG1883931
1,1-Dichloroethene	ND		1.00	1	06/23/2022 12:25	WG1883931
1,1-Dichloropropene	ND		1.00	1	06/23/2022 12:25	WG1883931
1,2,3-Trichlorobenzene	ND	C4 J4	1.00	1	06/23/2022 12:25	WG1883931
1,2,3-Trichloropropane	ND		1.00	1	06/23/2022 12:25	WG1883931
1,2,4-Trichlorobenzene	ND	C4	1.00	1	06/23/2022 12:25	WG1883931
1,2,4-Trimethylbenzene	ND		1.00	1	06/23/2022 12:25	WG1883931
1,2-Dibromo-3-Chloropropane	ND		1.00	1	06/23/2022 12:25	WG1883931
1,2-Dibromoethane	ND		1.00	1	06/23/2022 12:25	WG1883931
1,2-Dichlorobenzene	ND		1.00	1	06/23/2022 12:25	WG1883931
1,2-Dichloroethane	ND		1.00	1	06/23/2022 12:25	WG1883931
1,2-Dichloropropane	ND		1.00	1	06/23/2022 12:25	WG1883931
1,3,5-Trimethylbenzene	ND	C3	1.00	1	06/23/2022 12:25	WG1883931
1,3-Dichlorobenzene	ND		1.00	1	06/23/2022 12:25	WG1883931
1,3-Dichloropropane	ND		1.00	1	06/23/2022 12:25	WG1883931
1,4-Dichlorobenzene	ND		1.00	1	06/23/2022 12:25	WG1883931
2,2-Dichloropropane	ND		1.00	1	06/23/2022 12:25	WG1883931
2-Butanone (MEK)	ND		10.0	1	06/23/2022 12:25	WG1883931
2-Chlorotoluene	ND		1.00	1	06/23/2022 12:25	WG1883931
4-Chlorotoluene	ND	C3	1.00	1	06/23/2022 12:25	WG1883931
4-Methyl-2-pentanone (MIBK)	ND		5.00	1	06/23/2022 12:25	WG1883931
Acetone	ND	C5	10.0	1	06/23/2022 12:25	WG1883931
Allyl chloride	ND		1.00	1	06/23/2022 12:25	WG1883931
Benzene	ND		1.00	1	06/23/2022 12:25	WG1883931
Bromobenzene	ND		1.00	1	06/23/2022 12:25	WG1883931
Bromochloromethane	ND		1.00	1	06/23/2022 12:25	WG1883931
Bromodichloromethane	ND		1.00	1	06/23/2022 12:25	WG1883931
Bromoform	ND		1.00	1	06/23/2022 12:25	WG1883931
Bromomethane	ND	C3	1.00	1	06/23/2022 12:25	WG1883931
Carbon tetrachloride	ND		1.00	1	06/23/2022 12:25	WG1883931
Chlorobenzene	ND		1.00	1	06/23/2022 12:25	WG1883931
Chlorodibromomethane	ND		1.00	1	06/23/2022 12:25	WG1883931
Chloroethane	ND		1.00	1	06/23/2022 12:25	WG1883931
Chloroform	ND		1.00	1	06/23/2022 12:25	WG1883931
Chloromethane	ND		1.00	1	06/23/2022 12:25	WG1883931
Dibromomethane	ND		1.00	1	06/23/2022 12:25	WG1883931
Dichlorodifluoromethane	ND		1.00	1	06/23/2022 12:25	WG1883931
Dichlorofluoromethane	ND		1.00	1	06/23/2022 12:25	WG1883931
Ethyl ether	ND		1.00	1	06/23/2022 12:25	WG1883931
Ethylbenzene	ND		1.00	1	06/23/2022 12:25	WG1883931
Hexachloro-1,3-butadiene	ND		1.00	1	06/23/2022 12:25	WG1883931
Isopropylbenzene	ND		1.00	1	06/23/2022 12:25	WG1883931
Methyl tert-butyl ether	ND		1.00	1	06/23/2022 12:25	WG1883931
Methylene Chloride	ND		1.00	1	06/23/2022 12:25	WG1883931
Naphthalene	ND	C3	1.00	1	06/23/2022 12:25	WG1883931
Styrene	ND		1.00	1	06/23/2022 12:25	WG1883931
Tetrachloroethene	ND		1.00	1	06/23/2022 12:25	WG1883931
Tetrahydrofuran	ND		5.00	1	06/23/2022 12:25	WG1883931
Toluene	ND		1.00	1	06/23/2022 12:25	WG1883931
Trichloroethene	ND		1.00	1	06/23/2022 12:25	WG1883931
Trichlorofluoromethane	ND		1.00	1	06/23/2022 12:25	WG1883931
Vinyl chloride	ND		1.00	1	06/24/2022 12:51	WG1885068
Xylenes, Total	ND		2.00	1	06/23/2022 12:25	WG1883931

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

ACCOUNT:

Elk River Landfill

PROJECT:

200

SDG:

L1506115

DATE/TIME:

06/24/22 16:09

PAGE:

5 of 16

#876409

SAMPLE RESULTS - 01

Collected date/time: 06/16/22 12:00

L1506115

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
cis-1,2-Dichloroethene	ND		1.00	1	06/23/2022 12:25	WG1883931
cis-1,3-Dichloropropene	ND		1.00	1	06/23/2022 12:25	WG1883931
n-Butylbenzene	ND		1.00	1	06/23/2022 12:25	WG1883931
n-Propylbenzene	ND	C3	1.00	1	06/23/2022 12:25	WG1883931
p-Isopropyltoluene	ND		1.00	1	06/23/2022 12:25	WG1883931
sec-Butylbenzene	ND		1.00	1	06/23/2022 12:25	WG1883931
tert-Butylbenzene	ND		1.00	1	06/23/2022 12:25	WG1883931
trans-1,2-Dichloroethene	ND		1.00	1	06/23/2022 12:25	WG1883931
trans-1,3-Dichloropropene	ND		1.00	1	06/23/2022 12:25	WG1883931
(S) 4-Bromofluorobenzene	96.3			67.0-138	06/23/2022 12:25	WG1883931
(S) 4-Bromofluorobenzene	88.3			67.0-138	06/24/2022 12:51	WG1885068
(S) Toluene-d8	94.6			75.0-131	06/23/2022 12:25	WG1883931
(S) Toluene-d8	111			75.0-131	06/24/2022 12:51	WG1885068
(S) 1,2-Dichloroethane-d4	113			70.0-130	06/23/2022 12:25	WG1883931
(S) 1,2-Dichloroethane-d4	94.3			70.0-130	06/24/2022 12:51	WG1885068

¹ Cp² Tc³ Ss⁴ Cn⁵ Sr⁶ Qc⁷ Gl⁸ Al⁹ Sc

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
1,1,1,2-Tetrachloroethane	ND		1.00	1	06/23/2022 12:06	WG1883931
1,1,1-Trichloroethane	ND		1.00	1	06/23/2022 12:06	WG1883931
1,1,2,2-Tetrachloroethane	ND		1.00	1	06/23/2022 12:06	WG1883931
1,1-Dichloroethane	ND		1.00	1	06/23/2022 12:06	WG1883931
1,1-Dichloroethene	ND		1.00	1	06/23/2022 12:06	WG1883931
1,1-Dichloropropene	ND		1.00	1	06/23/2022 12:06	WG1883931
1,2,3-Trichlorobenzene	ND		1.00	1	06/24/2022 12:31	WG1885068
1,2,3-Trichloropropane	ND		1.00	1	06/23/2022 12:06	WG1883931
1,2,4-Trichlorobenzene	ND		1.00	1	06/24/2022 12:31	WG1885068
1,2,4-Trimethylbenzene	ND		1.00	1	06/23/2022 12:06	WG1883931
1,2-Dibromo-3-Chloropropane	ND		1.00	1	06/23/2022 12:06	WG1883931
1,2-Dibromoethane	ND		1.00	1	06/23/2022 12:06	WG1883931
1,2-Dichlorobenzene	ND		1.00	1	06/23/2022 12:06	WG1883931
1,2-Dichloroethane	ND		1.00	1	06/23/2022 12:06	WG1883931
1,2-Dichloropropane	ND		1.00	1	06/23/2022 12:06	WG1883931
1,3,5-Trimethylbenzene	ND	C3	1.00	1	06/23/2022 12:06	WG1883931
1,3-Dichlorobenzene	ND		1.00	1	06/23/2022 12:06	WG1883931
1,3-Dichloropropane	ND		1.00	1	06/23/2022 12:06	WG1883931
1,4-Dichlorobenzene	ND		1.00	1	06/23/2022 12:06	WG1883931
2,2-Dichloropropane	ND		1.00	1	06/23/2022 12:06	WG1883931
2-Butanone (MEK)	ND		10.0	1	06/23/2022 12:06	WG1883931
2-Chlorotoluene	ND		1.00	1	06/23/2022 12:06	WG1883931
4-Chlorotoluene	ND	C3	1.00	1	06/23/2022 12:06	WG1883931
4-Methyl-2-pentanone (MIBK)	ND		5.00	1	06/23/2022 12:06	WG1883931
Acetone	ND		10.0	1	06/23/2022 12:06	WG1883931
Allyl chloride	ND		1.00	1	06/23/2022 12:06	WG1883931
Benzene	ND		1.00	1	06/23/2022 12:06	WG1883931
Bromobenzene	ND		1.00	1	06/23/2022 12:06	WG1883931
Bromochloromethane	ND		1.00	1	06/23/2022 12:06	WG1883931
Bromodichloromethane	ND		1.00	1	06/23/2022 12:06	WG1883931
Bromoform	ND		1.00	1	06/23/2022 12:06	WG1883931
Bromomethane	ND	C3	1.00	1	06/23/2022 12:06	WG1883931
Carbon tetrachloride	ND		1.00	1	06/23/2022 12:06	WG1883931
Chlorobenzene	ND		1.00	1	06/23/2022 12:06	WG1883931
Chlorodibromomethane	ND		1.00	1	06/23/2022 12:06	WG1883931
Chloroethane	ND		1.00	1	06/23/2022 12:06	WG1883931
Chloroform	ND		1.00	1	06/23/2022 12:06	WG1883931
Chloromethane	ND		1.00	1	06/23/2022 12:06	WG1883931
Dibromomethane	ND		1.00	1	06/23/2022 12:06	WG1883931
Dichlorodifluoromethane	ND		1.00	1	06/23/2022 12:06	WG1883931
Dichlorofluoromethane	ND		1.00	1	06/23/2022 12:06	WG1883931
Ethyl ether	ND		1.00	1	06/23/2022 12:06	WG1883931
Ethylbenzene	ND		1.00	1	06/23/2022 12:06	WG1883931
Hexachloro-1,3-butadiene	ND		1.00	1	06/23/2022 12:06	WG1883931
Isopropylbenzene	ND		1.00	1	06/23/2022 12:06	WG1883931
Methyl tert-butyl ether	ND		1.00	1	06/23/2022 12:06	WG1883931
Methylene Chloride	ND		1.00	1	06/23/2022 12:06	WG1883931
Naphthalene	ND	C3	1.00	1	06/23/2022 12:06	WG1883931
Styrene	ND		1.00	1	06/23/2022 12:06	WG1883931
Tetrachloroethene	ND		1.00	1	06/23/2022 12:06	WG1883931
Tetrahydrofuran	ND		5.00	1	06/23/2022 12:06	WG1883931
Toluene	ND		1.00	1	06/23/2022 12:06	WG1883931
Trichloroethene	ND		1.00	1	06/23/2022 12:06	WG1883931
Trichlorofluoromethane	ND		1.00	1	06/23/2022 12:06	WG1883931
Vinyl chloride	ND		1.00	1	06/24/2022 12:31	WG1885068
Xylenes, Total	ND		2.00	1	06/23/2022 12:06	WG1883931

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
cis-1,2-Dichloroethene	ND		1.00	1	06/23/2022 12:06	WG1883931
cis-1,3-Dichloropropene	ND		1.00	1	06/23/2022 12:06	WG1883931
n-Butylbenzene	ND		1.00	1	06/23/2022 12:06	WG1883931
n-Propylbenzene	ND	C3	1.00	1	06/23/2022 12:06	WG1883931
p-Isopropyltoluene	ND		1.00	1	06/23/2022 12:06	WG1883931
sec-Butylbenzene	ND		1.00	1	06/23/2022 12:06	WG1883931
tert-Butylbenzene	ND		1.00	1	06/23/2022 12:06	WG1883931
trans-1,2-Dichloroethene	ND		1.00	1	06/23/2022 12:06	WG1883931
trans-1,3-Dichloropropene	ND		1.00	1	06/23/2022 12:06	WG1883931
(S) 4-Bromofluorobenzene	96.1			67.0-138	06/23/2022 12:06	WG1883931
(S) 4-Bromofluorobenzene	88.8			67.0-138	06/24/2022 12:31	WG1885068
(S) Toluene-d8	97.0			75.0-131	06/23/2022 12:06	WG1883931
(S) Toluene-d8	108			75.0-131	06/24/2022 12:31	WG1885068
(S) 1,2-Dichloroethane-d4	111			70.0-130	06/23/2022 12:06	WG1883931
(S) 1,2-Dichloroethane-d4	94.4			70.0-130	06/24/2022 12:31	WG1885068

¹ Cp² Tc³ Ss⁴ Cn⁵ Sr⁶ Qc⁷ Gl⁸ Al⁹ Sc

Method Blank (MB)

(MB) R3807136-3 06/23/22 09:51

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
1,1,1,2-Tetrachloroethane	ND		0.0379	0.100
1,1,1-Trichloroethane	ND		0.0369	0.100
1,1,2,2-Tetrachloroethane	ND		0.0278	0.100
1,1-Dichloroethane	ND		0.0196	0.100
1,1-Dichloroethene	ND		0.0242	0.100
1,1-Dichloropropene	ND		0.0324	0.100
1,2,3-Trichlorobenzene	ND		0.293	0.500
1,2,3-Trichloropropane	ND		0.0648	0.500
1,2,4-Trichlorobenzene	ND		0.176	0.500
1,2,4-Trimethylbenzene	ND		0.0632	0.200
1,2-Dibromo-3-Chloropropane	ND		0.156	1.00
1,2-Dibromoethane	ND		0.0259	0.100
1,2-Dichlorobenzene	ND		0.0170	0.200
1,2-Dichloroethane	ND		0.0260	0.100
1,2-Dichloropropane	ND		0.0568	0.200
1,3,5-Trimethylbenzene	ND		0.0800	0.200
1,3-Dichlorobenzene	ND		0.0240	0.200
1,3-Dichloropropane	ND		0.0200	0.200
1,4-Dichlorobenzene	ND		0.0280	0.200
2,2-Dichloropropane	ND		0.0552	0.100
2-Butanone (MEK)	ND		2.54	4.00
2-Chlorotoluene	ND		0.0346	0.100
4-Chlorotoluene	ND		0.0180	0.200
4-Methyl-2-pentanone (MIBK)	ND		0.0912	1.00
Acetone	ND		1.46	2.00
Allyl Chloride	ND		0.160	1.00
Benzene	ND		0.0187	0.0400
Bromobenzene	ND		0.0360	0.500
Bromochloromethane	ND		0.0226	0.200
Bromodichloromethane	ND		0.0290	0.100
Bromoform	ND		0.0468	1.00
Bromomethane	ND		0.0788	0.500
Carbon tetrachloride	ND		0.0359	0.200
Chlorobenzene	ND		0.00840	0.100
Chlorodibromomethane	ND		0.0245	0.100
Chloroethane	ND		0.0680	0.200
Chloroform	ND		0.0412	0.100
Chloromethane	ND		0.174	0.500
Dibromomethane	ND		0.0300	0.200
Dichlorodifluoromethane	ND		0.0644	0.100

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Method Blank (MB)

(MB) R3807136-3 06/23/22 09:51

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Dichlorofluoromethane	ND		0.0490	0.100
Ethyl ether	ND		0.0356	0.100
Ethylbenzene	ND		0.0295	0.100
Hexachloro-1,3-butadiene	ND		0.0485	1.00
Isopropylbenzene	ND		0.0170	0.100
Methyl tert-butyl ether	ND		0.0140	0.0400
Methylene Chloride	ND		0.266	1.00
Naphthalene	ND		0.195	0.500
Styrene	ND		0.00916	0.500
Tetrachloroethene	ND		0.0358	0.100
Tetrahydrofuran	ND		0.141	0.500
Toluene	ND		0.0520	0.200
Trichloroethene	ND		0.0234	0.0400
Trichlorofluoromethane	ND		0.0331	0.100
Xylenes, Total	ND		0.0352	0.260
cis-1,2-Dichloroethene	ND		0.0294	0.100
cis-1,3-Dichloropropene	ND		0.0303	0.100
n-Butylbenzene	ND		0.210	0.500
n-Propylbenzene	ND		0.0380	0.200
p-Isopropyltoluene	ND		0.102	0.200
sec-Butylbenzene	ND		0.115	0.500
tert-Butylbenzene	ND		0.0780	0.200
trans-1,2-Dichloroethene	ND		0.0416	0.200
trans-1,3-Dichloropropene	ND		0.0456	0.200
(S) 4-Bromofluorobenzene	99.7			67.0-138
(S) Toluene-d8	96.9			75.0-131
(S) 1,2-Dichloroethane-d4	114			70.0-130

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3807136-1 06/23/22 08:33 • (LCSD) R3807136-2 06/23/22 08:52

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
1,1,1,2-Tetrachloroethane	5.00	4.79	4.96	95.8	99.2	74.0-129			3.49	20
1,1,1-Trichloroethane	5.00	5.07	5.48	101	110	69.0-126			7.77	20
1,1,2,2-Tetrachloroethane	5.00	4.81	4.92	96.2	98.4	68.0-128			2.26	20
1,1-Dichloroethane	5.00	5.28	5.61	106	112	70.0-127			6.06	20
1,1-Dichloroethene	5.00	5.07	5.23	101	105	65.0-131			3.11	20
1,1-Dichloropropene	5.00	5.11	5.34	102	107	73.0-125			4.40	20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3807136-1 06/23/22 08:33 • (LCSD) R3807136-2 06/23/22 08:52

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	<u>LCS Qualifier</u>	<u>LCSD Qualifier</u>	RPD %	RPD Limits %
1,2,3-Trichlorobenzene	5.00	2.85	3.25	57.0	65.0	59.0-139	J4		13.1	20
1,2,3-Trichloropropane	5.00	5.05	5.01	101	100	67.0-129			0.795	20
1,2,4-Trichlorobenzene	5.00	4.27	4.28	85.4	85.6	62.0-137			0.234	20
1,2,4-Trimethylbenzene	5.00	4.05	4.29	81.0	85.8	70.0-126			5.76	20
1,2-Dibromo-3-Chloropropane	5.00	4.90	4.87	98.0	97.4	59.0-130			0.614	20
1,2-Dibromoethane	5.00	4.77	4.84	95.4	96.8	74.0-128			1.46	20
1,2-Dichlorobenzene	5.00	4.51	4.72	90.2	94.4	76.0-124			4.55	20
1,2-Dichloroethane	5.00	5.36	5.46	107	109	65.0-131			1.85	20
1,2-Dichloropropane	5.00	5.48	5.47	110	109	74.0-125			0.183	20
1,3,5-Trimethylbenzene	5.00	3.95	4.23	79.0	84.6	73.0-127			6.85	20
1,3-Dichlorobenzene	5.00	4.40	4.42	88.0	88.4	76.0-125			0.454	20
1,3-Dichloropropane	5.00	4.82	4.69	96.4	93.8	80.0-125			2.73	20
1,4-Dichlorobenzene	5.00	4.48	4.64	89.6	92.8	77.0-121			3.51	20
2,2-Dichloropropane	5.00	5.41	5.68	108	114	59.0-135			4.87	20
2-Butanone (MEK)	25.0	32.5	36.1	130	144	30.0-160			10.5	24
2-Chlorotoluene	5.00	4.14	4.28	82.8	85.6	75.0-124			3.33	20
4-Chlorotoluene	5.00	3.96	4.19	79.2	83.8	75.0-124			5.64	20
4-Methyl-2-pentanone (MIBK)	25.0	27.2	27.9	109	112	56.0-143			2.54	20
Acetone	25.0	33.6	37.4	134	150	10.0-160			10.7	31
Allyl chloride	25.0	23.2	24.9	92.8	99.6	70.0-131			7.07	20
Benzene	5.00	4.71	4.99	94.2	99.8	70.0-123			5.77	20
Bromobenzene	5.00	4.37	4.42	87.4	88.4	73.0-121			1.14	20
Bromochloromethane	5.00	5.30	5.77	106	115	77.0-128			8.49	20
Bromodichloromethane	5.00	5.02	5.16	100	103	73.0-121			2.75	20
Bromoform	5.00	4.84	4.99	96.8	99.8	64.0-132			3.05	20
Bromomethane	5.00	3.79	3.36	75.8	67.2	56.0-147			12.0	20
Carbon tetrachloride	5.00	5.23	5.41	105	108	66.0-128			3.38	20
Chlorobenzene	5.00	4.48	4.48	89.6	89.6	76.0-128			0.000	20
Chlorodibromomethane	5.00	4.59	4.67	91.8	93.4	74.0-127			1.73	20
Chloroethane	5.00	4.50	4.03	90.0	80.6	61.0-134			11.0	20
Chloroform	5.00	5.08	5.34	102	107	72.0-123			4.99	20
Chloromethane	5.00	4.60	5.03	92.0	101	51.0-138			8.93	20
Dibromomethane	5.00	5.74	5.61	115	112	75.0-122			2.29	20
Dichlorodifluoromethane	5.00	4.61	4.69	92.2	93.8	43.0-156			1.72	20
Dichlorofluoromethane	5.00	5.35	4.99	107	99.8	65.0-137			6.96	20
Ethyl ether	5.00	5.85	5.66	117	113	64.0-137			3.30	20
Ethylbenzene	5.00	4.37	4.49	87.4	89.8	74.0-126			2.71	20
Hexachloro-1,3-butadiene	5.00	4.13	4.51	82.6	90.2	57.0-150			8.80	20
Isopropylbenzene	5.00	4.31	4.48	86.2	89.6	72.0-127			3.87	20
Methyl tert-butyl ether	5.00	5.60	5.86	112	117	66.0-132			4.54	20

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3807136-1 06/23/22 08:33 • (LCSD) R3807136-2 06/23/22 08:52

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	<u>LCS Qualifier</u>	<u>LCSD Qualifier</u>	RPD %	RPD Limits %
Methylene Chloride	5.00	5.35	5.47	107	109	68.0-123			2.22	20
Naphthalene	5.00	3.72	3.96	74.4	79.2	59.0-130			6.25	20
Styrene	5.00	4.10	4.20	82.0	84.0	72.0-127			2.41	20
Tetrachloroethene	5.00	4.46	4.62	89.2	92.4	70.0-136			3.52	20
Tetrahydrofuran	5.00	7.08	6.93	142	139	37.0-146			2.14	24
Toluene	5.00	4.25	4.35	85.0	87.0	75.0-121			2.33	20
Trichloroethene	5.00	4.46	4.82	89.2	96.4	76.0-126			7.76	20
Trichlorofluoromethane	5.00	4.51	3.98	90.2	79.6	61.0-142			12.5	20
Xylenes, Total	15.0	13.1	13.6	87.3	90.7	72.0-127			3.75	20
cis-1,2-Dichloroethene	5.00	5.23	5.36	105	107	73.0-125			2.46	20
cis-1,3-Dichloropropene	5.00	5.15	5.28	103	106	76.0-127			2.49	20
n-Butylbenzene	5.00	4.38	4.61	87.6	92.2	68.0-135			5.12	20
n-Propylbenzene	5.00	3.95	4.15	79.0	83.0	74.0-126			4.94	20
p-Isopropyltoluene	5.00	4.26	4.52	85.2	90.4	72.0-133			5.92	20
sec-Butylbenzene	5.00	4.10	4.23	82.0	84.6	74.0-130			3.12	20
tert-Butylbenzene	5.00	3.98	4.07	79.6	81.4	75.0-127			2.24	20
trans-1,2-Dichloroethene	5.00	4.80	5.16	96.0	103	71.0-125			7.23	20
trans-1,3-Dichloropropene	5.00	4.89	4.92	97.8	98.4	73.0-127			0.612	20
(S) 4-Bromofluorobenzene				99.7	97.6	67.0-138				
(S) Toluene-d8				95.3	94.4	75.0-131				
(S) 1,2-Dichloroethane-d4				114	119	70.0-130				

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Method Blank (MB)

(MB) R3807168-3 06/24/22 05:20

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
1,2,3-Trichlorobenzene	ND		0.293	0.500
1,2,4-Trichlorobenzene	ND		0.176	0.500
Vinyl chloride	ND		0.0462	0.0500
(S) 4-Bromofluorobenzene	91.4			67.0-138
(S) Toluene-d8	109			75.0-131
(S) 1,2-Dichloroethane-d4	89.6			70.0-130

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3807168-1 06/24/22 04:21 • (LCSD) R3807168-2 06/24/22 04:41

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
1,2,3-Trichlorobenzene	5.00	5.01	4.37	100	87.4	59.0-139			13.6	20
1,2,4-Trichlorobenzene	5.00	5.04	4.40	101	88.0	62.0-137			13.6	20
Vinyl chloride	5.00	4.45	3.92	89.0	78.4	63.0-134			12.7	20
(S) 4-Bromofluorobenzene				93.3	92.4	67.0-138				
(S) Toluene-d8				103	105	75.0-131				
(S) 1,2-Dichloroethane-d4				99.1	97.4	70.0-130				

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

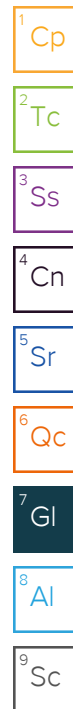
The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
C3	The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.
C4	The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Data is likely to show a low bias concerning the result.
C5	The reported concentration is an estimate. The continuing calibration standard associated with this data responded high. Data is likely to show a high bias concerning the result.
J4	The associated batch QC was outside the established quality control range for accuracy.



ACCREDITATIONS & LOCATIONS

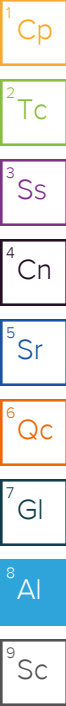
Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey--NELAP	TN002
California	2932	New Mexico ¹	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina ¹	DW21704
Georgia	NELAP	North Carolina ³	41
Georgia ¹	923	North Dakota	R-140
Idaho	TN00003	Ohio--VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LA000356
Kentucky ^{1 6}	KY90010	South Carolina	84004002
Kentucky ²	16	South Dakota	n/a
Louisiana	AI30792	Tennessee ^{1 4}	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas ⁵	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA -- ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA -- ISO 17025 ⁵	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA--Crypto	TN00003		

¹ Drinking Water ² Underground Storage Tanks ³ Aquatic Toxicity ⁴ Chemical/Microbiological ⁵ Mold ⁶ Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.





ANALYTICAL REPORT

September 30, 2022

¹ Cp

² Tc

³ Ss

⁴ Cn

⁵ Sr

⁶ Qc

⁷ Gl

⁸ Al

⁹ Sc

Elk River Landfill

Sample Delivery Group: L1538364
Samples Received: 09/22/2022
Project Number: 900
Description: Elk River Landfill Residential Well
Site: MN02
Report To: Andrea Nord
4300 MarketPoint Drive Suite 200
Minneapolis, MN 55435

Entire Report Reviewed By:

T. Alan Harvill
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.

Pace Analytical National

12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

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Sr: Sample Results	5
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TRIP BLANK L1538364-02	7
Qc: Quality Control Summary	9
Volatile Organic Compounds (GC/MS) by Method 8260D	9
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Al: Accreditations & Locations	15
Sc: Sample Chain of Custody	16

¹ Cp
² Tc
³ Ss
⁴ Cn
⁵ Sr
⁶ Qc
⁷ Gl
⁸ Al
⁹ Sc

SAMPLE SUMMARY

#876410 L1538364-01 GW

Collected by
Kevin McGilp

Collected date/time
09/21/22 11:50

Received date/time
09/22/22 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1933154	1	09/27/22 18:30	09/27/22 18:30	JHH	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1934357	1	09/29/22 13:46	09/29/22 13:46	ADM	Mt. Juliet, TN

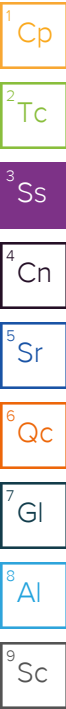
TRIP BLANK L1538364-02 GW

Collected by
Kevin McGilp

Collected date/time
09/21/22 00:00

Received date/time
09/22/22 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1933154	1	09/27/22 14:15	09/27/22 14:15	ACG	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1934357	1	09/29/22 14:07	09/29/22 14:07	ADM	Mt. Juliet, TN



CASE NARRATIVE

Unless qualified or notated within the narrative below, all sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



T. Alan Harvill
Project Manager

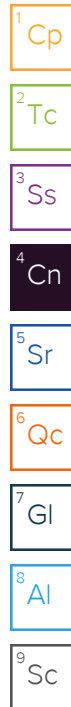
Project Comments

The requested project specific reporting limits may be less than laboratory standard quantitation limits (PQL) but will be greater than or equal to the laboratory method detection limits (MDL). It is noted that results reported below lab standard quantitation limits (PQLs) may result in false positive/false negative values that may require additional laboratory quality assurance review, if requested. Routine laboratory procedures do not initiate a data review process for detections below the laboratory's PQL unless requested by the client.

Volatile Organic Compounds (GC/MS) by Method 8260D

The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.

Batch	Lab Sample ID	Analytes
WG1933154	L1538364-01	Acetone, Bromomethane, Dichlorofluoromethane, tert-Butylbenzene and Tetrahydrofuran
WG1933154	L1538364-02	Acetone, Bromomethane, Dichlorofluoromethane, tert-Butylbenzene and Tetrahydrofuran



#876410

SAMPLE RESULTS - 01

Collected date/time: 09/21/22 11:50

L1538364

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
1,1,1,2-Tetrachloroethane	ND		1.00	1	09/27/2022 18:30	WG1933154
1,1,1-Trichloroethane	ND		1.00	1	09/27/2022 18:30	WG1933154
1,1,2,2-Tetrachloroethane	ND		1.00	1	09/27/2022 18:30	WG1933154
1,1-Dichloroethane	ND		1.00	1	09/27/2022 18:30	WG1933154
1,1-Dichloroethene	ND		1.00	1	09/27/2022 18:30	WG1933154
1,1-Dichloropropene	ND		1.00	1	09/27/2022 18:30	WG1933154
1,2,3-Trichlorobenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
1,2,3-Trichloropropane	ND		1.00	1	09/27/2022 18:30	WG1933154
1,2,4-Trichlorobenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
1,2,4-Trimethylbenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
1,2-Dibromo-3-Chloropropane	ND		1.00	1	09/27/2022 18:30	WG1933154
1,2-Dibromoethane	ND		1.00	1	09/27/2022 18:30	WG1933154
1,2-Dichlorobenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
1,2-Dichloroethane	ND		1.00	1	09/27/2022 18:30	WG1933154
1,2-Dichloropropane	ND		1.00	1	09/27/2022 18:30	WG1933154
1,3,5-Trimethylbenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
1,3-Dichlorobenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
1,3-Dichloropropane	ND		1.00	1	09/27/2022 18:30	WG1933154
1,4-Dichlorobenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
2,2-Dichloropropane	ND		1.00	1	09/27/2022 18:30	WG1933154
2-Butanone (MEK)	ND		10.0	1	09/27/2022 18:30	WG1933154
2-Chlorotoluene	ND		1.00	1	09/27/2022 18:30	WG1933154
4-Chlorotoluene	ND		1.00	1	09/27/2022 18:30	WG1933154
4-Methyl-2-pentanone (MIBK)	ND		5.00	1	09/27/2022 18:30	WG1933154
Acetone	ND	C3	10.0	1	09/27/2022 18:30	WG1933154
Allyl chloride	ND		1.00	1	09/27/2022 18:30	WG1933154
Benzene	ND		1.00	1	09/27/2022 18:30	WG1933154
Bromobenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
Bromochloromethane	ND		1.00	1	09/27/2022 18:30	WG1933154
Bromodichloromethane	ND		1.00	1	09/27/2022 18:30	WG1933154
Bromoform	ND		1.00	1	09/27/2022 18:30	WG1933154
Bromomethane	ND	C3	1.00	1	09/27/2022 18:30	WG1933154
Carbon tetrachloride	ND		1.00	1	09/27/2022 18:30	WG1933154
Chlorobenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
Chlorodibromomethane	ND		1.00	1	09/27/2022 18:30	WG1933154
Chloroethane	ND		1.00	1	09/27/2022 18:30	WG1933154
Chloroform	ND		1.00	1	09/27/2022 18:30	WG1933154
Chloromethane	ND		1.00	1	09/27/2022 18:30	WG1933154
Dibromomethane	ND		1.00	1	09/27/2022 18:30	WG1933154
Dichlorodifluoromethane	ND		1.00	1	09/27/2022 18:30	WG1933154
Dichlorofluoromethane	ND	C3	1.00	1	09/27/2022 18:30	WG1933154
Ethyl ether	ND		1.00	1	09/27/2022 18:30	WG1933154
Ethylbenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
Hexachloro-1,3-butadiene	ND		1.00	1	09/27/2022 18:30	WG1933154
Isopropylbenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
Methyl tert-butyl ether	ND		1.00	1	09/27/2022 18:30	WG1933154
Methylene Chloride	ND		1.00	1	09/27/2022 18:30	WG1933154
Naphthalene	ND		1.00	1	09/27/2022 18:30	WG1933154
Styrene	ND		1.00	1	09/27/2022 18:30	WG1933154
Tetrachloroethene	ND		1.00	1	09/27/2022 18:30	WG1933154
Tetrahydrofuran	ND	C3	5.00	1	09/27/2022 18:30	WG1933154
Toluene	ND		1.00	1	09/27/2022 18:30	WG1933154
Trichloroethene	ND		1.00	1	09/27/2022 18:30	WG1933154
Trichlorofluoromethane	ND		1.00	1	09/27/2022 18:30	WG1933154
Vinyl chloride	ND		1.00	1	09/29/2022 13:46	WG1934357
Xylenes, Total	ND		2.00	1	09/27/2022 18:30	WG1933154

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

ACCOUNT:

Elk River Landfill

PROJECT:

900

SDG:

L1538364

DATE/TIME:

09/30/22 10:23

PAGE:

5 of 16

#876410

SAMPLE RESULTS - 01

Collected date/time: 09/21/22 11:50

L1538364

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
cis-1,2-Dichloroethene	ND		1.00	1	09/27/2022 18:30	WG1933154
cis-1,3-Dichloropropene	ND		1.00	1	09/27/2022 18:30	WG1933154
n-Butylbenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
n-Propylbenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
p-Isopropyltoluene	ND		1.00	1	09/27/2022 18:30	WG1933154
sec-Butylbenzene	ND		1.00	1	09/27/2022 18:30	WG1933154
tert-Butylbenzene	ND	C3	1.00	1	09/27/2022 18:30	WG1933154
trans-1,2-Dichloroethene	ND		1.00	1	09/27/2022 18:30	WG1933154
trans-1,3-Dichloropropene	ND		1.00	1	09/27/2022 18:30	WG1933154
(S) 4-Bromofluorobenzene	101			67.0-138	09/27/2022 18:30	WG1933154
(S) 4-Bromofluorobenzene	101			67.0-138	09/29/2022 13:46	WG1934357
(S) Toluene-d8	99.5			75.0-131	09/27/2022 18:30	WG1933154
(S) Toluene-d8	101			75.0-131	09/29/2022 13:46	WG1934357
(S) 1,2-Dichloroethane-d4	101			70.0-130	09/27/2022 18:30	WG1933154
(S) 1,2-Dichloroethane-d4	101			70.0-130	09/29/2022 13:46	WG1934357

¹ Cp² Tc³ Ss⁴ Cn⁵ Sr⁶ Qc⁷ Gl⁸ Al⁹ Sc

TRIP BLANK

Collected date/time: 09/21/22 00:00

SAMPLE RESULTS - 02

L1538364

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
1,1,1,2-Tetrachloroethane	ND		1.00	1	09/27/2022 14:15	WG1933154
1,1,1-Trichloroethane	ND		1.00	1	09/27/2022 14:15	WG1933154
1,1,2,2-Tetrachloroethane	ND		1.00	1	09/27/2022 14:15	WG1933154
1,1-Dichloroethane	ND		1.00	1	09/27/2022 14:15	WG1933154
1,1-Dichloroethene	ND		1.00	1	09/27/2022 14:15	WG1933154
1,1-Dichloropropene	ND		1.00	1	09/27/2022 14:15	WG1933154
1,2,3-Trichlorobenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
1,2,3-Trichloropropane	ND		1.00	1	09/27/2022 14:15	WG1933154
1,2,4-Trichlorobenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
1,2,4-Trimethylbenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
1,2-Dibromo-3-Chloropropane	ND		1.00	1	09/27/2022 14:15	WG1933154
1,2-Dibromoethane	ND		1.00	1	09/27/2022 14:15	WG1933154
1,2-Dichlorobenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
1,2-Dichloroethane	ND		1.00	1	09/27/2022 14:15	WG1933154
1,2-Dichloropropane	ND		1.00	1	09/27/2022 14:15	WG1933154
1,3,5-Trimethylbenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
1,3-Dichlorobenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
1,3-Dichloropropane	ND		1.00	1	09/27/2022 14:15	WG1933154
1,4-Dichlorobenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
2,2-Dichloropropane	ND		1.00	1	09/27/2022 14:15	WG1933154
2-Butanone (MEK)	ND		10.0	1	09/27/2022 14:15	WG1933154
2-Chlorotoluene	ND		1.00	1	09/27/2022 14:15	WG1933154
4-Chlorotoluene	ND		1.00	1	09/27/2022 14:15	WG1933154
4-Methyl-2-pentanone (MIBK)	ND		5.00	1	09/27/2022 14:15	WG1933154
Acetone	ND	C3	10.0	1	09/27/2022 14:15	WG1933154
Allyl chloride	ND		1.00	1	09/27/2022 14:15	WG1933154
Benzene	ND		1.00	1	09/27/2022 14:15	WG1933154
Bromobenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
Bromochloromethane	ND		1.00	1	09/27/2022 14:15	WG1933154
Bromodichloromethane	ND		1.00	1	09/27/2022 14:15	WG1933154
Bromoform	ND		1.00	1	09/27/2022 14:15	WG1933154
Bromomethane	ND	C3	1.00	1	09/27/2022 14:15	WG1933154
Carbon tetrachloride	ND		1.00	1	09/27/2022 14:15	WG1933154
Chlorobenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
Chlorodibromomethane	ND		1.00	1	09/27/2022 14:15	WG1933154
Chloroethane	ND		1.00	1	09/27/2022 14:15	WG1933154
Chloroform	ND		1.00	1	09/27/2022 14:15	WG1933154
Chloromethane	ND		1.00	1	09/27/2022 14:15	WG1933154
Dibromomethane	ND		1.00	1	09/27/2022 14:15	WG1933154
Dichlorodifluoromethane	ND		1.00	1	09/27/2022 14:15	WG1933154
Dichlorofluoromethane	ND	C3	1.00	1	09/27/2022 14:15	WG1933154
Ethyl ether	ND		1.00	1	09/27/2022 14:15	WG1933154
Ethylbenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
Hexachloro-1,3-butadiene	ND		1.00	1	09/27/2022 14:15	WG1933154
Isopropylbenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
Methyl tert-butyl ether	ND		1.00	1	09/27/2022 14:15	WG1933154
Methylene Chloride	ND		1.00	1	09/27/2022 14:15	WG1933154
Naphthalene	ND		1.00	1	09/27/2022 14:15	WG1933154
Styrene	ND		1.00	1	09/27/2022 14:15	WG1933154
Tetrachloroethene	ND		1.00	1	09/27/2022 14:15	WG1933154
Tetrahydrofuran	ND	C3	5.00	1	09/27/2022 14:15	WG1933154
Toluene	ND		1.00	1	09/27/2022 14:15	WG1933154
Trichloroethene	ND		1.00	1	09/27/2022 14:15	WG1933154
Trichlorofluoromethane	ND		1.00	1	09/27/2022 14:15	WG1933154
Vinyl chloride	ND		1.00	1	09/29/2022 14:07	WG1934357
Xylenes, Total	ND		2.00	1	09/27/2022 14:15	WG1933154

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

ACCOUNT:

Elk River Landfill

PROJECT:

900

SDG:

L1538364

DATE/TIME:

09/30/22 10:23

PAGE:

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Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
cis-1,2-Dichloroethene	ND		1.00	1	09/27/2022 14:15	WG1933154
cis-1,3-Dichloropropene	ND		1.00	1	09/27/2022 14:15	WG1933154
n-Butylbenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
n-Propylbenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
p-Isopropyltoluene	ND		1.00	1	09/27/2022 14:15	WG1933154
sec-Butylbenzene	ND		1.00	1	09/27/2022 14:15	WG1933154
tert-Butylbenzene	ND	C3	1.00	1	09/27/2022 14:15	WG1933154
trans-1,2-Dichloroethene	ND		1.00	1	09/27/2022 14:15	WG1933154
trans-1,3-Dichloropropene	ND		1.00	1	09/27/2022 14:15	WG1933154
(S) 4-Bromofluorobenzene	102			67.0-138	09/27/2022 14:15	WG1933154
(S) 4-Bromofluorobenzene	98.9			67.0-138	09/29/2022 14:07	WG1934357
(S) Toluene-d8	101			75.0-131	09/27/2022 14:15	WG1933154
(S) Toluene-d8	103			75.0-131	09/29/2022 14:07	WG1934357
(S) 1,2-Dichloroethane-d4	99.4			70.0-130	09/27/2022 14:15	WG1933154
(S) 1,2-Dichloroethane-d4	107			70.0-130	09/29/2022 14:07	WG1934357

¹ Cp² Tc³ Ss⁴ Cn⁵ Sr⁶ Qc⁷ Gl⁸ Al⁹ Sc

Method Blank (MB)

(MB) R3841959-3 09/27/22 13:54

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
1,1,1,2-Tetrachloroethane	ND		0.0379	0.100
1,1,1-Trichloroethane	ND		0.0369	0.100
1,1,2,2-Tetrachloroethane	ND		0.0278	0.100
1,1-Dichloroethane	ND		0.0196	0.100
1,1-Dichloroethene	ND		0.0242	0.100
1,1-Dichloropropene	ND		0.0324	0.100
1,2,3-Trichlorobenzene	ND		0.293	0.500
1,2,3-Trichloropropane	ND		0.0648	0.500
1,2,4-Trichlorobenzene	ND		0.176	0.500
1,2,4-Trimethylbenzene	ND		0.0632	0.200
1,2-Dibromo-3-Chloropropane	ND		0.156	1.00
1,2-Dibromoethane	ND		0.0259	0.100
1,2-Dichlorobenzene	ND		0.0170	0.200
1,2-Dichloroethane	ND		0.0260	0.100
1,2-Dichloropropane	ND		0.0568	0.200
1,3,5-Trimethylbenzene	ND		0.0800	0.200
1,3-Dichlorobenzene	ND		0.0240	0.200
1,3-Dichloropropane	ND		0.0200	0.200
1,4-Dichlorobenzene	ND		0.0280	0.200
2,2-Dichloropropane	ND		0.0552	0.100
2-Butanone (MEK)	ND		2.54	4.00
2-Chlorotoluene	ND		0.0346	0.100
4-Chlorotoluene	ND		0.0180	0.200
4-Methyl-2-pentanone (MIBK)	ND		0.0912	1.00
Acetone	ND		1.46	2.00
Allyl Chloride	ND		0.160	1.00
Benzene	ND		0.0187	0.0400
Bromobenzene	ND		0.0360	0.500
Bromochloromethane	ND		0.0226	0.200
Bromodichloromethane	ND		0.0290	0.100
Bromoform	ND		0.0468	1.00
Bromomethane	ND		0.0788	0.500
Carbon tetrachloride	ND		0.0359	0.200
Chlorobenzene	ND		0.00840	0.100
Chlorodibromomethane	ND		0.0245	0.100
Chloroethane	ND		0.0680	0.200
Chloroform	ND		0.0412	0.100
Chloromethane	ND		0.174	0.500
Dibromomethane	ND		0.0300	0.200
Dichlorodifluoromethane	ND		0.0644	0.100

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Method Blank (MB)

(MB) R3841959-3 09/27/22 13:54

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Dichlorofluoromethane	ND		0.0490	0.100
Ethyl ether	ND		0.0356	0.100
Ethylbenzene	ND		0.0295	0.100
Hexachloro-1,3-butadiene	ND		0.0485	1.00
Isopropylbenzene	ND		0.0170	0.100
Methyl tert-butyl ether	ND		0.0140	0.0400
Methylene Chloride	ND		0.266	1.00
Naphthalene	ND		0.195	0.500
Styrene	ND		0.00916	0.500
Tetrachloroethene	ND		0.0358	0.100
Tetrahydrofuran	ND		0.141	0.500
Toluene	ND		0.0520	0.200
Trichloroethene	ND		0.0234	0.0400
Trichlorofluoromethane	ND		0.0331	0.100
Xylenes, Total	ND		0.0352	0.260
cis-1,2-Dichloroethene	ND		0.0294	0.100
cis-1,3-Dichloropropene	ND		0.0303	0.100
n-Butylbenzene	ND		0.210	0.500
n-Propylbenzene	ND		0.0380	0.200
p-Isopropyltoluene	ND		0.102	0.200
sec-Butylbenzene	ND		0.115	0.500
tert-Butylbenzene	ND		0.0780	0.200
trans-1,2-Dichloroethene	ND		0.0416	0.200
trans-1,3-Dichloropropene	ND		0.0456	0.200
(S) 4-Bromofluorobenzene	101			67.0-138
(S) Toluene-d8	102			75.0-131
(S) 1,2-Dichloroethane-d4	99.9			70.0-130

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3841959-1 09/27/22 11:44 • (LCSD) R3841959-2 09/27/22 12:06

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
1,1,1,2-Tetrachloroethane	5.00	4.31	4.46	86.2	89.2	74.0-129			3.42	20
1,1,1-Trichloroethane	5.00	4.77	4.87	95.4	97.4	69.0-126			2.07	20
1,1,2,2-Tetrachloroethane	5.00	5.18	4.94	104	98.8	68.0-128			4.74	20
1,1-Dichloroethane	5.00	4.38	3.92	87.6	78.4	70.0-127			11.1	20
1,1-Dichloroethene	5.00	5.36	5.05	107	101	65.0-131			5.96	20
1,1-Dichloropropene	5.00	4.93	4.85	98.6	97.0	73.0-125			1.64	20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3841959-1 09/27/22 11:44 • (LCSD) R3841959-2 09/27/22 12:06

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	<u>LCS Qualifier</u>	<u>LCSD Qualifier</u>	RPD %	RPD Limits %
1,2,3-Trichlorobenzene	5.00	4.52	4.64	90.4	92.8	59.0-139			2.62	20
1,2,3-Trichloropropane	5.00	5.29	4.92	106	98.4	67.0-129			7.25	20
1,2,4-Trichlorobenzene	5.00	4.64	4.62	92.8	92.4	62.0-137			0.432	20
1,2,4-Trimethylbenzene	5.00	4.71	4.70	94.2	94.0	70.0-126			0.213	20
1,2-Dibromo-3-Chloropropane	5.00	4.52	4.65	90.4	93.0	59.0-130			2.84	20
1,2-Dibromoethane	5.00	4.78	4.88	95.6	97.6	74.0-128			2.07	20
1,2-Dichlorobenzene	5.00	4.90	4.92	98.0	98.4	76.0-124			0.407	20
1,2-Dichloroethane	5.00	4.87	4.62	97.4	92.4	65.0-131			5.27	20
1,2-Dichloropropane	5.00	4.42	4.16	88.4	83.2	74.0-125			6.06	20
1,3,5-Trimethylbenzene	5.00	4.72	4.59	94.4	91.8	73.0-127			2.79	20
1,3-Dichlorobenzene	5.00	5.30	5.09	106	102	76.0-125			4.04	20
1,3-Dichloropropane	5.00	5.16	5.03	103	101	80.0-125			2.55	20
1,4-Dichlorobenzene	5.00	5.30	5.13	106	103	77.0-121			3.26	20
2,2-Dichloropropane	5.00	5.27	5.26	105	105	59.0-135			0.190	20
2-Butanone (MEK)	25.0	23.3	27.2	93.2	109	30.0-160			15.4	24
2-Chlorotoluene	5.00	4.84	4.34	96.8	86.8	75.0-124			10.9	20
4-Chlorotoluene	5.00	4.50	4.12	90.0	82.4	75.0-124			8.82	20
4-Methyl-2-pentanone (MIBK)	25.0	25.3	26.1	101	104	56.0-143			3.11	20
Acetone	25.0	18.4	22.7	73.6	90.8	10.0-160			20.9	31
Allyl chloride	25.0	23.0	22.9	92.0	91.6	70.0-131			0.436	20
Benzene	5.00	5.32	5.34	106	107	70.0-123			0.375	20
Bromobenzene	5.00	5.07	5.19	101	104	73.0-121			2.34	20
Bromochloromethane	5.00	4.89	4.61	97.8	92.2	77.0-128			5.89	20
Bromodichloromethane	5.00	4.52	4.52	90.4	90.4	73.0-121			0.000	20
Bromoform	5.00	5.25	5.03	105	101	64.0-132			4.28	20
Bromomethane	5.00	2.88	2.94	57.6	58.8	56.0-147			2.06	20
Carbon tetrachloride	5.00	5.03	4.82	101	96.4	66.0-128			4.26	20
Chlorobenzene	5.00	4.97	4.97	99.4	99.4	76.0-128			0.000	20
Chlorodibromomethane	5.00	4.56	4.87	91.2	97.4	74.0-127			6.57	20
Chloroethane	5.00	4.28	4.07	85.6	81.4	61.0-134			5.03	20
Chloroform	5.00	4.50	4.36	90.0	87.2	72.0-123			3.16	20
Chloromethane	5.00	5.28	5.36	106	107	51.0-138			1.50	20
Dibromomethane	5.00	4.48	4.55	89.6	91.0	75.0-122			1.55	20
Dichlorodifluoromethane	5.00	4.49	4.62	89.8	92.4	43.0-156			2.85	20
Dichlorofluoromethane	5.00	3.40	3.64	68.0	72.8	65.0-137			6.82	20
Ethyl ether	5.00	5.63	5.13	113	103	64.0-137			9.29	20
Ethylbenzene	5.00	4.80	4.73	96.0	94.6	74.0-126			1.47	20
Hexachloro-1,3-butadiene	5.00	5.75	5.77	115	115	57.0-150			0.347	20
Isopropylbenzene	5.00	4.70	4.62	94.0	92.4	72.0-127			1.72	20
Methyl tert-butyl ether	5.00	4.69	5.05	93.8	101	66.0-132			7.39	20

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3841959-1 09/27/22 11:44 • (LCSD) R3841959-2 09/27/22 12:06

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	<u>LCS Qualifier</u>	<u>LCSD Qualifier</u>	RPD %	RPD Limits %
Methylene Chloride	5.00	4.33	4.32	86.6	86.4	68.0-123			0.231	20
Naphthalene	5.00	4.39	4.44	87.8	88.8	59.0-130			1.13	20
Styrene	5.00	5.45	5.05	109	101	72.0-127			7.62	20
Tetrachloroethene	5.00	4.42	4.60	88.4	92.0	70.0-136			3.99	20
Tetrahydrofuran	5.00	3.68	4.26	73.6	85.2	37.0-146			14.6	24
Toluene	5.00	5.16	5.16	103	103	75.0-121			0.000	20
Trichloroethene	5.00	4.79	4.97	95.8	99.4	76.0-126			3.69	20
Trichlorofluoromethane	5.00	4.73	4.75	94.6	95.0	61.0-142			0.422	20
Xylenes, Total	15.0	14.5	14.7	96.7	98.0	72.0-127			1.37	20
cis-1,2-Dichloroethene	5.00	4.67	4.46	93.4	89.2	73.0-125			4.60	20
cis-1,3-Dichloropropene	5.00	4.81	4.68	96.2	93.6	76.0-127			2.74	20
n-Butylbenzene	5.00	5.15	5.07	103	101	68.0-135			1.57	20
n-Propylbenzene	5.00	5.01	4.85	100	97.0	74.0-126			3.25	20
p-Isopropyltoluene	5.00	4.86	4.77	97.2	95.4	72.0-133			1.87	20
sec-Butylbenzene	5.00	5.00	5.12	100	102	74.0-130			2.37	20
tert-Butylbenzene	5.00	3.89	3.76	77.8	75.2	75.0-127			3.40	20
trans-1,2-Dichloroethene	5.00	4.56	4.30	91.2	86.0	71.0-125			5.87	20
trans-1,3-Dichloropropene	5.00	4.77	4.91	95.4	98.2	73.0-127			2.89	20
(S) 4-Bromofluorobenzene				104	103	67.0-138				
(S) Toluene-d8				97.3	102	75.0-131				
(S) 1,2-Dichloroethane-d4				96.5	95.3	70.0-130				

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Method Blank (MB)

(MB) R3842978-3 09/29/22 09:05

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Vinyl chloride	ND		0.0462	0.0500
(S) 4-Bromofluorobenzene	92.3			67.0-138
(S) Toluene-d8	100			75.0-131
(S) 1,2-Dichloroethane-d4	103			70.0-130

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3842978-1 09/29/22 08:02 • (LCSD) R3842978-2 09/29/22 08:23

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Vinyl chloride	5.00	4.53	4.78	90.6	95.6	63.0-134			5.37	20
(S) 4-Bromofluorobenzene				101	100	67.0-138				
(S) Toluene-d8				105	102	75.0-131				
(S) 1,2-Dichloroethane-d4				109	105	70.0-130				

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier Description

C3	The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.

¹ Cp

² Tc

³ Ss

⁴ Cn

⁵ Sr

⁶ Qc

⁷ Gl

⁸ Al

⁹ Sc

ACCREDITATIONS & LOCATIONS

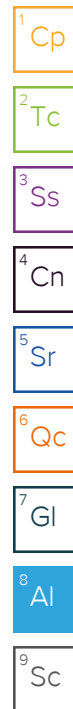
Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey--NELAP	TN002
California	2932	New Mexico ¹	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina ¹	DW21704
Georgia	NELAP	North Carolina ³	41
Georgia ¹	923	North Dakota	R-140
Idaho	TN00003	Ohio--VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LA000356
Kentucky ^{1 6}	KY90010	South Carolina	84004002
Kentucky ²	16	South Dakota	n/a
Louisiana	AI30792	Tennessee ^{1 4}	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas ⁵	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA -- ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA -- ISO 17025 ⁵	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA--Crypto	TN00003		

¹ Drinking Water ² Underground Storage Tanks ³ Aquatic Toxicity ⁴ Chemical/Microbiological ⁵ Mold ⁶ Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.



[illegible]



ANALYTICAL REPORT

September 30, 2022

¹ Cp

² Tc

³ Ss

⁴ Cn

⁵ Sr

⁶ Qc

⁷ Gl

⁸ Al

⁹ Sc

Elk River Landfill

Sample Delivery Group: L1539899
Samples Received: 09/27/2022
Project Number: 900
Description: Elk River Landfill Residential Well
Site: MN02
Report To: Andrea Nord
4300 MarketPoint Drive Suite 200
Minneapolis, MN 55435

Entire Report Reviewed By:

T. Alan Harvill
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.

Pace Analytical National

12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

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Qc: Quality Control Summary	9
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¹ Cp
² Tc
³ Ss
⁴ Cn
⁵ Sr
⁶ Qc
⁷ Gl
⁸ Al
⁹ Sc

SAMPLE SUMMARY

876411 L1539899-01 GW

Collected by
DP

Collected date/time
09/26/22 12:55

Received date/time
09/27/22 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1934751	1	09/30/22 03:07	09/30/22 03:07	ADM	Mt. Juliet, TN

TRIP BLANK L1539899-02 GW

Collected by
DP

Collected date/time
09/26/22 00:00

Received date/time
09/27/22 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1934751	1	09/30/22 01:52	09/30/22 01:52	ADM	Mt. Juliet, TN

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

CASE NARRATIVE

Unless qualified or notated within the narrative below, all sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



T. Alan Harvill
Project Manager

Project Comments

The requested project specific reporting limits may be less than laboratory standard quantitation limits (PQL) but will be greater than or equal to the laboratory method detection limits (MDL). It is noted that results reported below lab standard quantitation limits (PQLs) may result in false positive/false negative values that may require additional laboratory quality assurance review, if requested. Routine laboratory procedures do not initiate a data review process for detections below the laboratory's PQL unless requested by the client.

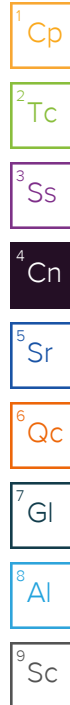
Volatile Organic Compounds (GC/MS) by Method 8260D

The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.

Batch	Lab Sample ID	Analytes
WG1934751	L1539899-01	2,2-Dichloropropane, 2-Butanone (MEK), Bromomethane and Trichlorofluoromethane
WG1934751	L1539899-02	2,2-Dichloropropane, 2-Butanone (MEK), Bromomethane and Trichlorofluoromethane

The associated batch QC was outside the established quality control range for precision.

Batch	Lab Sample ID	Analytes
WG1934751	(LCSD) R3843440-3, L1539899-01, 02	Trichlorofluoromethane



876411

SAMPLE RESULTS - 01

Collected date/time: 09/26/22 12:55

L1539899

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
1,1,2-Tetrachloroethane	ND		1.00	1	09/30/2022 03:07	WG1934751
1,1,1-Trichloroethane	ND		1.00	1	09/30/2022 03:07	WG1934751
1,1,2,2-Tetrachloroethane	ND		1.00	1	09/30/2022 03:07	WG1934751
1,1-Dichloroethane	ND		1.00	1	09/30/2022 03:07	WG1934751
1,1-Dichloroethene	ND		1.00	1	09/30/2022 03:07	WG1934751
1,1-Dichloropropene	ND		1.00	1	09/30/2022 03:07	WG1934751
1,2,3-Trichlorobenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
1,2,3-Trichloropropane	ND		1.00	1	09/30/2022 03:07	WG1934751
1,2,4-Trichlorobenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
1,2,4-Trimethylbenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
1,2-Dibromo-3-Chloropropane	ND		1.00	1	09/30/2022 03:07	WG1934751
1,2-Dibromoethane	ND		1.00	1	09/30/2022 03:07	WG1934751
1,2-Dichlorobenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
1,2-Dichloroethane	ND		1.00	1	09/30/2022 03:07	WG1934751
1,2-Dichloropropane	ND		1.00	1	09/30/2022 03:07	WG1934751
1,3,5-Trimethylbenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
1,3-Dichlorobenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
1,3-Dichloropropane	ND		1.00	1	09/30/2022 03:07	WG1934751
1,4-Dichlorobenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
2,2-Dichloropropane	ND	C3	1.00	1	09/30/2022 03:07	WG1934751
2-Butanone (MEK)	ND	C3	10.0	1	09/30/2022 03:07	WG1934751
2-Chlorotoluene	ND		1.00	1	09/30/2022 03:07	WG1934751
4-Chlorotoluene	ND		1.00	1	09/30/2022 03:07	WG1934751
4-Methyl-2-pentanone (MIBK)	ND		5.00	1	09/30/2022 03:07	WG1934751
Acetone	ND		10.0	1	09/30/2022 03:07	WG1934751
Allyl chloride	ND		1.00	1	09/30/2022 03:07	WG1934751
Benzene	ND		1.00	1	09/30/2022 03:07	WG1934751
Bromobenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
Bromochloromethane	ND		1.00	1	09/30/2022 03:07	WG1934751
Bromodichloromethane	ND		1.00	1	09/30/2022 03:07	WG1934751
Bromoform	ND		1.00	1	09/30/2022 03:07	WG1934751
Bromomethane	ND	C3	1.00	1	09/30/2022 03:07	WG1934751
Carbon tetrachloride	ND		1.00	1	09/30/2022 03:07	WG1934751
Chlorobenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
Chlorodibromomethane	ND		1.00	1	09/30/2022 03:07	WG1934751
Chloroethane	ND		1.00	1	09/30/2022 03:07	WG1934751
Chloroform	ND		1.00	1	09/30/2022 03:07	WG1934751
Chloromethane	ND		1.00	1	09/30/2022 03:07	WG1934751
Dibromomethane	ND		1.00	1	09/30/2022 03:07	WG1934751
Dichlorodifluoromethane	ND		1.00	1	09/30/2022 03:07	WG1934751
Dichlorofluoromethane	ND		1.00	1	09/30/2022 03:07	WG1934751
Ethyl ether	ND		1.00	1	09/30/2022 03:07	WG1934751
Ethylbenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
Hexachloro-1,3-butadiene	ND		1.00	1	09/30/2022 03:07	WG1934751
Isopropylbenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
Methyl tert-butyl ether	ND		1.00	1	09/30/2022 03:07	WG1934751
Methylene Chloride	ND		1.00	1	09/30/2022 03:07	WG1934751
Naphthalene	ND		1.00	1	09/30/2022 03:07	WG1934751
Styrene	ND		1.00	1	09/30/2022 03:07	WG1934751
Tetrachloroethene	ND		1.00	1	09/30/2022 03:07	WG1934751
Tetrahydrofuran	ND		5.00	1	09/30/2022 03:07	WG1934751
Toluene	ND		1.00	1	09/30/2022 03:07	WG1934751
Trichloroethene	ND		1.00	1	09/30/2022 03:07	WG1934751
Trichlorofluoromethane	ND	C3 J3	1.00	1	09/30/2022 03:07	WG1934751
Vinyl chloride	ND		1.00	1	09/30/2022 03:07	WG1934751
Xylenes, Total	ND		2.00	1	09/30/2022 03:07	WG1934751

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

ACCOUNT:

Elk River Landfill

PROJECT:

900

SDG:

L1539899

DATE/TIME:

09/30/22 17:13

PAGE:

5 of 15

876411

SAMPLE RESULTS - 01

Collected date/time: 09/26/22 12:55

L1539899

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
cis-1,2-Dichloroethene	ND		1.00	1	09/30/2022 03:07	WG1934751
cis-1,3-Dichloropropene	ND		1.00	1	09/30/2022 03:07	WG1934751
n-Butylbenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
n-Propylbenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
p-Isopropyltoluene	ND		1.00	1	09/30/2022 03:07	WG1934751
sec-Butylbenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
tert-Butylbenzene	ND		1.00	1	09/30/2022 03:07	WG1934751
trans-1,2-Dichloroethene	ND		1.00	1	09/30/2022 03:07	WG1934751
trans-1,3-Dichloropropene	ND		1.00	1	09/30/2022 03:07	WG1934751
(S) 4-Bromofluorobenzene	96.8			67.0-138	09/30/2022 03:07	WG1934751
(S) Toluene-d8	101			75.0-131	09/30/2022 03:07	WG1934751
(S) 1,2-Dichloroethane-d4	90.7			70.0-130	09/30/2022 03:07	WG1934751

¹Cp²Tc³Ss⁴Cn⁵Sr⁶Qc⁷Gl⁸Al⁹Sc

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Collected date/time: 09/26/22 00:00

SAMPLE RESULTS - 02

L1539899

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
1,1,2-Tetrachloroethane	ND		1.00	1	09/30/2022 01:52	WG1934751
1,1,1-Trichloroethane	ND		1.00	1	09/30/2022 01:52	WG1934751
1,1,2,2-Tetrachloroethane	ND		1.00	1	09/30/2022 01:52	WG1934751
1,1-Dichloroethane	ND		1.00	1	09/30/2022 01:52	WG1934751
1,1-Dichloroethene	ND		1.00	1	09/30/2022 01:52	WG1934751
1,1-Dichloropropene	ND		1.00	1	09/30/2022 01:52	WG1934751
1,2,3-Trichlorobenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
1,2,3-Trichloropropane	ND		1.00	1	09/30/2022 01:52	WG1934751
1,2,4-Trichlorobenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
1,2,4-Trimethylbenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
1,2-Dibromo-3-Chloropropane	ND		1.00	1	09/30/2022 01:52	WG1934751
1,2-Dibromoethane	ND		1.00	1	09/30/2022 01:52	WG1934751
1,2-Dichlorobenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
1,2-Dichloroethane	ND		1.00	1	09/30/2022 01:52	WG1934751
1,2-Dichloropropane	ND		1.00	1	09/30/2022 01:52	WG1934751
1,3,5-Trimethylbenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
1,3-Dichlorobenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
1,3-Dichloropropane	ND		1.00	1	09/30/2022 01:52	WG1934751
1,4-Dichlorobenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
2,2-Dichloropropane	ND	C3	1.00	1	09/30/2022 01:52	WG1934751
2-Butanone (MEK)	ND	C3	10.0	1	09/30/2022 01:52	WG1934751
2-Chlorotoluene	ND		1.00	1	09/30/2022 01:52	WG1934751
4-Chlorotoluene	ND		1.00	1	09/30/2022 01:52	WG1934751
4-Methyl-2-pentanone (MIBK)	ND		5.00	1	09/30/2022 01:52	WG1934751
Acetone	ND		10.0	1	09/30/2022 01:52	WG1934751
Allyl chloride	ND		1.00	1	09/30/2022 01:52	WG1934751
Benzene	ND		1.00	1	09/30/2022 01:52	WG1934751
Bromobenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
Bromochloromethane	ND		1.00	1	09/30/2022 01:52	WG1934751
Bromodichloromethane	ND		1.00	1	09/30/2022 01:52	WG1934751
Bromoform	ND		1.00	1	09/30/2022 01:52	WG1934751
Bromomethane	ND	C3	1.00	1	09/30/2022 01:52	WG1934751
Carbon tetrachloride	ND		1.00	1	09/30/2022 01:52	WG1934751
Chlorobenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
Chlorodibromomethane	ND		1.00	1	09/30/2022 01:52	WG1934751
Chloroethane	ND		1.00	1	09/30/2022 01:52	WG1934751
Chloroform	ND		1.00	1	09/30/2022 01:52	WG1934751
Chloromethane	ND		1.00	1	09/30/2022 01:52	WG1934751
Dibromomethane	ND		1.00	1	09/30/2022 01:52	WG1934751
Dichlorodifluoromethane	ND		1.00	1	09/30/2022 01:52	WG1934751
Dichlorofluoromethane	ND		1.00	1	09/30/2022 01:52	WG1934751
Ethyl ether	ND		1.00	1	09/30/2022 01:52	WG1934751
Ethylbenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
Hexachloro-1,3-butadiene	ND		1.00	1	09/30/2022 01:52	WG1934751
Isopropylbenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
Methyl tert-butyl ether	ND		1.00	1	09/30/2022 01:52	WG1934751
Methylene Chloride	ND		1.00	1	09/30/2022 01:52	WG1934751
Naphthalene	ND		1.00	1	09/30/2022 01:52	WG1934751
Styrene	ND		1.00	1	09/30/2022 01:52	WG1934751
Tetrachloroethene	ND		1.00	1	09/30/2022 01:52	WG1934751
Tetrahydrofuran	ND		5.00	1	09/30/2022 01:52	WG1934751
Toluene	ND		1.00	1	09/30/2022 01:52	WG1934751
Trichloroethene	ND		1.00	1	09/30/2022 01:52	WG1934751
Trichlorofluoromethane	ND	C3 J3	1.00	1	09/30/2022 01:52	WG1934751
Vinyl chloride	ND		1.00	1	09/30/2022 01:52	WG1934751
Xylenes, Total	ND		2.00	1	09/30/2022 01:52	WG1934751

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

ACCOUNT:

Elk River Landfill

PROJECT:

900

SDG:

L1539899

DATE/TIME:

09/30/22 17:13

PAGE:

7 of 15

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SAMPLE RESULTS - 02

Collected date/time: 09/26/22 00:00

L1539899

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
cis-1,2-Dichloroethene	ND		1.00	1	09/30/2022 01:52	WG1934751
cis-1,3-Dichloropropene	ND		1.00	1	09/30/2022 01:52	WG1934751
n-Butylbenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
n-Propylbenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
p-Isopropyltoluene	ND		1.00	1	09/30/2022 01:52	WG1934751
sec-Butylbenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
tert-Butylbenzene	ND		1.00	1	09/30/2022 01:52	WG1934751
trans-1,2-Dichloroethene	ND		1.00	1	09/30/2022 01:52	WG1934751
trans-1,3-Dichloropropene	ND		1.00	1	09/30/2022 01:52	WG1934751
(S) 4-Bromofluorobenzene	99.7			67.0-138	09/30/2022 01:52	WG1934751
(S) Toluene-d8	101			75.0-131	09/30/2022 01:52	WG1934751
(S) 1,2-Dichloroethane-d4	89.9			70.0-130	09/30/2022 01:52	WG1934751

¹Cp²Tc³Ss⁴Cn⁵Sr⁶Qc⁷Gl⁸Al⁹Sc

Method Blank (MB)

(MB) R3843440-2 09/30/22 01:34

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
1,1,1,2-Tetrachloroethane	ND		0.0379	0.100
1,1,1-Trichloroethane	ND		0.0369	0.100
1,1,2,2-Tetrachloroethane	ND		0.0278	0.100
1,1-Dichloroethane	ND		0.0196	0.100
1,1-Dichloroethene	ND		0.0242	0.100
1,1-Dichloropropene	ND		0.0324	0.100
1,2,3-Trichlorobenzene	ND		0.293	0.500
1,2,3-Trichloropropane	ND		0.0648	0.500
1,2,4-Trichlorobenzene	ND		0.176	0.500
1,2,4-Trimethylbenzene	ND		0.0632	0.200
1,2-Dibromo-3-Chloropropane	ND		0.156	1.00
1,2-Dibromoethane	ND		0.0259	0.100
1,2-Dichlorobenzene	ND		0.0170	0.200
1,2-Dichloroethane	ND		0.0260	0.100
1,2-Dichloropropane	ND		0.0568	0.200
1,3,5-Trimethylbenzene	ND		0.0800	0.200
1,3-Dichlorobenzene	ND		0.0240	0.200
1,3-Dichloropropane	ND		0.0200	0.200
1,4-Dichlorobenzene	ND		0.0280	0.200
2,2-Dichloropropane	ND		0.0552	0.100
2-Butanone (MEK)	ND		2.54	4.00
2-Chlorotoluene	ND		0.0346	0.100
4-Chlorotoluene	ND		0.0180	0.200
4-Methyl-2-pentanone (MIBK)	ND		0.0912	1.00
Acetone	ND		1.46	2.00
Allyl Chloride	ND		0.160	1.00
Benzene	ND		0.0187	0.0400
Bromobenzene	ND		0.0360	0.500
Bromochloromethane	ND		0.0226	0.200
Bromodichloromethane	ND		0.0290	0.100
Bromoform	ND		0.0468	1.00
Bromomethane	ND		0.0788	0.500
Carbon tetrachloride	ND		0.0359	0.200
Chlorobenzene	ND		0.00840	0.100
Chlorodibromomethane	ND		0.0245	0.100
Chloroethane	ND		0.0680	0.200
Chloroform	ND		0.0412	0.100
Chloromethane	ND		0.174	0.500
Dibromomethane	ND		0.0300	0.200
Dichlorodifluoromethane	ND		0.0644	0.100

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Method Blank (MB)

(MB) R3843440-2 09/30/22 01:34

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Dichlorofluoromethane	ND		0.0490	0.100
Ethyl ether	ND		0.0356	0.100
Ethylbenzene	ND		0.0295	0.100
Hexachloro-1,3-butadiene	ND		0.0485	1.00
Isopropylbenzene	ND		0.0170	0.100
Methyl tert-butyl ether	ND		0.0140	0.0400
Methylene Chloride	ND		0.266	1.00
Naphthalene	ND		0.195	0.500
Styrene	ND		0.00916	0.500
Tetrachloroethene	ND		0.0358	0.100
Tetrahydrofuran	ND		0.141	0.500
Toluene	ND		0.0520	0.200
Trichloroethene	ND		0.0234	0.0400
Trichlorofluoromethane	ND		0.0331	0.100
Vinyl chloride	ND		0.0462	0.0500
Xylenes, Total	ND		0.0352	0.260
cis-1,2-Dichloroethene	ND		0.0294	0.100
cis-1,3-Dichloropropene	ND		0.0303	0.100
n-Butylbenzene	ND		0.210	0.500
n-Propylbenzene	ND		0.0380	0.200
p-Isopropyltoluene	ND		0.102	0.200
sec-Butylbenzene	ND		0.115	0.500
tert-Butylbenzene	ND		0.0780	0.200
trans-1,2-Dichloroethene	ND		0.0416	0.200
trans-1,3-Dichloropropene	ND		0.0456	0.200
(S) 4-Bromofluorobenzene	100			67.0-138
(S) Toluene-d8	103			75.0-131
(S) 1,2-Dichloroethane-d4	87.4			70.0-130

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3843440-1 09/30/22 00:38 • (LCSD) R3843440-3 09/30/22 09:03

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
1,1,1,2-Tetrachloroethane	5.00	4.31	4.22	86.2	84.4	74.0-129			2.11	20
1,1,1-Trichloroethane	5.00	4.50	4.58	90.0	91.6	69.0-126			1.76	20
1,1,2,2-Tetrachloroethane	5.00	5.01	4.60	100	92.0	68.0-128			8.53	20
1,1-Dichloroethane	5.00	4.96	4.80	99.2	96.0	70.0-127			3.28	20
1,1-Dichloroethene	5.00	4.85	5.03	97.0	101	65.0-131			3.64	20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3843440-1 09/30/22 00:38 • (LCSD) R3843440-3 09/30/22 09:03

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	<u>LCS Qualifier</u>	<u>LCSD Qualifier</u>	RPD %	RPD Limits %
1,1-Dichloropropene	5.00	4.96	4.94	99.2	98.8	73.0-125			0.404	20
1,2,3-Trichlorobenzene	5.00	5.22	4.34	104	86.8	59.0-139			18.4	20
1,2,3-Trichloropropane	5.00	5.00	4.43	100	88.6	67.0-129			12.1	20
1,2,4-Trichlorobenzene	5.00	4.74	4.28	94.8	85.6	62.0-137			10.2	20
1,2,4-Trimethylbenzene	5.00	4.56	4.48	91.2	89.6	70.0-126			1.77	20
1,2-Dibromo-3-Chloropropane	5.00	5.18	4.68	104	93.6	59.0-130			10.1	20
1,2-Dibromoethane	5.00	5.07	4.75	101	95.0	74.0-128			6.52	20
1,2-Dichlorobenzene	5.00	4.43	4.79	88.6	95.8	76.0-124			7.81	20
1,2-Dichloroethane	5.00	4.21	4.45	84.2	89.0	65.0-131			5.54	20
1,2-Dichloropropane	5.00	4.64	4.76	92.8	95.2	74.0-125			2.55	20
1,3,5-Trimethylbenzene	5.00	4.75	4.63	95.0	92.6	73.0-127			2.56	20
1,3-Dichlorobenzene	5.00	4.57	4.69	91.4	93.8	76.0-125			2.59	20
1,3-Dichloropropane	5.00	5.28	4.99	106	99.8	80.0-125			5.65	20
1,4-Dichlorobenzene	5.00	4.51	4.61	90.2	92.2	77.0-121			2.19	20
2,2-Dichloropropane	5.00	3.83	3.92	76.6	78.4	59.0-135			2.32	20
2-Butanone (MEK)	25.0	23.7	21.3	94.8	85.2	30.0-160			10.7	24
2-Chlorotoluene	5.00	4.92	5.00	98.4	100	75.0-124			1.61	20
4-Chlorotoluene	5.00	4.92	4.97	98.4	99.4	75.0-124			1.01	20
4-Methyl-2-pentanone (MIBK)	25.0	24.8	24.4	99.2	97.6	56.0-143			1.63	20
Acetone	25.0	27.7	28.8	111	115	10.0-160			3.89	31
Allyl chloride	25.0	26.7	25.5	107	102	70.0-131			4.60	20
Benzene	5.00	5.10	5.06	102	101	70.0-123			0.787	20
Bromobenzene	5.00	4.93	5.10	98.6	102	73.0-121			3.39	20
Bromochloromethane	5.00	5.44	5.00	109	100	77.0-128			8.43	20
Bromodichloromethane	5.00	4.78	4.49	95.6	89.8	73.0-121			6.26	20
Bromoform	5.00	5.53	5.45	111	109	64.0-132			1.46	20
Bromomethane	5.00	3.64	3.48	72.8	69.6	56.0-147			4.49	20
Carbon tetrachloride	5.00	4.33	4.47	86.6	89.4	66.0-128			3.18	20
Chlorobenzene	5.00	4.74	4.65	94.8	93.0	76.0-128			1.92	20
Chlorodibromomethane	5.00	5.05	4.81	101	96.2	74.0-127			4.87	20
Chloroethane	5.00	4.45	4.32	89.0	86.4	61.0-134			2.96	20
Chloroform	5.00	4.35	4.50	87.0	90.0	72.0-123			3.39	20
Chloromethane	5.00	4.24	4.52	84.8	90.4	51.0-138			6.39	20
Dibromomethane	5.00	4.88	5.12	97.6	102	75.0-122			4.80	20
Dichlorodifluoromethane	5.00	4.40	4.90	88.0	98.0	43.0-156			10.8	20
Dichlorofluoromethane	5.00	4.23	4.46	84.6	89.2	65.0-137			5.29	20
Ethyl ether	5.00	4.60	4.96	92.0	99.2	64.0-137			7.53	20
Ethylbenzene	5.00	4.78	4.59	95.6	91.8	74.0-126			4.06	20
Hexachloro-1,3-butadiene	5.00	5.06	4.62	101	92.4	57.0-150			9.09	20
Isopropylbenzene	5.00	4.56	4.40	91.2	88.0	72.0-127			3.57	20

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3843440-1 09/30/22 00:38 • (LCSD) R3843440-3 09/30/22 09:03

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	<u>LCS Qualifier</u>	<u>LCSD Qualifier</u>	RPD %	RPD Limits %
Methyl tert-butyl ether	5.00	4.50	4.61	90.0	92.2	66.0-132			2.41	20
Methylene Chloride	5.00	5.18	5.19	104	104	68.0-123			0.193	20
Naphthalene	5.00	5.79	5.03	116	101	59.0-130			14.0	20
Styrene	5.00	4.56	4.34	91.2	86.8	72.0-127			4.94	20
Tetrachloroethene	5.00	4.48	4.42	89.6	88.4	70.0-136			1.35	20
Tetrahydrofuran	5.00	4.52	5.20	90.4	104	37.0-146			14.0	24
Toluene	5.00	4.62	4.58	92.4	91.6	75.0-121			0.870	20
Trichloroethene	5.00	4.69	4.99	93.8	99.8	76.0-126			6.20	20
Trichlorofluoromethane	5.00	3.54	4.36	70.8	87.2	61.0-142		J3	20.8	20
Vinyl chloride	5.00	5.07	4.89	101	97.8	63.0-134			3.61	20
Xylenes, Total	15.0	14.1	14.0	94.0	93.3	72.0-127			0.712	20
cis-1,2-Dichloroethene	5.00	5.04	5.11	101	102	73.0-125			1.38	20
cis-1,3-Dichloropropene	5.00	4.76	4.56	95.2	91.2	76.0-127			4.29	20
n-Butylbenzene	5.00	4.44	4.48	88.8	89.6	68.0-135			0.897	20
n-Propylbenzene	5.00	4.80	4.79	96.0	95.8	74.0-126			0.209	20
p-Isopropyltoluene	5.00	4.60	4.70	92.0	94.0	72.0-133			2.15	20
sec-Butylbenzene	5.00	4.57	4.58	91.4	91.6	74.0-130			0.219	20
tert-Butylbenzene	5.00	4.92	4.77	98.4	95.4	75.0-127			3.10	20
trans-1,2-Dichloroethene	5.00	4.76	4.32	95.2	86.4	71.0-125			9.69	20
trans-1,3-Dichloropropene	5.00	4.98	4.76	99.6	95.2	73.0-127			4.52	20
(S) 4-Bromofluorobenzene				99.6	104	67.0-138				
(S) Toluene-d8				101	99.6	75.0-131				
(S) 1,2-Dichloroethane-d4				87.9	101	70.0-130				

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier Description

C3	The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.
J3	The associated batch QC was outside the established quality control range for precision.

¹ Cp

² Tc

³ Ss

⁴ Cn

⁵ Sr

⁶ Qc

⁷ Gl

⁸ Al

⁹ Sc

ACCREDITATIONS & LOCATIONS

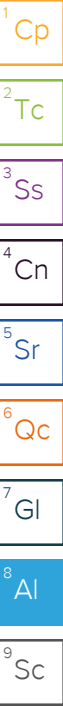
Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey--NELAP	TN002
California	2932	New Mexico ¹	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina ¹	DW21704
Georgia	NELAP	North Carolina ³	41
Georgia ¹	923	North Dakota	R-140
Idaho	TN00003	Ohio--VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LA000356
Kentucky ^{1 6}	KY90010	South Carolina	84004002
Kentucky ²	16	South Dakota	n/a
Louisiana	AI30792	Tennessee ^{1 4}	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas ⁵	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA -- ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA -- ISO 17025 ⁵	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA--Crypto	TN00003		

¹ Drinking Water ² Underground Storage Tanks ³ Aquatic Toxicity ⁴ Chemical/Microbiological ⁵ Mold ⁶ Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.





ANALYTICAL REPORT

October 07, 2022

Elk River Landfill

Sample Delivery Group: L1541347
Samples Received: 09/30/2022
Project Number: 900
Description: Elk River Landfill Residential Well
Site: MN02
Report To: Andrea Nord
4300 MarketPoint Drive Suite 200
Minneapolis, MN 55435

¹ Cp

² Tc

³ Ss

⁴ Cn

⁵ Sr

⁶ Qc

⁷ Gl

⁸ Al

⁹ Sc

Entire Report Reviewed By:

T. Alan Harvill
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.

Pace Analytical National

12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

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TRIP BLANK L1541347-02	7
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Gl: Glossary of Terms	13
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¹ Cp
² Tc
³ Ss
⁴ Cn
⁵ Sr
⁶ Qc
⁷ Gl
⁸ Al
⁹ Sc

SAMPLE SUMMARY

876412 L1541347-01 GW

Collected by

Collected date/time

Received date/time

09/29/22 12:15

09/30/22 10:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1936825	1	10/06/22 17:43	10/06/22 17:43	JHH	Mt. Juliet, TN

TRIP BLANK L1541347-02 GW

Collected by

Collected date/time

Received date/time

09/29/22 00:00

09/30/22 10:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1936825	1	10/06/22 11:03	10/06/22 11:03	JHH	Mt. Juliet, TN

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

CASE NARRATIVE

Unless qualified or notated within the narrative below, all sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



T. Alan Harvill
Project Manager

Project Comments

The requested project specific reporting limits may be less than laboratory standard quantitation limits (PQL) but will be greater than or equal to the laboratory method detection limits (MDL). It is noted that results reported below lab standard quantitation limits (PQLs) may result in false positive/false negative values that may require additional laboratory quality assurance review, if requested. Routine laboratory procedures do not initiate a data review process for detections below the laboratory's PQL unless requested by the client.

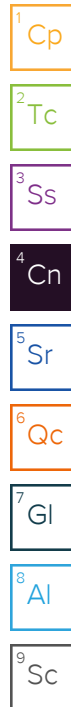
Volatile Organic Compounds (GC/MS) by Method 8260D

The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Data is likely to show a low bias concerning the result.

Batch	Lab Sample ID	Analytes
WG1936825	L1541347-01	1,2,3-Trichlorobenzene and 1,2,4-Trichlorobenzene
WG1936825	L1541347-02	1,2,3-Trichlorobenzene and 1,2,4-Trichlorobenzene

The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.

Batch	Lab Sample ID	Analytes
WG1936825	L1541347-01	Acetone and Tetrahydrofuran



876412

SAMPLE RESULTS - 01

Collected date/time: 09/29/22 12:15

L1541347

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
1,1,1,2-Tetrachloroethane	ND		1.00	1	10/06/2022 17:43	WG1936825
1,1,1-Trichloroethane	ND		1.00	1	10/06/2022 17:43	WG1936825
1,1,2,2-Tetrachloroethane	ND		1.00	1	10/06/2022 17:43	WG1936825
1,1-Dichloroethane	ND		1.00	1	10/06/2022 17:43	WG1936825
1,1-Dichloroethene	ND		1.00	1	10/06/2022 17:43	WG1936825
1,1-Dichloropropene	ND		1.00	1	10/06/2022 17:43	WG1936825
1,2,3-Trichlorobenzene	ND	C4	1.00	1	10/06/2022 17:43	WG1936825
1,2,3-Trichloropropane	ND		1.00	1	10/06/2022 17:43	WG1936825
1,2,4-Trichlorobenzene	ND	C4	1.00	1	10/06/2022 17:43	WG1936825
1,2,4-Trimethylbenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
1,2-Dibromo-3-Chloropropane	ND		1.00	1	10/06/2022 17:43	WG1936825
1,2-Dibromoethane	ND		1.00	1	10/06/2022 17:43	WG1936825
1,2-Dichlorobenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
1,2-Dichloroethane	ND		1.00	1	10/06/2022 17:43	WG1936825
1,2-Dichloropropane	ND		1.00	1	10/06/2022 17:43	WG1936825
1,3,5-Trimethylbenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
1,3-Dichlorobenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
1,3-Dichloropropane	ND		1.00	1	10/06/2022 17:43	WG1936825
1,4-Dichlorobenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
2,2-Dichloropropane	ND		1.00	1	10/06/2022 17:43	WG1936825
2-Butanone (MEK)	ND		10.0	1	10/06/2022 17:43	WG1936825
2-Chlorotoluene	ND		1.00	1	10/06/2022 17:43	WG1936825
4-Chlorotoluene	ND		1.00	1	10/06/2022 17:43	WG1936825
4-Methyl-2-pentanone (MIBK)	ND		5.00	1	10/06/2022 17:43	WG1936825
Acetone	ND	C3	10.0	1	10/06/2022 17:43	WG1936825
Allyl chloride	ND		1.00	1	10/06/2022 17:43	WG1936825
Benzene	ND		1.00	1	10/06/2022 17:43	WG1936825
Bromobenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
Bromochloromethane	ND		1.00	1	10/06/2022 17:43	WG1936825
Bromodichloromethane	ND		1.00	1	10/06/2022 17:43	WG1936825
Bromoform	ND		1.00	1	10/06/2022 17:43	WG1936825
Bromomethane	ND		1.00	1	10/06/2022 17:43	WG1936825
Carbon tetrachloride	ND		1.00	1	10/06/2022 17:43	WG1936825
Chlorobenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
Chlorodibromomethane	ND		1.00	1	10/06/2022 17:43	WG1936825
Chloroethane	ND		1.00	1	10/06/2022 17:43	WG1936825
Chloroform	ND		1.00	1	10/06/2022 17:43	WG1936825
Chloromethane	ND		1.00	1	10/06/2022 17:43	WG1936825
Dibromomethane	ND		1.00	1	10/06/2022 17:43	WG1936825
Dichlorodifluoromethane	ND		1.00	1	10/06/2022 17:43	WG1936825
Dichlorofluoromethane	ND		1.00	1	10/06/2022 17:43	WG1936825
Ethyl ether	ND		1.00	1	10/06/2022 17:43	WG1936825
Ethylbenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
Hexachloro-1,3-butadiene	ND		1.00	1	10/06/2022 17:43	WG1936825
Isopropylbenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
Methyl tert-butyl ether	ND		1.00	1	10/06/2022 17:43	WG1936825
Methylene Chloride	ND		1.00	1	10/06/2022 17:43	WG1936825
Naphthalene	ND		1.00	1	10/06/2022 17:43	WG1936825
Styrene	ND		1.00	1	10/06/2022 17:43	WG1936825
Tetrachloroethene	ND		1.00	1	10/06/2022 17:43	WG1936825
Tetrahydrofuran	ND	C3	5.00	1	10/06/2022 17:43	WG1936825
Toluene	ND		1.00	1	10/06/2022 17:43	WG1936825
Trichloroethene	ND		1.00	1	10/06/2022 17:43	WG1936825
Trichlorofluoromethane	ND		1.00	1	10/06/2022 17:43	WG1936825
Vinyl chloride	ND		1.00	1	10/06/2022 17:43	WG1936825
Xylenes, Total	ND		2.00	1	10/06/2022 17:43	WG1936825

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

ACCOUNT:

Elk River Landfill

PROJECT:

900

SDG:

L1541347

DATE/TIME:

10/07/22 13:04

PAGE:

5 of 15

876412

SAMPLE RESULTS - 01

Collected date/time: 09/29/22 12:15

L1541347

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
cis-1,2-Dichloroethene	ND		1.00	1	10/06/2022 17:43	WG1936825
cis-1,3-Dichloropropene	ND		1.00	1	10/06/2022 17:43	WG1936825
n-Butylbenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
n-Propylbenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
p-Isopropyltoluene	ND		1.00	1	10/06/2022 17:43	WG1936825
sec-Butylbenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
tert-Butylbenzene	ND		1.00	1	10/06/2022 17:43	WG1936825
trans-1,2-Dichloroethene	ND		1.00	1	10/06/2022 17:43	WG1936825
trans-1,3-Dichloropropene	ND		1.00	1	10/06/2022 17:43	WG1936825
(S) 4-Bromofluorobenzene	99.1			67.0-138	10/06/2022 17:43	WG1936825
(S) Toluene-d8	109			75.0-131	10/06/2022 17:43	WG1936825
(S) 1,2-Dichloroethane-d4	103			70.0-130	10/06/2022 17:43	WG1936825

¹Cp²Tc³Ss⁴Cn⁵Sr⁶Qc⁷Gl⁸Al⁹Sc

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
1,1,1,2-Tetrachloroethane	ND		1.00	1	10/06/2022 11:03	WG1936825
1,1,1-Trichloroethane	ND		1.00	1	10/06/2022 11:03	WG1936825
1,1,2,2-Tetrachloroethane	ND		1.00	1	10/06/2022 11:03	WG1936825
1,1-Dichloroethane	ND		1.00	1	10/06/2022 11:03	WG1936825
1,1-Dichloroethene	ND		1.00	1	10/06/2022 11:03	WG1936825
1,1-Dichloropropene	ND		1.00	1	10/06/2022 11:03	WG1936825
1,2,3-Trichlorobenzene	ND	C4	1.00	1	10/06/2022 11:03	WG1936825
1,2,3-Trichloropropane	ND		1.00	1	10/06/2022 11:03	WG1936825
1,2,4-Trichlorobenzene	ND	C4	1.00	1	10/06/2022 11:03	WG1936825
1,2,4-Trimethylbenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
1,2-Dibromo-3-Chloropropane	ND		1.00	1	10/06/2022 11:03	WG1936825
1,2-Dibromoethane	ND		1.00	1	10/06/2022 11:03	WG1936825
1,2-Dichlorobenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
1,2-Dichloroethane	ND		1.00	1	10/06/2022 11:03	WG1936825
1,2-Dichloropropane	ND		1.00	1	10/06/2022 11:03	WG1936825
1,3,5-Trimethylbenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
1,3-Dichlorobenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
1,3-Dichloropropane	ND		1.00	1	10/06/2022 11:03	WG1936825
1,4-Dichlorobenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
2,2-Dichloropropane	ND		1.00	1	10/06/2022 11:03	WG1936825
2-Butanone (MEK)	ND		10.0	1	10/06/2022 11:03	WG1936825
2-Chlorotoluene	ND		1.00	1	10/06/2022 11:03	WG1936825
4-Chlorotoluene	ND		1.00	1	10/06/2022 11:03	WG1936825
4-Methyl-2-pentanone (MIBK)	ND		5.00	1	10/06/2022 11:03	WG1936825
Acetone	ND		10.0	1	10/06/2022 11:03	WG1936825
Allyl chloride	ND		1.00	1	10/06/2022 11:03	WG1936825
Benzene	ND		1.00	1	10/06/2022 11:03	WG1936825
Bromobenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
Bromochloromethane	ND		1.00	1	10/06/2022 11:03	WG1936825
Bromodichloromethane	ND		1.00	1	10/06/2022 11:03	WG1936825
Bromoform	ND		1.00	1	10/06/2022 11:03	WG1936825
Bromomethane	ND		1.00	1	10/06/2022 11:03	WG1936825
Carbon tetrachloride	ND		1.00	1	10/06/2022 11:03	WG1936825
Chlorobenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
Chlorodibromomethane	ND		1.00	1	10/06/2022 11:03	WG1936825
Chloroethane	ND		1.00	1	10/06/2022 11:03	WG1936825
Chloroform	ND		1.00	1	10/06/2022 11:03	WG1936825
Chloromethane	ND		1.00	1	10/06/2022 11:03	WG1936825
Dibromomethane	ND		1.00	1	10/06/2022 11:03	WG1936825
Dichlorodifluoromethane	ND		1.00	1	10/06/2022 11:03	WG1936825
Dichlorofluoromethane	ND		1.00	1	10/06/2022 11:03	WG1936825
Ethyl ether	ND		1.00	1	10/06/2022 11:03	WG1936825
Ethylbenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
Hexachloro-1,3-butadiene	ND		1.00	1	10/06/2022 11:03	WG1936825
Isopropylbenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
Methyl tert-butyl ether	ND		1.00	1	10/06/2022 11:03	WG1936825
Methylene Chloride	ND		1.00	1	10/06/2022 11:03	WG1936825
Naphthalene	ND		1.00	1	10/06/2022 11:03	WG1936825
Styrene	ND		1.00	1	10/06/2022 11:03	WG1936825
Tetrachloroethene	ND		1.00	1	10/06/2022 11:03	WG1936825
Tetrahydrofuran	ND		5.00	1	10/06/2022 11:03	WG1936825
Toluene	ND		1.00	1	10/06/2022 11:03	WG1936825
Trichloroethene	ND		1.00	1	10/06/2022 11:03	WG1936825
Trichlorofluoromethane	ND		1.00	1	10/06/2022 11:03	WG1936825
Vinyl chloride	ND		1.00	1	10/06/2022 11:03	WG1936825
Xylenes, Total	ND		2.00	1	10/06/2022 11:03	WG1936825

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

TRIP BLANK

Collected date/time: 09/29/22 00:00

SAMPLE RESULTS - 02

L1541347

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
cis-1,2-Dichloroethene	ND		1.00	1	10/06/2022 11:03	WG1936825
cis-1,3-Dichloropropene	ND		1.00	1	10/06/2022 11:03	WG1936825
n-Butylbenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
n-Propylbenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
p-Isopropyltoluene	ND		1.00	1	10/06/2022 11:03	WG1936825
sec-Butylbenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
tert-Butylbenzene	ND		1.00	1	10/06/2022 11:03	WG1936825
trans-1,2-Dichloroethene	ND		1.00	1	10/06/2022 11:03	WG1936825
trans-1,3-Dichloropropene	ND		1.00	1	10/06/2022 11:03	WG1936825
(S) 4-Bromofluorobenzene	104			67.0-138	10/06/2022 11:03	WG1936825
(S) Toluene-d8	109			75.0-131	10/06/2022 11:03	WG1936825
(S) 1,2-Dichloroethane-d4	95.8			70.0-130	10/06/2022 11:03	WG1936825

¹Cp²Tc³Ss⁴Cn⁵Sr⁶Qc⁷Gl⁸Al⁹Sc

Method Blank (MB)

(MB) R3845747-3 10/06/22 10:06

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
1,1,1,2-Tetrachloroethane	ND		0.0379	0.100
1,1,1-Trichloroethane	ND		0.0369	0.100
1,1,2,2-Tetrachloroethane	ND		0.0278	0.100
1,1-Dichloroethane	ND		0.0196	0.100
1,1-Dichloroethene	ND		0.0242	0.100
1,1-Dichloropropene	ND		0.0324	0.100
1,2,3-Trichlorobenzene	ND		0.293	0.500
1,2,3-Trichloropropane	ND		0.0648	0.500
1,2,4-Trichlorobenzene	ND		0.176	0.500
1,2,4-Trimethylbenzene	ND		0.0632	0.200
1,2-Dibromo-3-Chloropropane	ND		0.156	1.00
1,2-Dibromoethane	ND		0.0259	0.100
1,2-Dichlorobenzene	ND		0.0170	0.200
1,2-Dichloroethane	ND		0.0260	0.100
1,2-Dichloropropane	ND		0.0568	0.200
1,3,5-Trimethylbenzene	ND		0.0800	0.200
1,3-Dichlorobenzene	ND		0.0240	0.200
1,3-Dichloropropane	ND		0.0200	0.200
1,4-Dichlorobenzene	ND		0.0280	0.200
2,2-Dichloropropane	ND		0.0552	0.100
2-Butanone (MEK)	ND		2.54	4.00
2-Chlorotoluene	ND		0.0346	0.100
4-Chlorotoluene	ND		0.0180	0.200
4-Methyl-2-pentanone (MIBK)	ND		0.0912	1.00
Acetone	ND		1.46	2.00
Allyl Chloride	ND		0.160	1.00
Benzene	ND		0.0187	0.0400
Bromobenzene	ND		0.0360	0.500
Bromochloromethane	ND		0.0226	0.200
Bromodichloromethane	ND		0.0290	0.100
Bromoform	ND		0.0468	1.00
Bromomethane	ND		0.0788	0.500
Carbon tetrachloride	ND		0.0359	0.200
Chlorobenzene	ND		0.00840	0.100
Chlorodibromomethane	ND		0.0245	0.100
Chloroethane	ND		0.0680	0.200
Chloroform	ND		0.0412	0.100
Chloromethane	ND		0.174	0.500
Dibromomethane	ND		0.0300	0.200
Dichlorodifluoromethane	ND		0.0644	0.100

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Method Blank (MB)

(MB) R3845747-3 10/06/22 10:06

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Dichlorofluoromethane	ND		0.0490	0.100
Ethyl ether	ND		0.0356	0.100
Ethylbenzene	ND		0.0295	0.100
Hexachloro-1,3-butadiene	ND		0.0485	1.00
Isopropylbenzene	ND		0.0170	0.100
Methyl tert-butyl ether	ND		0.0140	0.0400
Methylene Chloride	ND		0.266	1.00
Naphthalene	ND		0.195	0.500
Styrene	ND		0.00916	0.500
Tetrachloroethene	ND		0.0358	0.100
Tetrahydrofuran	ND		0.141	0.500
Toluene	ND		0.0520	0.200
Trichloroethene	ND		0.0234	0.0400
Trichlorofluoromethane	ND		0.0331	0.100
Vinyl chloride	ND		0.0462	0.0500
Xylenes, Total	ND		0.0352	0.260
cis-1,2-Dichloroethene	ND		0.0294	0.100
cis-1,3-Dichloropropene	ND		0.0303	0.100
n-Butylbenzene	ND		0.210	0.500
n-Propylbenzene	ND		0.0380	0.200
p-Isopropyltoluene	ND		0.102	0.200
sec-Butylbenzene	ND		0.115	0.500
tert-Butylbenzene	ND		0.0780	0.200
trans-1,2-Dichloroethene	ND		0.0416	0.200
trans-1,3-Dichloropropene	ND		0.0456	0.200
(S) 4-Bromofluorobenzene	105			67.0-138
(S) Toluene-d8	108			75.0-131
(S) 1,2-Dichloroethane-d4	97.4			70.0-130

¹Cp

²Tc

³Ss

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Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3845747-1 10/06/22 01:42 • (LCSD) R3845747-2 10/06/22 02:01

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
1,1,1,2-Tetrachloroethane	5.00	5.77	6.02	115	120	74.0-129			4.24	20
1,1,1-Trichloroethane	5.00	5.41	5.75	108	115	69.0-126			6.09	20
1,1,2,2-Tetrachloroethane	5.00	4.47	5.13	89.4	103	68.0-128			13.7	20
1,1-Dichloroethane	5.00	4.43	4.62	88.6	92.4	70.0-127			4.20	20
1,1-Dichloroethene	5.00	4.92	5.09	98.4	102	65.0-131			3.40	20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3845747-1 10/06/22 01:42 • (LCSD) R3845747-2 10/06/22 02:01

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	<u>LCS Qualifier</u>	<u>LCSD Qualifier</u>	RPD %	RPD Limits %
1,1-Dichloropropene	5.00	5.19	5.17	104	103	73.0-125			0.386	20
1,2,3-Trichlorobenzene	5.00	4.94	5.06	98.8	101	59.0-139			2.40	20
1,2,3-Trichloropropane	5.00	5.17	5.77	103	115	67.0-129			11.0	20
1,2,4-Trichlorobenzene	5.00	4.81	4.92	96.2	98.4	62.0-137			2.26	20
1,2,4-Trimethylbenzene	5.00	4.93	5.03	98.6	101	70.0-126			2.01	20
1,2-Dibromo-3-Chloropropane	5.00	5.32	6.04	106	121	59.0-130			12.7	20
1,2-Dibromoethane	5.00	5.78	5.86	116	117	74.0-128			1.37	20
1,2-Dichlorobenzene	5.00	5.18	5.30	104	106	76.0-124			2.29	20
1,2-Dichloroethane	5.00	4.47	4.49	89.4	89.8	65.0-131			0.446	20
1,2-Dichloropropane	5.00	4.84	5.00	96.8	100	74.0-125			3.25	20
1,3,5-Trimethylbenzene	5.00	4.79	5.19	95.8	104	73.0-127			8.02	20
1,3-Dichlorobenzene	5.00	5.07	5.10	101	102	76.0-125			0.590	20
1,3-Dichloropropane	5.00	5.39	5.39	108	108	80.0-125			0.000	20
1,4-Dichlorobenzene	5.00	4.87	5.21	97.4	104	77.0-121			6.75	20
2,2-Dichloropropane	5.00	5.40	5.24	108	105	59.0-135			3.01	20
2-Butanone (MEK)	25.0	24.8	26.2	99.2	105	30.0-160			5.49	24
2-Chlorotoluene	5.00	5.20	5.52	104	110	75.0-124			5.97	20
4-Chlorotoluene	5.00	4.32	4.73	86.4	94.6	75.0-124			9.06	20
4-Methyl-2-pentanone (MIBK)	25.0	26.7	27.7	107	111	56.0-143			3.68	20
Acetone	25.0	20.7	16.5	82.8	66.0	10.0-160			22.6	31
Allyl chloride	25.0	22.2	22.5	88.8	90.0	70.0-131			1.34	20
Benzene	5.00	4.63	4.77	92.6	95.4	70.0-123			2.98	20
Bromobenzene	5.00	5.35	5.91	107	118	73.0-121			9.95	20
Bromochloromethane	5.00	5.27	5.41	105	108	77.0-128			2.62	20
Bromodichloromethane	5.00	5.01	5.14	100	103	73.0-121			2.56	20
Bromoform	5.00	6.15	6.45	123	129	64.0-132			4.76	20
Bromomethane	5.00	5.25	5.35	105	107	56.0-147			1.89	20
Carbon tetrachloride	5.00	5.79	6.20	116	124	66.0-128			6.84	20
Chlorobenzene	5.00	5.22	5.46	104	109	76.0-128			4.49	20
Chlorodibromomethane	5.00	6.03	6.16	121	123	74.0-127			2.13	20
Chloroethane	5.00	5.99	5.87	120	117	61.0-134			2.02	20
Chloroform	5.00	4.47	4.70	89.4	94.0	72.0-123			5.02	20
Chloromethane	5.00	4.35	4.48	87.0	89.6	51.0-138			2.94	20
Dibromomethane	5.00	4.99	5.21	99.8	104	75.0-122			4.31	20
Dichlorodifluoromethane	5.00	4.00	3.93	80.0	78.6	43.0-156			1.77	20
Dichlorofluoromethane	5.00	5.25	5.29	105	106	65.0-137			0.759	20
Ethyl ether	5.00	4.66	4.56	93.2	91.2	64.0-137			2.17	20
Ethylbenzene	5.00	5.43	5.60	109	112	74.0-126			3.08	20
Hexachloro-1,3-butadiene	5.00	5.84	6.03	117	121	57.0-150			3.20	20
Isopropylbenzene	5.00	5.59	5.73	112	115	72.0-127			2.47	20

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3845747-1 10/06/22 01:42 • (LCSD) R3845747-2 10/06/22 02:01

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	<u>LCS Qualifier</u>	<u>LCSD Qualifier</u>	RPD %	RPD Limits %
Methyl tert-butyl ether	5.00	4.63	4.68	92.6	93.6	66.0-132			1.07	20
Methylene Chloride	5.00	4.47	4.35	89.4	87.0	68.0-123			2.72	20
Naphthalene	5.00	4.90	5.73	98.0	115	59.0-130			15.6	20
Styrene	5.00	5.24	5.23	105	105	72.0-127			0.191	20
Tetrachloroethene	5.00	6.74	6.81	135	136	70.0-136			1.03	20
Tetrahydrofuran	5.00	4.27	4.23	85.4	84.6	37.0-146			0.941	24
Toluene	5.00	5.05	5.20	101	104	75.0-121			2.93	20
Trichloroethene	5.00	5.88	5.90	118	118	76.0-126			0.340	20
Trichlorofluoromethane	5.00	4.85	5.11	97.0	102	61.0-142			5.22	20
Vinyl chloride	5.00	6.01	6.30	120	126	63.0-134			4.71	20
Xylenes, Total	15.0	16.5	16.7	110	111	72.0-127			1.20	20
cis-1,2-Dichloroethene	5.00	4.75	4.88	95.0	97.6	73.0-125			2.70	20
cis-1,3-Dichloropropene	5.00	5.06	5.09	101	102	76.0-127			0.591	20
n-Butylbenzene	5.00	4.59	4.69	91.8	93.8	68.0-135			2.16	20
n-Propylbenzene	5.00	4.49	5.00	89.8	100	74.0-126			10.7	20
p-Isopropyltoluene	5.00	4.71	4.98	94.2	99.6	72.0-133			5.57	20
sec-Butylbenzene	5.00	5.08	5.54	102	111	74.0-130			8.66	20
tert-Butylbenzene	5.00	6.02	5.71	120	114	75.0-127			5.29	20
trans-1,2-Dichloroethene	5.00	4.69	4.75	93.8	95.0	71.0-125			1.27	20
trans-1,3-Dichloropropene	5.00	5.25	5.51	105	110	73.0-127			4.83	20
(S) 4-Bromofluorobenzene				102	100	67.0-138				
(S) Toluene-d8				108	110	75.0-131				
(S) 1,2-Dichloroethane-d4				96.6	93.8	70.0-130				

¹Cp

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GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

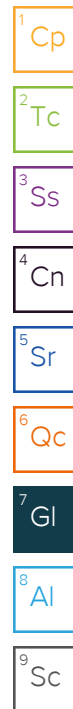
The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
C3	The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.
C4	The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Data is likely to show a low bias concerning the result.



ACCREDITATIONS & LOCATIONS

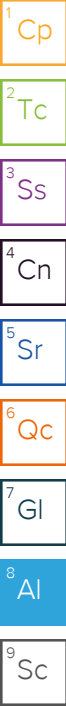
Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey--NELAP	TN002
California	2932	New Mexico ¹	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina ¹	DW21704
Georgia	NELAP	North Carolina ³	41
Georgia ¹	923	North Dakota	R-140
Idaho	TN00003	Ohio--VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LA000356
Kentucky ^{1 6}	KY90010	South Carolina	84004002
Kentucky ²	16	South Dakota	n/a
Louisiana	AI30792	Tennessee ^{1 4}	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas ⁵	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA -- ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA -- ISO 17025 ⁵	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA--Crypto	TN00003		

¹ Drinking Water ² Underground Storage Tanks ³ Aquatic Toxicity ⁴ Chemical/Microbiological ⁵ Mold ⁶ Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.



[illegible]



ANALYTICAL REPORT

December 22, 2022

Elk River Landfill

Sample Delivery Group: L1567589
Samples Received: 12/14/2022
Project Number: 900
Description: Elk River Landfill Residential Well
Site: MN02
Report To: Andrea Nord
4300 MarketPoint Drive Suite 200
Minneapolis, MN 55435

¹Cp

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Entire Report Reviewed By:

Stacy Kennedy
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.

Pace Analytical National

12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

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Cn: Case Narrative	4	
Sr: Sample Results	5	³ Ss
#876413 L1567589-01	5	⁴ Cn
Qc: Quality Control Summary	7	
Volatile Organic Compounds (GC/MS) by Method 8260D	7	⁵ Sr
Gl: Glossary of Terms	11	
Al: Accreditations & Locations	12	⁶ Qc
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		⁸ Al
		⁹ Sc

SAMPLE SUMMARY

#876413 L1567589-01 GW

Collected by
Kevin McGilp

Collected date/time
12/10/22 16:15

Received date/time
12/14/22 09:10

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1977432	1	12/21/22 14:59	12/21/22 14:59	JHH	Mt. Juliet, TN

¹Cp

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CASE NARRATIVE

Unless qualified or notated within the narrative below, all sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



Stacy Kennedy
Project Manager

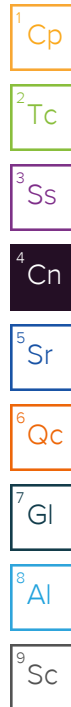
Project Comments

The requested project specific reporting limits may be less than laboratory standard quantitation limits (PQL) but will be greater than or equal to the laboratory method detection limits (MDL). It is noted that results reported below lab standard quantitation limits (PQLs) may result in false positive/false negative values that may require additional laboratory quality assurance review, if requested. Routine laboratory procedures do not initiate a data review process for detections below the laboratory's PQL unless requested by the client.

Volatile Organic Compounds (GC/MS) by Method 8260D

The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.

Batch	Lab Sample ID	Analytes
WG1977432	L1567589-01	1,1,2-Trichlorotrifluoroethane, Dichlorodifluoromethane and Trichlorofluoromethane



#876413

SAMPLE RESULTS - 01

Collected date/time: 12/10/22 16:15

L1567589

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
1,1,1,2-Tetrachloroethane	ND	C3	1.00	1	12/21/2022 14:59	WG1977432
1,1,1-Trichloroethane	ND		1.00	1	12/21/2022 14:59	WG1977432
1,1,2-Trichloroethane	ND		0.750	1	12/21/2022 14:59	WG1977432
1,1,2-Trichlorotrifluoroethane	ND	C3	1.00	1	12/21/2022 14:59	WG1977432
1,1,2,2-Tetrachloroethane	ND		1.00	1	12/21/2022 14:59	WG1977432
1,1-Dichloroethane	ND		1.00	1	12/21/2022 14:59	WG1977432
1,1-Dichloroethene	ND		1.00	1	12/21/2022 14:59	WG1977432
1,1-Dichloropropene	ND		1.00	1	12/21/2022 14:59	WG1977432
1,2,3-Trichlorobenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
1,2,3-Trichloropropane	ND		1.00	1	12/21/2022 14:59	WG1977432
1,2,4-Trichlorobenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
1,2,4-Trimethylbenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
1,2-Dibromo-3-Chloropropane	ND		1.00	1	12/21/2022 14:59	WG1977432
1,2-Dibromoethane	ND		1.00	1	12/21/2022 14:59	WG1977432
1,2-Dichlorobenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
1,2-Dichloroethane	ND		1.00	1	12/21/2022 14:59	WG1977432
1,2-Dichloropropane	ND		1.00	1	12/21/2022 14:59	WG1977432
1,3,5-Trimethylbenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
1,3-Dichlorobenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
1,3-Dichloropropane	ND		1.00	1	12/21/2022 14:59	WG1977432
1,4-Dichlorobenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
2,2-Dichloropropane	ND		1.00	1	12/21/2022 14:59	WG1977432
2-Butanone (MEK)	ND		10.0	1	12/21/2022 14:59	WG1977432
2-Chlorotoluene	ND		1.00	1	12/21/2022 14:59	WG1977432
4-Chlorotoluene	ND		1.00	1	12/21/2022 14:59	WG1977432
4-Methyl-2-pentanone (MIBK)	ND		5.00	1	12/21/2022 14:59	WG1977432
Acetone	ND		10.0	1	12/21/2022 14:59	WG1977432
Allyl chloride	ND		1.00	1	12/21/2022 14:59	WG1977432
Benzene	ND		1.00	1	12/21/2022 14:59	WG1977432
Bromobenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
Bromochloromethane	ND		1.00	1	12/21/2022 14:59	WG1977432
Bromodichloromethane	ND		1.00	1	12/21/2022 14:59	WG1977432
Bromoform	ND		1.00	1	12/21/2022 14:59	WG1977432
Bromomethane	ND		1.00	1	12/21/2022 14:59	WG1977432
Carbon tetrachloride	ND		1.00	1	12/21/2022 14:59	WG1977432
Chlorobenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
Chlorodibromomethane	ND		1.00	1	12/21/2022 14:59	WG1977432
Chloroethane	ND		1.00	1	12/21/2022 14:59	WG1977432
Chloroform	ND		1.00	1	12/21/2022 14:59	WG1977432
Chloromethane	ND		1.00	1	12/21/2022 14:59	WG1977432
Dibromomethane	ND		1.00	1	12/21/2022 14:59	WG1977432
Dichlorodifluoromethane	ND	C3	1.00	1	12/21/2022 14:59	WG1977432
Dichlorofluoromethane	ND		1.00	1	12/21/2022 14:59	WG1977432
Ethyl ether	ND		1.00	1	12/21/2022 14:59	WG1977432
Ethylbenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
Hexachloro-1,3-butadiene	ND		1.00	1	12/21/2022 14:59	WG1977432
Isopropylbenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
Methyl tert-butyl ether	ND		1.00	1	12/21/2022 14:59	WG1977432
Methylene Chloride	ND		1.00	1	12/21/2022 14:59	WG1977432
Naphthalene	ND		1.00	1	12/21/2022 14:59	WG1977432
Styrene	ND		1.00	1	12/21/2022 14:59	WG1977432
Tetrachloroethene	ND		1.00	1	12/21/2022 14:59	WG1977432
Tetrahydrofuran	ND		5.00	1	12/21/2022 14:59	WG1977432
Toluene	ND		1.00	1	12/21/2022 14:59	WG1977432
Trichloroethene	ND		1.00	1	12/21/2022 14:59	WG1977432
Trichlorofluoromethane	ND	C3	1.00	1	12/21/2022 14:59	WG1977432

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

ACCOUNT:

Elk River Landfill

PROJECT:

900

SDG:

L1567589

DATE/TIME:

12/22/22 17:06

PAGE:

5 of 13

#876413

SAMPLE RESULTS - 01

Collected date/time: 12/10/22 16:15

L1567589

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
Vinyl chloride	ND		1.00	1	12/21/2022 14:59	WG1977432
Xylenes, Total	ND		2.00	1	12/21/2022 14:59	WG1977432
cis-1,2-Dichloroethene	ND		1.00	1	12/21/2022 14:59	WG1977432
cis-1,3-Dichloropropene	ND		1.00	1	12/21/2022 14:59	WG1977432
n-Butylbenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
n-Propylbenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
p-Isopropyltoluene	ND		1.00	1	12/21/2022 14:59	WG1977432
sec-Butylbenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
tert-Butylbenzene	ND		1.00	1	12/21/2022 14:59	WG1977432
trans-1,2-Dichloroethene	ND		1.00	1	12/21/2022 14:59	WG1977432
trans-1,3-Dichloropropene	ND		1.00	1	12/21/2022 14:59	WG1977432
(S) 4-Bromofluorobenzene	102			67.0-138	12/21/2022 14:59	WG1977432
(S) Toluene-d8	98.5			75.0-131	12/21/2022 14:59	WG1977432
(S) 1,2-Dichloroethane-d4	96.3			70.0-130	12/21/2022 14:59	WG1977432

¹Cp²Tc³Ss⁴Cn⁵Sr⁶Qc⁷Gl⁸Al⁹Sc

Method Blank (MB)

(MB) R3874556-2 12/21/22 14:11

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
1,1,1,2-Tetrachloroethane	ND		0.0379	0.100
1,1,1-Trichloroethane	ND		0.0369	0.100
1,1,2-Trichloroethane	ND		0.0239	0.100
1,1,2-Trichlorotrifluoroethane	ND		0.0302	0.100
1,1,2,2-Tetrachloroethane	ND		0.0278	0.100
1,1-Dichloroethane	ND		0.0196	0.100
1,1-Dichloroethene	ND		0.0242	0.100
1,1-Dichloropropene	ND		0.0324	0.100
1,2,3-Trichlorobenzene	ND		0.293	0.500
1,2,3-Trichloropropane	ND		0.0648	0.500
1,2,4-Trichlorobenzene	ND		0.176	0.500
1,2,4-Trimethylbenzene	ND		0.0632	0.200
1,2-Dibromo-3-Chloropropane	ND		0.156	1.00
1,2-Dibromoethane	ND		0.0259	0.100
1,2-Dichlorobenzene	ND		0.0170	0.200
1,2-Dichloroethane	ND		0.0260	0.100
1,2-Dichloropropane	ND		0.0568	0.200
1,3,5-Trimethylbenzene	ND		0.0800	0.200
1,3-Dichlorobenzene	ND		0.0240	0.200
1,3-Dichloropropane	ND		0.0200	0.200
1,4-Dichlorobenzene	ND		0.0280	0.200
2,2-Dichloropropane	ND		0.0552	0.100
2-Butanone (MEK)	ND		2.54	4.00
2-Chlorotoluene	ND		0.0346	0.100
4-Chlorotoluene	ND		0.0180	0.200
4-Methyl-2-pentanone (MIBK)	ND		0.0912	1.00
Acetone	ND		1.46	2.00
Allyl Chloride	ND		0.160	1.00
Benzene	ND		0.0187	0.0400
Bromobenzene	ND		0.0360	0.500
Bromochloromethane	ND		0.0226	0.200
Bromodichloromethane	ND		0.0290	0.100
Bromoform	ND		0.0468	1.00
Bromomethane	ND		0.0788	0.500
Carbon tetrachloride	ND		0.0359	0.200
Chlorobenzene	ND		0.00840	0.100
Chlorodibromomethane	ND		0.0245	0.100
Chloroethane	ND		0.0680	0.200
Chloroform	ND		0.0412	0.100
Chloromethane	ND		0.174	0.500

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

Method Blank (MB)

(MB) R3874556-2 12/21/22 14:11

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Dibromomethane	ND		0.0300	0.200
Dichlorodifluoromethane	ND		0.0644	0.100
Dichlorofluoromethane	ND		0.0490	0.100
Ethyl ether	ND		0.0356	0.100
Ethylbenzene	ND		0.0295	0.100
Hexachloro-1,3-butadiene	ND		0.0485	1.00
Isopropylbenzene	ND		0.0170	0.100
Methyl tert-butyl ether	ND		0.0140	0.0400
Methylene Chloride	ND		0.266	1.00
Naphthalene	ND		0.195	0.500
Styrene	0.0110		0.00916	0.500
Tetrachloroethene	ND		0.0358	0.100
Tetrahydrofuran	0.334	U	0.141	0.500
Toluene	ND		0.0520	0.200
Trichloroethene	ND		0.0234	0.0400
Trichlorofluoromethane	ND		0.0331	0.100
Vinyl chloride	ND		0.0462	0.0500
Xylenes, Total	ND		0.0352	0.260
cis-1,2-Dichloroethene	ND		0.0294	0.100
cis-1,3-Dichloropropene	ND		0.0303	0.100
n-Butylbenzene	ND		0.210	0.500
n-Propylbenzene	ND		0.0380	0.200
p-Isopropyltoluene	ND		0.102	0.200
sec-Butylbenzene	ND		0.115	0.500
tert-Butylbenzene	ND		0.0780	0.200
trans-1,2-Dichloroethene	ND		0.0416	0.200
trans-1,3-Dichloropropene	ND		0.0456	0.200
(S) 4-Bromofluorobenzene	102			67.0-138
(S) Toluene-d8	99.7			75.0-131
(S) 1,2-Dichloroethane-d4	95.4			70.0-130

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

Laboratory Control Sample (LCS)

(LCS) R3874556-1 12/21/22 11:18

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
1,1,1,2-Tetrachloroethane	5.00	5.69	114	74.0-129	
1,1,1-Trichloroethane	5.00	5.59	112	69.0-126	
1,1,2-Trichloroethane	5.00	5.60	112	78.0-123	

Laboratory Control Sample (LCS)

(LCS) R3874556-1 12/21/22 11:18

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	<u>LCS Qualifier</u>
1,1,2-Trichlorotrifluoroethane	5.00	3.73	74.6	61.0-139	
1,1,2,2-Tetrachloroethane	5.00	5.37	107	68.0-128	
1,1-Dichloroethane	5.00	5.69	114	70.0-127	
1,1-Dichloroethene	5.00	4.96	99.2	65.0-131	
1,1-Dichloropropene	5.00	5.15	103	73.0-125	
1,2,3-Trichlorobenzene	5.00	5.42	108	59.0-139	
1,2,3-Trichloropropane	5.00	5.65	113	67.0-129	
1,2,4-Trichlorobenzene	5.00	5.84	117	62.0-137	
1,2,4-Trimethylbenzene	5.00	5.51	110	70.0-126	
1,2-Dibromo-3-Chloropropane	5.00	4.92	98.4	59.0-130	
1,2-Dibromoethane	5.00	5.39	108	74.0-128	
1,2-Dichlorobenzene	5.00	5.74	115	76.0-124	
1,2-Dichloroethane	5.00	4.95	99.0	65.0-131	
1,2-Dichloropropane	5.00	5.63	113	74.0-125	
1,3,5-Trimethylbenzene	5.00	5.58	112	73.0-127	
1,3-Dichlorobenzene	5.00	5.80	116	76.0-125	
1,3-Dichloropropane	5.00	5.49	110	80.0-125	
1,4-Dichlorobenzene	5.00	5.44	109	77.0-121	
2,2-Dichloropropane	5.00	4.95	99.0	59.0-135	
2-Butanone (MEK)	25.0	25.1	100	30.0-160	
2-Chlorotoluene	5.00	5.25	105	75.0-124	
4-Chlorotoluene	5.00	4.13	82.6	75.0-124	
4-Methyl-2-pentanone (MIBK)	25.0	27.2	109	56.0-143	
Acetone	25.0	26.9	108	10.0-160	
Allyl chloride	25.0	27.6	110	70.0-131	
Benzene	5.00	5.29	106	70.0-123	
Bromobenzene	5.00	5.54	111	73.0-121	
Bromochloromethane	5.00	5.89	118	77.0-128	
Bromodichloromethane	5.00	5.54	111	73.0-121	
Bromoform	5.00	5.62	112	64.0-132	
Bromomethane	5.00	4.05	81.0	56.0-147	
Carbon tetrachloride	5.00	5.13	103	66.0-128	
Chlorobenzene	5.00	5.59	112	76.0-128	
Chlorodibromomethane	5.00	5.78	116	74.0-127	
Chloroethane	5.00	4.41	88.2	61.0-134	
Chloroform	5.00	5.55	111	72.0-123	
Chloromethane	5.00	4.77	95.4	51.0-138	
Dibromomethane	5.00	5.32	106	75.0-122	
Dichlorodifluoromethane	5.00	3.26	65.2	43.0-156	
Dichlorofluoromethane	5.00	5.93	119	65.0-137	

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Laboratory Control Sample (LCS)

(LCS) R3874556-1 12/21/22 11:18

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	<u>LCS Qualifier</u>
Ethyl ether	5.00	5.68	114	64.0-137	
Ethylbenzene	5.00	5.69	114	74.0-126	
Hexachloro-1,3-butadiene	5.00	6.09	122	57.0-150	
Isopropylbenzene	5.00	5.82	116	72.0-127	
Methyl tert-butyl ether	5.00	6.01	120	66.0-132	
Methylene Chloride	5.00	5.37	107	68.0-123	
Naphthalene	5.00	5.13	103	59.0-130	
Styrene	5.00	5.70	114	72.0-127	
Tetrachloroethene	5.00	5.39	108	70.0-136	
Tetrahydrofuran	5.00	5.31	106	37.0-146	
Toluene	5.00	5.48	110	75.0-121	
Trichloroethene	5.00	5.48	110	76.0-126	
Trichlorofluoromethane	5.00	3.96	79.2	61.0-142	
Vinyl chloride	5.00	4.89	97.8	63.0-134	
Xylenes, Total	15.0	17.3	115	72.0-127	
cis-1,2-Dichloroethene	5.00	5.56	111	73.0-125	
cis-1,3-Dichloropropene	5.00	5.52	110	76.0-127	
n-Butylbenzene	5.00	5.34	107	68.0-135	
n-Propylbenzene	5.00	5.35	107	74.0-126	
p-Isopropyltoluene	5.00	5.38	108	72.0-133	
sec-Butylbenzene	5.00	5.37	107	74.0-130	
tert-Butylbenzene	5.00	5.55	111	75.0-127	
trans-1,2-Dichloroethene	5.00	5.45	109	71.0-125	
trans-1,3-Dichloropropene	5.00	5.68	114	73.0-127	
(S) 4-Bromofluorobenzene			98.5	67.0-138	
(S) Toluene-d8			98.7	75.0-131	
(S) 1,2-Dichloroethane-d4			91.7	70.0-130	

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

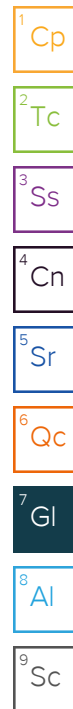
The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
C3	The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.
J	The identification of the analyte is acceptable; the reported value is an estimate.



ACCREDITATIONS & LOCATIONS

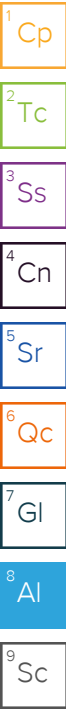
Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey--NELAP	TN002
California	2932	New Mexico ¹	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina ¹	DW21704
Georgia	NELAP	North Carolina ³	41
Georgia ¹	923	North Dakota	R-140
Idaho	TN00003	Ohio--VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LA000356
Kentucky ^{1 6}	KY90010	South Carolina	84004002
Kentucky ²	16	South Dakota	n/a
Louisiana	AI30792	Tennessee ^{1 4}	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas ⁵	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA -- ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA -- ISO 17025 ⁵	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA--Crypto	TN00003		

¹ Drinking Water ² Underground Storage Tanks ³ Aquatic Toxicity ⁴ Chemical/Microbiological ⁵ Mold ⁶ Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.



Company Name/Address: Elk River Landfill 4300 MarketPoint Drive Suite 200 Minneapolis, MN 55435				Billing Information: Accounts Payable / mkostrze@wm.com P.O. Box 4745 Portland, OR 97208-4745				Pres Chk			
Report to: Andrea Nord				Email To: anord@barr.com; datamgt@barr.com; jeibems@b							
Project Description: Elk River Landfill Residential Well				City/State Collected:				Please Circle: PT MT CT ET			
Phone: 952-832-2893		Client Project # 900		Lab Project # WMELKRIVMN-RESIDENT							
Collected by (print): <i>Kevin McGrip</i>		Site/Facility ID # MN02		P.O. #							
Collected by (signature): <i>[Signature]</i>		Rush? (Lab MUST Be Notified) ☐ Same Day ☒ Five Day ☐ Next Day ☐ 5 Day (Rad Only) ☐ Two Day ☐ 10 Day (Rad Only)		Quote #							
Immediately Packed on Ice N ___ Y ☒				Date Results Needed							
Sample ID	Camp/Grab	Matrix *	Depth	Date	Time	No. of Entrs					
#876413	grab	GW	/	12.10.22	16:15	3	X				
(AAA)		GW				1	X				

* Matrix: SS - Soil AIR - Air F - Filter GW - Groundwater B - Biossay WW - Waste Water DW - Drinking Water OT - Other _____				Remarks: 22272 Quinn St. pH ____ Temp ____ Flow ____ Other ____				Sample Receipt Checklist COC Seal Present/Intact: ☒ COC Signed/Accurate: ☒ Bottles arrive intact: ☒ Correct bottles used: ☒ Sufficient volume sent: ☒ IF Applicable: VOA Seal Headspace: ☒ Preservation Correct/Checked: ☒ RAD Screen <0.1 mB/hr: ☒			
Samples returned via: UPS ☒ FedEx _____ Courier _____				Tracking # 5882 7541 8719							
Relinquished by: (Signature) <i>[Signature]</i>		Date: 12.12.22		Time: 10:00		Received by: (Signature) <i>[Signature]</i>		Trip Blank Received: Yes/ ☒ HD./Main TBR		Temp NEPTOC Bottles Received 1.8 3	
Relinquished by: (Signature)		Date:		Time:		Received by: (Signature)		If preservation required by Login Date/Time			
Relinquished by: (Signature)		Date:		Time:		Decided for labby: (Signature) <i>[Signature]</i>		Date: 12/14/22		Time: 0910	
Hold:				Condition: NCF 1 OK							



ANALYTICAL REPORT

December 23, 2022

Revised Report

Elk River Landfill

Sample Delivery Group: L1568315
Samples Received: 12/16/2022
Project Number: 900
Description: Elk River Landfill Residential Well
Site: MN02
Report To: Andrea Nord
4300 MarketPoint Drive Suite 200
Minneapolis, MN 55435

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Entire Report Reviewed By:

Stacy Kennedy
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.

Pace Analytical National

12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

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SAMPLE SUMMARY

876414 L1568315-01 GW

Collected by
Dean Myers

Collected date/time
12/14/22 15:45

Received date/time
12/16/22 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1976062	1	12/19/22 17:56	12/19/22 17:56	GLN	Mt. Juliet, TN

TRIP BLANK L1568315-02 GW

Collected by
Dean Myers

Collected date/time
12/14/22 00:00

Received date/time
12/16/22 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (GC/MS) by Method 8260D	WG1976062	1	12/19/22 13:38	12/19/22 13:38	GLN	Mt. Juliet, TN

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

CASE NARRATIVE

Unless qualified or notated within the narrative below, all sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



Stacy Kennedy
Project Manager

Report Revision History

Level II Report - Version 1: 12/20/22 11:51

Project Comments

Report reissued to adjust project specific compound list. SK 12/22/22

The requested project specific reporting limits may be less than laboratory standard quantitation limits (PQL) but will be greater than or equal to the laboratory method detection limits (MDL). It is noted that results reported below lab standard quantitation limits (PQLs) may result in false positive/false negative values that may require additional laboratory quality assurance review, if requested. Routine laboratory procedures do not initiate a data review process for detections below the laboratory's PQL unless requested by the client.

Sample Delivery Group (SDG) Narrative

Analyzed from headspace vial.

Batch	Method	Lab Sample ID
WG1976062	8260D	L1568315-02

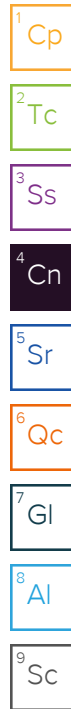
Volatile Organic Compounds (GC/MS) by Method 8260D

The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.

Batch	Lab Sample ID	Analytes
WG1976062	L1568315-01	1,2,3-Trichlorobenzene, 1,2,4-Trichlorobenzene, Bromomethane and Naphthalene
WG1976062	L1568315-02	1,2,3-Trichlorobenzene, 1,2,4-Trichlorobenzene, Bromomethane and Naphthalene

The associated batch QC was outside the established quality control range for precision.

Batch	Lab Sample ID	Analytes
WG1976062	(LCSD) R3873714-2, L1568315-01, 02	Dichlorofluoromethane



876414

SAMPLE RESULTS - 01

Collected date/time: 12/14/22 15:45

L1568315

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
1,1,1,2-Tetrachloroethane	ND		1.00	1	12/19/2022 17:56	WG1976062
1,1,1-Trichloroethane	ND		1.00	1	12/19/2022 17:56	WG1976062
1,1,2-Trichloroethane	ND		0.750	1	12/19/2022 17:56	WG1976062
1,1,2-Trichlorotrifluoroethane	ND		1.00	1	12/19/2022 17:56	WG1976062
1,1,2,2-Tetrachloroethane	ND		1.00	1	12/19/2022 17:56	WG1976062
1,1-Dichloroethane	ND		1.00	1	12/19/2022 17:56	WG1976062
1,1-Dichloroethene	ND		1.00	1	12/19/2022 17:56	WG1976062
1,1-Dichloropropene	ND		1.00	1	12/19/2022 17:56	WG1976062
1,2,3-Trichlorobenzene	ND	C3	1.00	1	12/19/2022 17:56	WG1976062
1,2,3-Trichloropropane	ND		1.00	1	12/19/2022 17:56	WG1976062
1,2,4-Trichlorobenzene	ND	C3	1.00	1	12/19/2022 17:56	WG1976062
1,2,4-Trimethylbenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
1,2-Dibromo-3-Chloropropane	ND		1.00	1	12/19/2022 17:56	WG1976062
1,2-Dibromoethane	ND		1.00	1	12/19/2022 17:56	WG1976062
1,2-Dichlorobenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
1,2-Dichloroethane	ND		1.00	1	12/19/2022 17:56	WG1976062
1,2-Dichloropropane	ND		1.00	1	12/19/2022 17:56	WG1976062
1,3,5-Trimethylbenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
1,3-Dichlorobenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
1,3-Dichloropropane	ND		1.00	1	12/19/2022 17:56	WG1976062
1,4-Dichlorobenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
2,2-Dichloropropane	ND		1.00	1	12/19/2022 17:56	WG1976062
2-Butanone (MEK)	ND		10.0	1	12/19/2022 17:56	WG1976062
2-Chlorotoluene	ND		1.00	1	12/19/2022 17:56	WG1976062
4-Chlorotoluene	ND		1.00	1	12/19/2022 17:56	WG1976062
4-Methyl-2-pentanone (MIBK)	ND		5.00	1	12/19/2022 17:56	WG1976062
Acetone	ND		10.0	1	12/19/2022 17:56	WG1976062
Allyl chloride	ND		1.00	1	12/19/2022 17:56	WG1976062
Benzene	ND		1.00	1	12/19/2022 17:56	WG1976062
Bromobenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
Bromochloromethane	ND		1.00	1	12/19/2022 17:56	WG1976062
Bromodichloromethane	ND		1.00	1	12/19/2022 17:56	WG1976062
Bromoform	ND		1.00	1	12/19/2022 17:56	WG1976062
Bromomethane	ND	C3	1.00	1	12/19/2022 17:56	WG1976062
Carbon tetrachloride	ND		1.00	1	12/19/2022 17:56	WG1976062
Chlorobenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
Chlorodibromomethane	ND		1.00	1	12/19/2022 17:56	WG1976062
Chloroethane	ND		1.00	1	12/19/2022 17:56	WG1976062
Chloroform	ND		1.00	1	12/19/2022 17:56	WG1976062
Chloromethane	ND		1.00	1	12/19/2022 17:56	WG1976062
Dibromomethane	ND		1.00	1	12/19/2022 17:56	WG1976062
Dichlorodifluoromethane	ND		1.00	1	12/19/2022 17:56	WG1976062
Dichlorofluoromethane	ND	J3	1.00	1	12/19/2022 17:56	WG1976062
Ethyl ether	ND		1.00	1	12/19/2022 17:56	WG1976062
Ethylbenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
Hexachloro-1,3-butadiene	ND		1.00	1	12/19/2022 17:56	WG1976062
Isopropylbenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
Methyl tert-butyl ether	ND		1.00	1	12/19/2022 17:56	WG1976062
Methylene Chloride	ND		1.00	1	12/19/2022 17:56	WG1976062
Naphthalene	ND	C3	1.00	1	12/19/2022 17:56	WG1976062
Styrene	ND		1.00	1	12/19/2022 17:56	WG1976062
Tetrachloroethene	ND		1.00	1	12/19/2022 17:56	WG1976062
Tetrahydrofuran	ND		5.00	1	12/19/2022 17:56	WG1976062
Toluene	ND		1.00	1	12/19/2022 17:56	WG1976062
Trichloroethene	ND		1.00	1	12/19/2022 17:56	WG1976062
Trichlorofluoromethane	ND		1.00	1	12/19/2022 17:56	WG1976062

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

876414

SAMPLE RESULTS - 01

Collected date/time: 12/14/22 15:45

L1568315

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
Vinyl chloride	ND		1.00	1	12/19/2022 17:56	WG1976062
Xylenes, Total	ND		2.00	1	12/19/2022 17:56	WG1976062
cis-1,2-Dichloroethene	ND		1.00	1	12/19/2022 17:56	WG1976062
cis-1,3-Dichloropropene	ND		1.00	1	12/19/2022 17:56	WG1976062
n-Butylbenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
n-Propylbenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
p-Isopropyltoluene	ND		1.00	1	12/19/2022 17:56	WG1976062
sec-Butylbenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
tert-Butylbenzene	ND		1.00	1	12/19/2022 17:56	WG1976062
trans-1,2-Dichloroethene	ND		1.00	1	12/19/2022 17:56	WG1976062
trans-1,3-Dichloropropene	ND		1.00	1	12/19/2022 17:56	WG1976062
(S) 4-Bromofluorobenzene	79.9			67.0-138	12/19/2022 17:56	WG1976062
(S) Toluene-d8	95.5			75.0-131	12/19/2022 17:56	WG1976062
(S) 1,2-Dichloroethane-d4	94.9			70.0-130	12/19/2022 17:56	WG1976062

¹Cp²Tc³Ss⁴Cn⁵Sr⁶Qc⁷Gl⁸Al⁹Sc

TRIP BLANK

Collected date/time: 12/14/22 00:00

SAMPLE RESULTS - 02

L1568315

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
1,1,1,2-Tetrachloroethane	ND		1.00	1	12/19/2022 13:38	WG1976062
1,1,1-Trichloroethane	ND		1.00	1	12/19/2022 13:38	WG1976062
1,1,2-Trichloroethane	ND		0.750	1	12/19/2022 13:38	WG1976062
1,1,2-Trichlorotrifluoroethane	ND		1.00	1	12/19/2022 13:38	WG1976062
1,1,2,2-Tetrachloroethane	ND		1.00	1	12/19/2022 13:38	WG1976062
1,1-Dichloroethane	ND		1.00	1	12/19/2022 13:38	WG1976062
1,1-Dichloroethene	ND		1.00	1	12/19/2022 13:38	WG1976062
1,1-Dichloropropene	ND		1.00	1	12/19/2022 13:38	WG1976062
1,2,3-Trichlorobenzene	ND	C3	1.00	1	12/19/2022 13:38	WG1976062
1,2,3-Trichloropropane	ND		1.00	1	12/19/2022 13:38	WG1976062
1,2,4-Trichlorobenzene	ND	C3	1.00	1	12/19/2022 13:38	WG1976062
1,2,4-Trimethylbenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
1,2-Dibromo-3-Chloropropane	ND		1.00	1	12/19/2022 13:38	WG1976062
1,2-Dibromoethane	ND		1.00	1	12/19/2022 13:38	WG1976062
1,2-Dichlorobenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
1,2-Dichloroethane	ND		1.00	1	12/19/2022 13:38	WG1976062
1,2-Dichloropropane	ND		1.00	1	12/19/2022 13:38	WG1976062
1,3,5-Trimethylbenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
1,3-Dichlorobenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
1,3-Dichloropropane	ND		1.00	1	12/19/2022 13:38	WG1976062
1,4-Dichlorobenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
2,2-Dichloropropane	ND		1.00	1	12/19/2022 13:38	WG1976062
2-Butanone (MEK)	ND		10.0	1	12/19/2022 13:38	WG1976062
2-Chlorotoluene	ND		1.00	1	12/19/2022 13:38	WG1976062
4-Chlorotoluene	ND		1.00	1	12/19/2022 13:38	WG1976062
4-Methyl-2-pentanone (MIBK)	ND		5.00	1	12/19/2022 13:38	WG1976062
Acetone	ND		10.0	1	12/19/2022 13:38	WG1976062
Allyl chloride	ND		1.00	1	12/19/2022 13:38	WG1976062
Benzene	ND		1.00	1	12/19/2022 13:38	WG1976062
Bromobenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
Bromochloromethane	ND		1.00	1	12/19/2022 13:38	WG1976062
Bromodichloromethane	ND		1.00	1	12/19/2022 13:38	WG1976062
Bromoform	ND		1.00	1	12/19/2022 13:38	WG1976062
Bromomethane	ND	C3	1.00	1	12/19/2022 13:38	WG1976062
Carbon tetrachloride	ND		1.00	1	12/19/2022 13:38	WG1976062
Chlorobenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
Chlorodibromomethane	ND		1.00	1	12/19/2022 13:38	WG1976062
Chloroethane	ND		1.00	1	12/19/2022 13:38	WG1976062
Chloroform	ND		1.00	1	12/19/2022 13:38	WG1976062
Chloromethane	ND		1.00	1	12/19/2022 13:38	WG1976062
Dibromomethane	ND		1.00	1	12/19/2022 13:38	WG1976062
Dichlorodifluoromethane	ND		1.00	1	12/19/2022 13:38	WG1976062
Dichlorofluoromethane	ND	J3	1.00	1	12/19/2022 13:38	WG1976062
Ethyl ether	ND		1.00	1	12/19/2022 13:38	WG1976062
Ethylbenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
Hexachloro-1,3-butadiene	ND		1.00	1	12/19/2022 13:38	WG1976062
Isopropylbenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
Methyl tert-butyl ether	ND		1.00	1	12/19/2022 13:38	WG1976062
Methylene Chloride	ND		1.00	1	12/19/2022 13:38	WG1976062
Naphthalene	ND	C3	1.00	1	12/19/2022 13:38	WG1976062
Styrene	ND		1.00	1	12/19/2022 13:38	WG1976062
Tetrachloroethene	ND		1.00	1	12/19/2022 13:38	WG1976062
Tetrahydrofuran	ND		5.00	1	12/19/2022 13:38	WG1976062
Toluene	ND		1.00	1	12/19/2022 13:38	WG1976062
Trichloroethene	ND		1.00	1	12/19/2022 13:38	WG1976062
Trichlorofluoromethane	ND		1.00	1	12/19/2022 13:38	WG1976062

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

ACCOUNT:

Elk River Landfill

PROJECT:

900

SDG:

L1568315

DATE/TIME:

12/23/22 13:36

PAGE:

7 of 15

TRIP BLANK

Collected date/time: 12/14/22 00:00

SAMPLE RESULTS - 02

L1568315

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	RL ug/l	Dilution	Analysis date / time	Batch
Vinyl chloride	ND		1.00	1	12/19/2022 13:38	WG1976062
Xylenes, Total	ND		2.00	1	12/19/2022 13:38	WG1976062
cis-1,2-Dichloroethene	ND		1.00	1	12/19/2022 13:38	WG1976062
cis-1,3-Dichloropropene	ND		1.00	1	12/19/2022 13:38	WG1976062
n-Butylbenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
n-Propylbenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
p-Isopropyltoluene	ND		1.00	1	12/19/2022 13:38	WG1976062
sec-Butylbenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
tert-Butylbenzene	ND		1.00	1	12/19/2022 13:38	WG1976062
trans-1,2-Dichloroethene	ND		1.00	1	12/19/2022 13:38	WG1976062
trans-1,3-Dichloropropene	ND		1.00	1	12/19/2022 13:38	WG1976062
(S) 4-Bromofluorobenzene	93.8			67.0-138	12/19/2022 13:38	WG1976062
(S) Toluene-d8	92.7			75.0-131	12/19/2022 13:38	WG1976062
(S) 1,2-Dichloroethane-d4	93.4			70.0-130	12/19/2022 13:38	WG1976062

¹Cp²Tc³Ss⁴Cn⁵Sr⁶Qc⁷Gl⁸Al⁹Sc

Method Blank (MB)

(MB) R3873714-3 12/19/22 12:22

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
1,1,1,2-Tetrachloroethane	ND		0.0379	0.100
1,1,1-Trichloroethane	ND		0.0369	0.100
1,1,2-Trichloroethane	ND		0.0239	0.100
1,1,2-Trichlorotrifluoroethane	ND		0.0302	0.100
1,1,2,2-Tetrachloroethane	ND		0.0278	0.100
1,1-Dichloroethane	ND		0.0196	0.100
1,1-Dichloroethene	ND		0.0242	0.100
1,1-Dichloropropene	ND		0.0324	0.100
1,2,3-Trichlorobenzene	ND		0.293	0.500
1,2,3-Trichloropropane	ND		0.0648	0.500
1,2,4-Trichlorobenzene	ND		0.176	0.500
1,2,4-Trimethylbenzene	ND		0.0632	0.200
1,2-Dibromo-3-Chloropropane	ND		0.156	1.00
1,2-Dibromoethane	ND		0.0259	0.100
1,2-Dichlorobenzene	ND		0.0170	0.200
1,2-Dichloroethane	ND		0.0260	0.100
1,2-Dichloropropane	ND		0.0568	0.200
1,3,5-Trimethylbenzene	ND		0.0800	0.200
1,3-Dichlorobenzene	ND		0.0240	0.200
1,3-Dichloropropane	ND		0.0200	0.200
1,4-Dichlorobenzene	ND		0.0280	0.200
2,2-Dichloropropane	ND		0.0552	0.100
2-Butanone (MEK)	ND		2.54	4.00
2-Chlorotoluene	ND		0.0346	0.100
4-Chlorotoluene	ND		0.0180	0.200
4-Methyl-2-pentanone (MIBK)	ND		0.0912	1.00
Acetone	ND		1.46	2.00
Allyl Chloride	ND		0.160	1.00
Benzene	ND		0.0187	0.0400
Bromobenzene	ND		0.0360	0.500
Bromochloromethane	ND		0.0226	0.200
Bromodichloromethane	ND		0.0290	0.100
Bromoform	ND		0.0468	1.00
Bromomethane	ND		0.0788	0.500
Carbon tetrachloride	ND		0.0359	0.200
Chlorobenzene	ND		0.00840	0.100
Chlorodibromomethane	ND		0.0245	0.100
Chloroethane	ND		0.0680	0.200
Chloroform	ND		0.0412	0.100
Chloromethane	ND		0.174	0.500

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Method Blank (MB)

(MB) R3873714-3 12/19/22 12:22

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Dibromomethane	ND		0.0300	0.200
Dichlorodifluoromethane	ND		0.0644	0.100
Dichlorofluoromethane	ND		0.0490	0.100
Ethyl ether	ND		0.0356	0.100
Ethylbenzene	ND		0.0295	0.100
Hexachloro-1,3-butadiene	ND		0.0485	1.00
Isopropylbenzene	ND		0.0170	0.100
Methyl tert-butyl ether	ND		0.0140	0.0400
Methylene Chloride	ND		0.266	1.00
Naphthalene	ND		0.195	0.500
Styrene	ND		0.00916	0.500
Tetrachloroethene	ND		0.0358	0.100
Tetrahydrofuran	ND		0.141	0.500
Toluene	ND		0.0520	0.200
Trichloroethene	ND		0.0234	0.0400
Trichlorofluoromethane	ND		0.0331	0.100
Vinyl chloride	ND		0.0462	0.0500
Xylenes, Total	ND		0.0352	0.260
cis-1,2-Dichloroethene	ND		0.0294	0.100
cis-1,3-Dichloropropene	ND		0.0303	0.100
n-Butylbenzene	ND		0.210	0.500
n-Propylbenzene	ND		0.0380	0.200
p-Isopropyltoluene	ND		0.102	0.200
sec-Butylbenzene	ND		0.115	0.500
tert-Butylbenzene	ND		0.0780	0.200
trans-1,2-Dichloroethene	ND		0.0416	0.200
trans-1,3-Dichloropropene	ND		0.0456	0.200
(S) 4-Bromofluorobenzene	91.2			67.0-138
(S) Toluene-d8	92.3			75.0-131
(S) 1,2-Dichloroethane-d4	90.6			70.0-130

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3873714-1 12/19/22 10:18 • (LCSD) R3873714-2 12/19/22 10:38

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
1,1,1,2-Tetrachloroethane	5.00	4.79	4.92	95.8	98.4	74.0-129			2.68	20
1,1,1-Trichloroethane	5.00	5.17	4.92	103	98.4	69.0-126			4.96	20
1,1,2-Trichloroethane	5.00	4.55	4.38	91.0	87.6	78.0-123			3.81	20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3873714-1 12/19/22 10:18 • (LCSD) R3873714-2 12/19/22 10:38

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	<u>LCS Qualifier</u>	<u>LCSD Qualifier</u>	RPD %	RPD Limits %
1,1,2-Trichlorotrifluoroethane	5.00	5.16	4.97	103	99.4	61.0-139			3.75	20
1,1,2,2-Tetrachloroethane	5.00	5.02	5.06	100	101	68.0-128			0.794	20
1,1-Dichloroethane	5.00	4.75	4.66	95.0	93.2	70.0-127			1.91	20
1,1-Dichloroethene	5.00	5.32	5.29	106	106	65.0-131			0.566	20
1,1-Dichloropropene	5.00	5.12	5.09	102	102	73.0-125			0.588	20
1,2,3-Trichlorobenzene	5.00	3.62	3.71	72.4	74.2	59.0-139			2.46	20
1,2,3-Trichloropropane	5.00	4.95	4.91	99.0	98.2	67.0-129			0.811	20
1,2,4-Trichlorobenzene	5.00	3.69	3.91	73.8	78.2	62.0-137			5.79	20
1,2,4-Trimethylbenzene	5.00	5.03	5.06	101	101	70.0-126			0.595	20
1,2-Dibromo-3-Chloropropane	5.00	4.47	4.22	89.4	84.4	59.0-130			5.75	20
1,2-Dibromoethane	5.00	5.00	4.85	100	97.0	74.0-128			3.05	20
1,2-Dichlorobenzene	5.00	4.38	4.68	87.6	93.6	76.0-124			6.62	20
1,2-Dichloroethane	5.00	4.45	4.68	89.0	93.6	65.0-131			5.04	20
1,2-Dichloropropane	5.00	5.00	5.09	100	102	74.0-125			1.78	20
1,3,5-Trimethylbenzene	5.00	4.75	4.77	95.0	95.4	73.0-127			0.420	20
1,3-Dichlorobenzene	5.00	5.04	5.18	101	104	76.0-125			2.74	20
1,3-Dichloropropane	5.00	4.98	4.82	99.6	96.4	80.0-125			3.27	20
1,4-Dichlorobenzene	5.00	4.82	4.56	96.4	91.2	77.0-121			5.54	20
2,2-Dichloropropane	5.00	5.06	4.93	101	98.6	59.0-135			2.60	20
2-Butanone (MEK)	25.0	21.0	19.1	84.0	76.4	30.0-160			9.48	24
2-Chlorotoluene	5.00	5.24	5.61	105	112	75.0-124			6.82	20
4-Chlorotoluene	5.00	5.20	5.27	104	105	75.0-124			1.34	20
4-Methyl-2-pentanone (MIBK)	25.0	22.0	21.9	88.0	87.6	56.0-143			0.456	20
Acetone	25.0	20.9	21.8	83.6	87.2	10.0-160			4.22	31
Allyl chloride	25.0	26.1	26.4	104	106	70.0-131			1.14	20
Benzene	5.00	4.89	4.91	97.8	98.2	70.0-123			0.408	20
Bromobenzene	5.00	4.97	5.02	99.4	100	73.0-121			1.00	20
Bromochloromethane	5.00	4.64	4.70	92.8	94.0	77.0-128			1.28	20
Bromodichloromethane	5.00	5.04	4.97	101	99.4	73.0-121			1.40	20
Bromoform	5.00	4.31	4.26	86.2	85.2	64.0-132			1.17	20
Bromomethane	5.00	3.94	3.88	78.8	77.6	56.0-147			1.53	20
Carbon tetrachloride	5.00	5.29	5.36	106	107	66.0-128			1.31	20
Chlorobenzene	5.00	4.45	4.44	89.0	88.8	76.0-128			0.225	20
Chlorodibromomethane	5.00	4.81	4.92	96.2	98.4	74.0-127			2.26	20
Chloroethane	5.00	4.53	4.67	90.6	93.4	61.0-134			3.04	20
Chloroform	5.00	4.47	4.69	89.4	93.8	72.0-123			4.80	20
Chloromethane	5.00	4.67	4.88	93.4	97.6	51.0-138			4.40	20
Dibromomethane	5.00	4.98	5.03	99.6	101	75.0-122			0.999	20
Dichlorodifluoromethane	5.00	4.25	4.48	85.0	89.6	43.0-156			5.27	20
Dichlorofluoromethane	5.00	5.66	4.58	113	91.6	65.0-137		J3	21.1	20

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3873714-1 12/19/22 10:18 • (LCSD) R3873714-2 12/19/22 10:38

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	<u>LCS Qualifier</u>	<u>LCSD Qualifier</u>	RPD %	RPD Limits %
Ethyl ether	5.00	4.87	5.02	97.4	100	64.0-137			3.03	20
Ethylbenzene	5.00	4.49	4.55	89.8	91.0	74.0-126			1.33	20
Hexachloro-1,3-butadiene	5.00	4.35	4.58	87.0	91.6	57.0-150			5.15	20
Isopropylbenzene	5.00	4.85	4.82	97.0	96.4	72.0-127			0.620	20
Methyl tert-butyl ether	5.00	5.35	5.21	107	104	66.0-132			2.65	20
Methylene Chloride	5.00	4.92	4.59	98.4	91.8	68.0-123			6.94	20
Naphthalene	5.00	3.47	3.66	69.4	73.2	59.0-130			5.33	20
Styrene	5.00	4.04	4.09	80.8	81.8	72.0-127			1.23	20
Tetrachloroethene	5.00	4.62	4.66	92.4	93.2	70.0-136			0.862	20
Tetrahydrofuran	5.00	4.36	5.10	87.2	102	37.0-146			15.6	24
Toluene	5.00	4.76	4.60	95.2	92.0	75.0-121			3.42	20
Trichloroethene	5.00	5.26	5.08	105	102	76.0-126			3.48	20
Trichlorofluoromethane	5.00	5.57	4.88	111	97.6	61.0-142			13.2	20
Vinyl chloride	5.00	4.82	4.94	96.4	98.8	63.0-134			2.46	20
Xylenes, Total	15.0	14.1	14.2	94.0	94.7	72.0-127			0.707	20
cis-1,2-Dichloroethene	5.00	5.04	5.06	101	101	73.0-125			0.396	20
cis-1,3-Dichloropropene	5.00	4.61	4.52	92.2	90.4	76.0-127			1.97	20
n-Butylbenzene	5.00	4.66	4.73	93.2	94.6	68.0-135			1.49	20
n-Propylbenzene	5.00	4.81	4.89	96.2	97.8	74.0-126			1.65	20
p-Isopropyltoluene	5.00	4.92	4.97	98.4	99.4	72.0-133			1.01	20
sec-Butylbenzene	5.00	5.02	4.96	100	99.2	74.0-130			1.20	20
tert-Butylbenzene	5.00	5.24	5.02	105	100	75.0-127			4.29	20
trans-1,2-Dichloroethene	5.00	5.16	5.28	103	106	71.0-125			2.30	20
trans-1,3-Dichloropropene	5.00	5.16	4.94	103	98.8	73.0-127			4.36	20
(S) 4-Bromofluorobenzene				87.2	88.5	67.0-138				
(S) Toluene-d8				89.8	89.5	75.0-131				
(S) 1,2-Dichloroethane-d4				90.6	90.5	70.0-130				

1Cp

2Tc

3Ss

4Cn

5Sr

6Qc

7Gl

8Al

9Sc

GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
C3	The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.
J3	The associated batch QC was outside the established quality control range for precision.

¹ Cp

² Tc

³ Ss

⁴ Cn

⁵ Sr

⁶ Qc

⁷ Gl

⁸ Al

⁹ Sc

ACCREDITATIONS & LOCATIONS

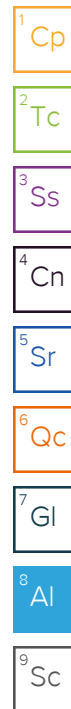
Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey--NELAP	TN002
California	2932	New Mexico ¹	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina ¹	DW21704
Georgia	NELAP	North Carolina ³	41
Georgia ¹	923	North Dakota	R-140
Idaho	TN00003	Ohio--VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LA000356
Kentucky ^{1 6}	KY90010	South Carolina	84004002
Kentucky ²	16	South Dakota	n/a
Louisiana	AI30792	Tennessee ^{1 4}	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas ⁵	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA -- ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA -- ISO 17025 ⁵	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA--Crypto	TN00003		

¹ Drinking Water ² Underground Storage Tanks ³ Aquatic Toxicity ⁴ Chemical/Microbiological ⁵ Mold ⁶ Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.



11/19B

WELL OR BORING LOCATION

County Name

Sherburne

**MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING SEALING RECORD**
Minnesota Statutes, Chapter 103

Minnesota Well and Boring
Sealing No.
Minnesota Unique Well No.
or Wellbore No.
Sealant Used

H 387579

Township Name Elk River Township No. 33 Range No. 26 Section No. 4 Fraction (e.g. 1/4) NWNESE Date Sealed 7-15-22 Date Well or Boring Completed unknown

GPS LOCATION - (decimal degrees to four decimal places)

Latitude Longitude

Numerical Street Address or Plot Number and City of Well or Boring Location

12163 223rd Ave. NW, Elk River

Show exact location of well or boring in open grid with "X"

Sketch map of well or boring location, showing property lines, roads, and buildings.



For temporary borings, provide additional location information in site sketch, and geology on a separate page

PROPERTY OWNER'S NAME/COMPANY NAME

Kevin Erickson

Property owner's address, telephone, e-mail, and hours of address, indicated above

WELL OWNER'S NAME/COMPANY NAME

Well owner's mailing address (different than property owner's address) listed above

WELL OWNER'S NAME/COMPANY NAME

Well owner's mailing address (different than property owner's address) listed above

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IMPORTANT: FILE WITH PROPERTY PAPERS. WELL OWNER COPY

H 387579

Depth or Time of Boring 100 ft

Original Depth 100

AQUIFER(S)

☒ Single Aquifer ☐ Multiple

WELLBORING

☒ Water Supply Well ☐ Eros. Well

☐ Temp. Boring ☐ Other

☒ Measured Date Measured 7-15-22 ☐ Estimated

45 ft ☒ Jet ☐ Air ☐ Steam and Air

CASING TYPE(S)

☒ Steel ☐ Plastic ☐ Tile ☐ Other

WELLHEAD COMPLETION

Outer Diameter 4 in. to 6 in. ☐ At Crown ☐ Bored

☒ Well PC ☐ Other

Inside: ☐ Basement Floor

☐ Well House

☐ Well Pit

☐ Bored

☐ Other

CASING(S)

Diameter 4 in. to 6 in. Depth 95 ft

Set in overburden hole? ☐ Yes ☒ No

Artificially grouted? ☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

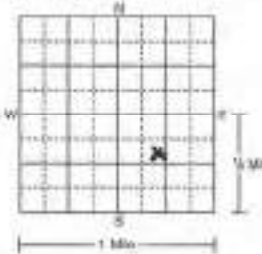
☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

☐ Yes ☒ No

☐ Yes ☐ No ☒ Unknown

4 in. to 6 in. to 95 ft

MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING SEALING RECORD Minnesota Statutes, chapter 1031					Minnesota Well and Boring Sealing No. Minnesota Unique Well No. or W-series No. (Leave blank if not known)	
WELL OR BORING LOCATION					H 387619	
County Name <u>Sherburne</u>						
Township Name <u>Elk River</u>	Township No. <u>33</u>	Range No. <u>26</u>	Section No. <u>4</u>	Fraction (am. → lg.) <u>SE NW SE</u>	Date Sealed <u>11-15-23</u>	Date Well or Boring Constructed <u>1970^{us}</u>
GPS LOCATION - decimal degrees (to four decimal places)						
Latitude _____ Longitude _____						
Numerical Street Address or File Number and City of Well or Boring Location <u>12183 223rd Ave. NW, Elk River</u>						
Show exact location of well or boring in section grid with "X"					Sketch map of well or boring location, showing property lines, roads, and buildings.	
					Depth at Time of Sealing <u>101</u> ft. Original Depth <u>101</u> ft. AQUIFER(S) ☒ Single Aquifer ☐ Multi-aquifer WELL/BORING ☒ Water-Supply Well ☐ Env. Well ☐ Temp. Boring ☐ Other _____	
					STATIC WATER LEVEL ☐ Measured Date Measured _____ ☒ Estimated <u>40</u> ft. ☒ below ☐ above land surface	
Casing Type(s) ☒ Steel ☐ Plastic ☐ Tile ☐ Other _____						
WELLHEAD COMPLETION						
Outside: ☒ Pile-on Adapter/Unit ☐ At Grade ☐ Well Pit ☐ Other _____ Inside: ☐ Basement Offset ☐ Well House ☐ Well Pit ☐ Buried ☐ Other _____						
Casing(s)						
Diameter <u>4</u> in. from <u>0</u> to <u>98</u> ft. Depth <u>98</u> ft. Set in oversize hole? ☒ Yes ☐ No Annular space initially grouted? ☐ Yes ☐ No ☒ Unknown						
_____ in. from _____ to _____ ft. ☐ Yes ☐ No ☐ Yes ☐ No ☐ Unknown						
_____ in. from _____ to _____ ft. ☐ Yes ☐ No ☐ Yes ☐ No ☐ Unknown						
SCREEN/OPEN HOLE						
Screen from <u>98</u> to <u>101</u> ft. Open Hole from _____ to _____ ft.						
OBSTRUCTIONS						
☒ Rods/Drop Pipe ☐ Check Valve(s) ☐ Debris ☐ PB ☐ No Obstruction						
Type of Obstruction (Describe): <u>1" Sch 80 PVC + Pump - 80'</u>						
Obstructions removed? ☒ Yes ☐ No Describe: <u>pulled out</u>						
PUMP						
☐ Not Present ☒ Present, Removed Prior to Sealing ☐ Other _____						
Type: <u>Submersible</u>						
METHOD USED TO SEAL ANNULAR SPACE BETWEEN 2 CASINGS, OR CASING AND BORE HOLE						
☒ No Annular Space Exists ☐ Annular Space Grouted with Tremie Pipe ☐ Casing Perforation/Removal						
Casing Diameter _____ in. from _____ to _____ ft. ☐ Perforated ☐ Removed						
_____ in. from _____ to _____ ft. ☐ Perforated ☐ Removed						
Type of Perforation _____						
VARIANCE						
Was a variance granted from the MDH for this well? ☐ Yes ☒ No TN# _____						
GROUTING MATERIAL(S)						
Grouting Material <u>Bentonite</u> from <u>0</u> to <u>101</u> ft. _____ yards _____ bags						
_____ from _____ to _____ ft. _____ yards _____ bags						
_____ from _____ to _____ ft. _____ yards _____ bags						
OTHER WELLS AND BORINGS						
Other unsealed and unused well or boring on property? ☐ Yes ☒ No How many? _____						
LICENSED OR REGISTERED CONTRACTOR CERTIFICATION						
This well or boring was sealed in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.						
<u>Able Well, Inc.</u> License or Registration No. <u>1377</u> <u>Scott + Darl</u> 972 Certified Rep. No. <u>11-15-23</u> Name of Person Sealing Well or Boring						
REMARKS, SOURCE OF DATA, DIFFICULTIES IN SEALING						
MINN. DEPT. OF HEALTH COPY H 387619						

WELL OR BORING LOCATION

County Name

Sherburne

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING SEALING RECORD
Minnesota Statutes, Chapter 1031Minnesota Well and Boring
Sealing No.
Minnesota Unique Well No.
or Wellbore No.
Assigned by DPH

H 387618

Township Name | Township No. | Range No. | Section No. | Filed on (date - yr.)

GP LOCATION (bottom degrees 110 only one final degree)

Latitude

Longitude

Date Sealed

Duration: Time of Sealing

Date Well or Boring Constructed

Municipal (Street Address or Post Number and City of Well or Boring Location)

17265 773rd Ave NW, Elk River

Sketch exact location of well or boring in section grid with 1/4"

Sketch map of well or boring location, show no property lines, roads, and buildings

ADJACENT(S)

W. Single Aquifer | Multiple

WELLBORING

Water-Supply Well | Flow Well

| Temp. Boring | Other

Original Depth

2 Measured Date Measured 10-21-22 | Estimated

50 ft below | above land surface

CASING TYPE(S)

Steel | Plastic | Tile | Other

WELLHEAD COMPLETION

Delayed | New Adapter/Unit | At Grade

Well P | Buried

Other

Inside | Basement Orifice

Well House

Well P |

Buried

Other

CASING(S)

Casing

Depth

Set in concrete hole?

Annular space in fully grouted?

4 in from 0 to 89 ft | Yes | No | Yes | No | Unknown

in from to ft | Yes | No | Yes | No | Unknown

in from to ft | Yes | No | Yes | No | Unknown

SCREEN/OPEN HOLE

Screen from 89 to 93 ft Open Hole from to

OBSTRUCTIONS

Rock/Drill Pipe | Check Valve(s) | Debris | Fill | No Obstruction

Type of Obstruction (Describe) 80' Drill pipe + Sub Pump

Obstructions removed? Yes | No Describe pulled out

PUMP

Not Present | Present | Removed Prior to Sealing | Other

Type

Submersible

METHOD USED TO SEAL ANNULAR SPACE BETWEEN 2 CASINGS, OR CASING AND BORE HOLE

No Annular Space Sealed | Annular Space Grouted with Grout | Casing Replacement/Removal

Casing Details:

in from to ft | Perforated | Removed

in from to ft | Perforated | Removed

Type of Particular

WARNING

Was a warning given to the MDH for this well? Yes | No | Yes

GROUTING MATERIAL(S)

Grouting Material Bentonite from 0 to 93 ft | 4 bags

ft to ft | bags

from to ft | bags

OTHER WELLS AND BORINGS

Other unsealed and unused well or boring on property? Yes | No How many?

LICENSED OR REGISTERED CONTRACTOR CERTIFICATION

This well or boring was sealed in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Able Well, Inc.

Licensee/Representative Name

1377
Licensee or Registration No.

Scott H. Thompson

Certified Representative Signature

972

Certified Rep. No.

10-27-22

Date

Scott H. Thompson

Name of Person Sealing Well or Boring

GEOLOGICAL MATERIAL	COLOR	HARDNESS OR FORMATION	FROM	TO
Sand + gravel	Brown		0	5
Clay w/ gravel	Brown		5	10
Sand + gravel	Brown		10	35
Clay	Tan		35	61
Sand	Tan		61	63
Clay	Gray		63	69
Gravel	Tan		69	72
Clay	Gray		72	79
Gravel	White		79	81
Clay + gravel	Brown		81	95

REMARKS, SOURCE OF DATA, DIFFICULTIES IN SEALING

IMPORTANT: FILE WITH PROPERTY
PAPERS-WELL OWNER COPY

H 387618

WELL OR BORING LOCATION
County Name
St. Louis

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING SEALING RECORD
Minnesota Statutes, Chapter 102

Minnesota Well and Boring
Sealing No.
Minnesota Unique Well No.
or Boring No.
[Leave blank if not applicable]

H 387617
626780

Township Name Elk River Township No. 33 Range No. 26 Section No. 4 Fractional (N - S) NORTH

Date Sealed 10-21-22

Date Well or Boring Constructed 9-21-2001

GPS LOCATION - see 10-21-22 (to four decimal places)

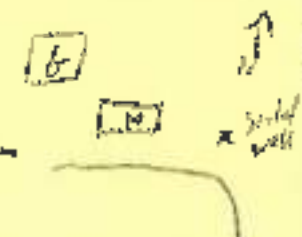
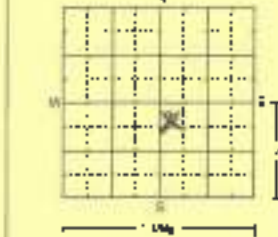
Latitude _____ Longitude _____

Normalized Street Address or File Number and City or Boring Location

12269 223rd Ave. NW, Elk River

Show exact location of well or boring
in sections and well log

Sketch map of well or boring
location showing property
lines, roads, and buildings



For temporary bridge, provide additional location
information, a site sketch, and geology on a separate page

PROPERTY OWNER'S WORK/COMPANY NAME

Property owner's mailing address if different than property owner's address, located above

WELL OWNER'S NAME/COMPANY NAME

Well owner's mailing address if different than property owner's address, located above

GEOLOGICAL MATERIAL COLOR HARDNESS OR FORMATION FROM TO

If not known, indicate estimated formation log from nearby well or boring

Sand	Brown	Soft	0	15
Clay	Gray	Med	15	60
Clay	Gray	Med	60	75
Sand	Brown	Soft	75	88
Clay	Gray	Med	88	145
Sand	Tan	Soft	145	151

REMARKS, SOURCE OF DATA, DIFFICULTIES IN SEALING

Depth at Time of Sealing 150 ft

Casing Depth 150 ft

AQUIFER(S)
☐ Single Aquifer ☐ Multiple

STATIC WATER LEVEL 10-21-22

WELLBORING
☒ Water Supply Well ☐ Dry Well

☒ MEASURED Date Measured 9-21-2001 ☐ Estimated

☐ Temp. Boring ☐ Other

47 ft ☒ Inside ☐ Across land surface

CASING TYPE(S)

☒ Steel ☐ Mason ☐ Tile ☐ Other

WELLHEAD COMPLETION

Outside: ☒ Pilehead At/above Lms ☐ At Grade

Inside: ☐ Basement Offset

☐ Well Pit

☐ Buried

☐ Well House

☐ Well Pit

☐ Buried

☐ Other

CASINGS

Diameter 4 in. from 0 in. 146 ft Sort or Swirl Side Entry ☒ Yes ☐ No ☐ Unknown

_____ in. from _____ ft _____ Yes ☐ No ☐ Unknown

_____ in. from _____ ft _____ Yes ☐ No ☐ Unknown

BORER/OPEN HOLE

Screen from 146 to 150 ft Open Hole from _____ to _____ ft

OBSTRUCTIONS

☒ Road(s) on Pipe ☐ Check Valve(s) ☐ Other ☐ No Obstruction

Type of Obstruction (Describe) Pump & drop pipe - 84' - 1 1/4"

Obstructions removed? ☒ Yes ☐ No Describe pulled out

PUMP

☐ Not Present ☒ Present, Removed Prior to Sealing ☐ Other

Type Submersible

METHOD USED TO SEAL ANNUAL SPACE BETWEEN CASINGS OR CASING AND BORE HOLE

☒ No Annular Space Closed ☐ Annular Space Sealed with Tension Pipe ☐ Casing Perforated/Removed

Casing Diameter _____ in. from _____ ft _____ in. ☐ Perforated ☐ Removed

_____ in. from _____ ft _____ in. ☐ Perforated ☐ Removed

Type of Perforator

VARIANCE

Was a variance granted from the MDH for this well? ☐ Yes ☐ No ☐ True

GROUTING MATERIAL(S)

Grouting Material Grout from 0 to 151 ft _____ yards 5 bags

_____ from _____ to _____ ft _____ yards _____ bags

_____ from _____ to _____ ft _____ yards _____ bags

OTHER WELLS AND BORINGS

Other unsealed and unused well or boring on property? ☐ Yes ☒ No (for note)

LICENSED OR REBUILT CONTRACTOR CERTIFICATION

This well or boring was sealed in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Abi Well, Inc.

1377

Contractor Business Name

License or Registration No.

Scott Thompson

972

10-25-22

Contractor Representative Signature

Certified Rep. No.

Date

Scott Thompson

Name of Person Sealing Well or Boring

IMPORTANT: FILE WITH PROPERTY
PAPERS-WELL OWNER COPY

H 387617

WELL OR BORING LOCATION

County Name

Sherburne

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING SEALING RECORD
Minnesota Statutes, chapter 1037Minnesota Well and Boring
Sealing No.
Minnesota Unique Well No.
or W-series No.
(Source: March 17, 2008 version)H 387620
527979

Township Name	Township No.	Range No.	Section No.	Fraction (sm. → lg.)	Date Sealed	Date Well or Boring Constructed
Elk River	33	26	4	NE 1/4 SE 1/4	12-10-22	6-21-1993

GPS LOCATION - decimal degrees (to four decimal places):

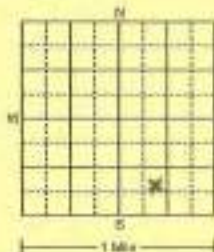
Latitude Longitude

Numerical Street Address or Fire Number and City of Well or Boring Location

22772 Quince St NW, Elk River

Show exact location of well or boring in section grid with "X"

Sketch map of well or boring location, showing property lines, roads, and buildings.



For temporary borings, provide additional location information, a site sketch, and geology on a separate page.

PROPERTY OWNER'S NAME/COMPANY NAME

Paul H. Hagg

Property owner's mailing address if different than well location address indicated above

WELL OWNER'S NAME/COMPANY NAME

Well owner's mailing address if different than property owner's address indicated above

Depth at Time of Sealing 140 ft.

Original Depth 140 ft.

AQUIFER(S)

☒ Single Aquifer ☐ Multi-aquifer

WELL/BORING

☒ Water-Supply Well ☐ Env. Well☐ Temp. Boring ☐ Other

STATIC WATER LEVEL

☒ Measured Date Measured 12-10-22 ☐ Estimated50 ft. ☒ Below ☐ Above land surface

CASING TYPE(S)

☐ Steel ☒ Plastic ☐ Tile ☐ Other

WELLHEAD COMPLETION

Outside: ☒ Press Adapter/Unit ☐ At Grade☐ Well Pit ☐ Buried☐ OtherInside: ☐ Basement Offset☐ Well House☐ Well Pit☐ Buried☐ Other

CASING(S)

Diameter Depth

4 in. from 0 to 135 ft.

Set in oversize hole?

☒ Yes ☐ No

Annular space initially grouted?

☒ Yes ☐ No ☐ Unknown

in. from to ft.

☐ Yes ☐ No☐ Yes ☐ No ☐ Unknown

in. from to ft.

☐ Yes ☐ No☐ Yes ☐ No ☐ Unknown

in. from to ft.

☐ Yes ☐ No☐ Yes ☐ No ☐ Unknown

SCREEN/OPEN HOLE

Screen from 135 to 140 ft. Open Hole from to ft.

OBSTRUCTIONS

☒ Rod/Drop Pipe ☐ Check Valve(s) ☐ Debris ☐ Fill ☐ No Obstruction

Type of Obstruction (Describe) Sub. pump + drop pipe

Obstructions removed? ☒ Yes ☐ No Describe Pulled out

PUMP

☐ Not Present ☒ Present, Removed Prior to Sealing ☐ Other

Type Submersible

METHOD USED TO SEAL ANNULAR SPACE BETWEEN 2 CASINGS, OR CASING AND BORE HOLE

☐ No Annular Space Exists ☒ Annular Space Grouted with Tremie Pipe ☐ Casing Perforation/Removal

Casing Diameter

in. from to ft.

☐ Perforated ☐ Removed

in. from to ft.

☐ Perforated ☐ Removed

Type of Perforator

VARIANCE

Was a variance granted from the MDH for this well? ☐ Yes ☒ No Title

GROUTING MATERIAL(S)

Grouting Material Bentonite from 6 to 140 ft. yards 4 1/2 bags

from to ft. yards bags

from to ft. yards bags

OTHER WELLS AND BORINGS

Other unsealed and unused well or boring on property? ☐ Yes ☒ No How many?

LICENSED OR REGISTERED CONTRACTOR CERTIFICATION

This well or boring was sealed in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Able Well, Inc.

Licensee Business Name

1377

License or Registration No.

Scott G. Th...

Certified Representative Signature

972

Certified Rep. No.

12-15-22

Date

Scott + Ogel

Name of Person Sealing Well or Boring

REMARKS, SOURCE OF DATA, DIFFICULTIES IN SEALING

Original well log

IMPORTANT: FILE WITH PROPERTY PAPERS-WELL OWNER COPY

H 387620

Appendix C

Monitoring Well Installation Information

Technical Memorandum

To: File
From: Jim Eidem P.G. and Kevin McGilp
Subject: 2021 – 2023 Monitoring Well Installation
Date: February 7, 2024
Project: Elk River Landfill, Groundwater Corrective Action Work Plan Implementation

This memorandum describes the installation of four new monitoring wells to enhance the existing monitoring well network at Elk River Landfill (ERL). The monitoring well installations were completed as part of the Groundwater Corrective Action Work Plan (Work Plan) (Barr, 2021), as approved by the Minnesota Pollution Control Agency (MPCA). Monitoring well P-339L identified in the Work Plan could not be installed at the proposed location due to the landowner not granting access for a well installation. Therefore, monitoring well P-342L was installed to the east of the proposed P-339L location. The new monitoring wells P-338L, P-340L, P-341L, and P-342L are generally located west of ERL and are shown on Figure 1.

1 Well Installation

Monitoring wells P-338L and P-340L were installed in September, 2021 by Cascade Drilling, LP. (Cascade) using sonic drilling methods and in conformance with Minnesota Rules 4725 (Well Code). The drilling locations required minor brushing and/or leveling prior to setting up the drill rig. The well bores were advanced to the base of the lower outwash and constructed with 2-inch diameter steel riser casing and 2-inch diameter stainless steel well screens 15 feet in length. The well screens were sand packed with #40 mesh Red Flint sand and bentonite chips were installed on top of the sand packs for an intermediate well seal. The remaining annular space of the wells were grouted with neat cement grout by pumping through a tremie pipe from the top of the bentonite seal to the surface. The sonic drill casing was incrementally removed from the well bore between installation of grout batches. A 6-inch diameter protective steel casing was installed over the riser casing and was fitted with a metal locking cap.

In February 2023, a winter road was constructed over swampy ground to access the location of P-342L. Minor brush clearing was required at the drilling location and the well was installed in March 2023. Monitoring well P-341L was constructed in June, 2023 at a location that did not require any site preparation. Both wells were constructed at the base of the lower outwash by Cascade using sonic drilling methods and were constructed the same as described for P-338L and P-340L above. A summary of the monitoring well construction is provided in Table 1 and the well construction records are in Attachment A.

Soil samples from the boreholes were logged by Barr Engineering Co. (Barr) using methods described in ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures). The

well logs are included in Attachment A. The data collected from these boreholes was used to enhance previous geologic cross sections for the ERL site (Figures 2, 3, and 4)

2 Well Development

The monitoring wells were developed by over pumping and surging using a 2-inch diameter submersible pump. Monitoring wells P-338L was developed more than 48 hours after the placement of the neat cement grout. Wells P-340L, P-341L, and P-342L, were developed after the sand pack and bentonite well seal were placed and before the annular space was grouted. Groundwater was pumped from the wells until the water appeared clear and was free of sediment.

3 Investigation Derived Waste

Investigation derived waste (IDW) included soil cuttings and development water. All soil cuttings from the well drilling were placed in 55-gallon drums. Groundwater produced during well development was containerized in either 55-gallon drums or a portable polyethylene tank. The containerized soil and groundwater were brought to the ERL and was placed or thin spread in an area designated by the site manager.

4 References

Barr Engineering Co. (Barr), 2021. Groundwater Corrective Action Work Plan, Elk River Landfill (SW-74), Elk River, Minnesota, prepared for Elk River Landfill, Inc., March, 2021.

Attachments

Table 1 – Well Construction Summary
Figure 1 – Well Locations
Figure 2 – Geologic Cross Section H'-H''
Figure 3 – Geologic Cross Section P-P'
Figure 4 – Geologic Cross Section Q-Q'
Attachment A - Well Logs and Construction Records

Attachments

Table 1
Monitoring Well Construction Details
Elk River Landfill - Groundwater Corrective Action Work Plan
Elk River, Minnesota

Identification Number	Unique Well ID Number	Installation Date	Well Location Coordinates		Top of Casing Elevation (feet MSL)	Ground Elevation (feet MSL)	TD Elevation (feet MSL)	Total Depth (feet bgs)	Total Depth ¹ (feet bTOC)	Construction Details					Comments
			Northing	Easting						Diameter (inches)	Casing Material	Screen Material	Screen Length (feet)	Slot Size (inches)	
P-338L	853139	9/17/2021	246826.8	577160.1	961.13	958.3	859.9	98.4	101.2	2	Steel	Stainless Steel	15	0.010	Base of the lower outwash
P-340L	853140	9/14/2021	250146.2	574958.2	946.43	943.8	840.4	103.4	106	2	Steel	Stainless Steel	15	0.010	Base of the lower outwash
P-341L	877298	6/6/2023	245319.9	578868.8	988.58	986.1	843.6	142.5	145	2	Steel	Stainless Steel	15	0.010	Base of the lower outwash
P-342L	871179	3/6/2023	246081.0	574891.7	947.27	943.9	844.8	99.1	102.5	2	Steel	Stainless Steel	15	0.010	Base of the lower outwash

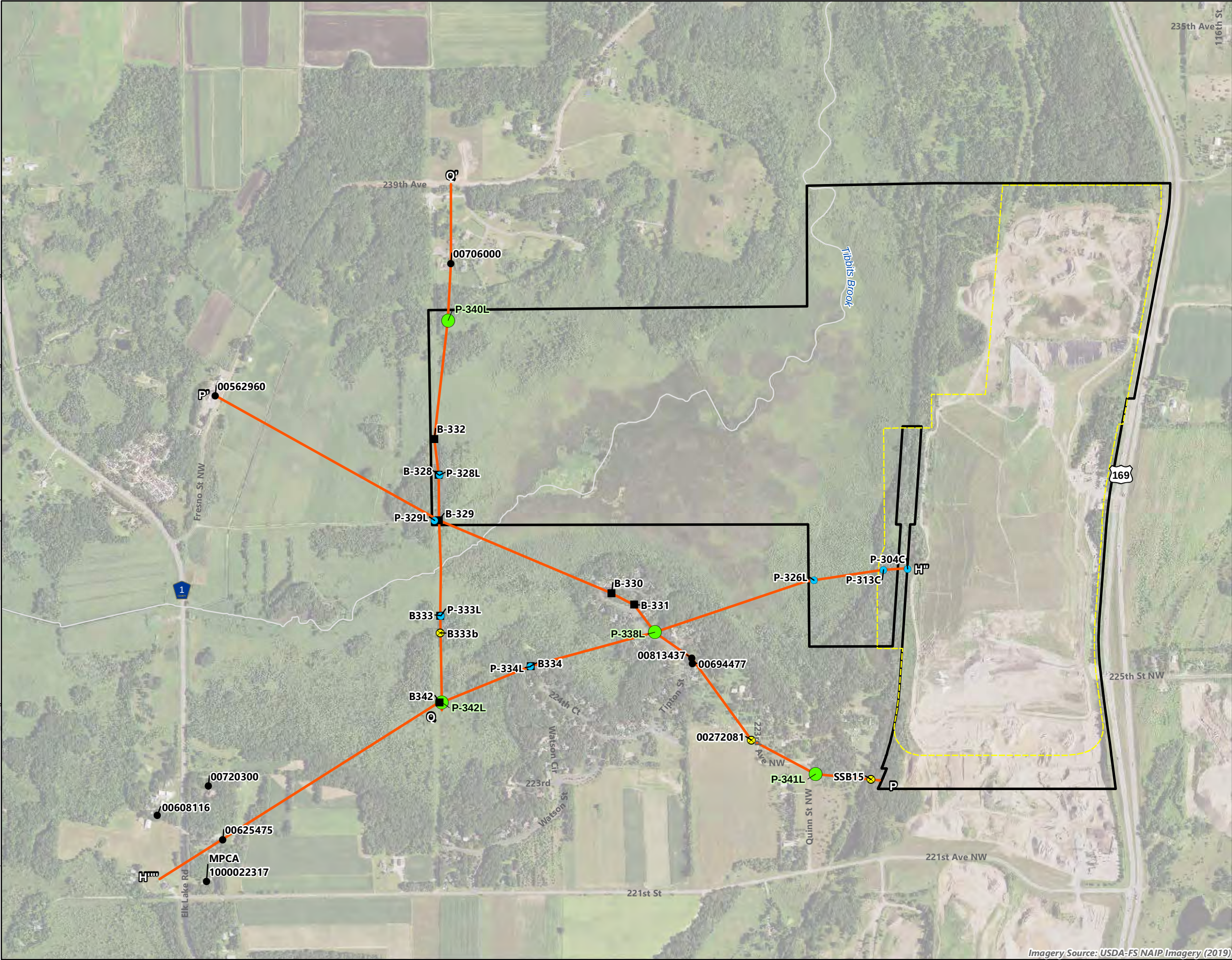
Notes:

¹ Based on field measurement.

MSL - Mean sea level

bgs - Below ground surface

Well Survey Datum: Sherburne County Coordinate System (NAD83 1986 Adjustment). The Elevation Datum is NGVD 29.



- Property Boundary
- Groundwater Compliance Boundary
- Cross Section Location
- Monitoring Well (2021-2023)
- Vertical Groundwater Profile Boring
- Monitoring Well/Piezometer
- Residential Well
- Soil Boring

Note: Not all wells are shown.

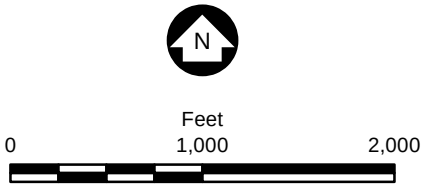


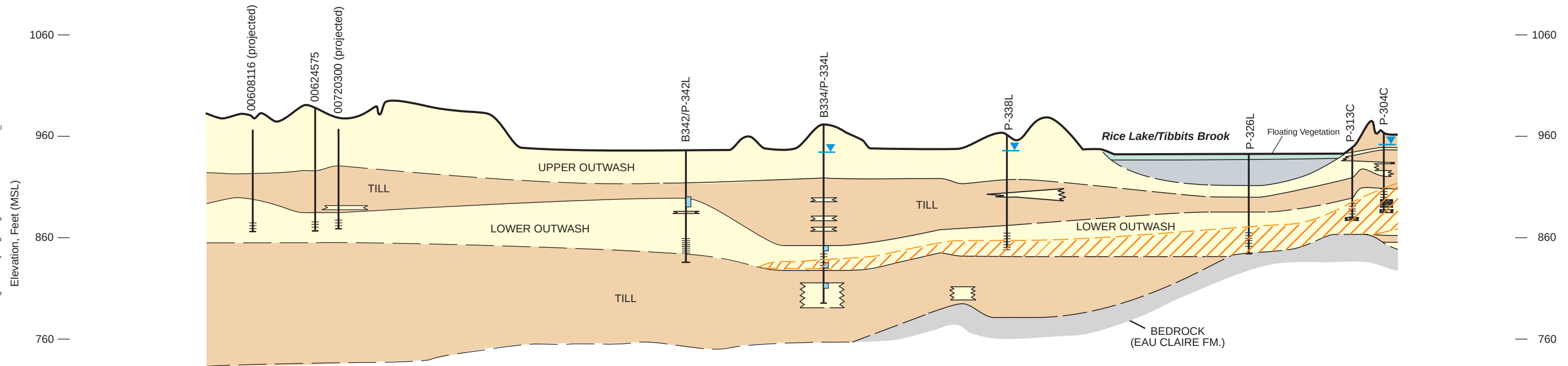
Figure 1
WELL LOCATIONS
Elk River Landfill
Elk River, Minnesota



H'
WEST

H''
EAST

P:\Mpls\23 MN\71\23711005 ERL, GW Network Development\WorkFiles\Corrective Action\Implementation\Monitoring Wells\2023\Cross-sections\H'-H''_20240221.ai User: KJN3



EXPLANATION

OUTWASH	Includes the following soil types: SP: Sand with <5% fines; thin/discontinuous gravel lenses rare to common. SM: (Where in contact with SP); Silty sand; silt content approximately 30 to 50%.
TILL	Includes the following soil types: ML: Sandy silt - diamict with approximately 10 to 50% Sand and Gravel; firm to very hard. CL: Clay textured diamict with varying amounts of sand and gravel; firm to hard. SM: (Where bounded by ML or CL); Silty sand; silt content approximately 30 - 50% ML/CL: Silt or clay, <5% sand, massive to thinly bedded
EAU CLAIRE	Eau Claire Formation: Fine-grained sandstone/siltstone with shale partings present locally.

0 750
Approximate Horizontal Scale in Feet
7.5X Vertical Exaggeration

LEGEND

	Ground Surface (Approximate)
	Geologic Contact (Dashed where approximate)
	October 2023 Groundwater Elevation (Measured in deepest nested well shown on figure)
	Existing Well Screen
	Groundwater Sample Locations
	Approximate/Inferred Extent of Vinyl Chloride Above Health Risk Limits

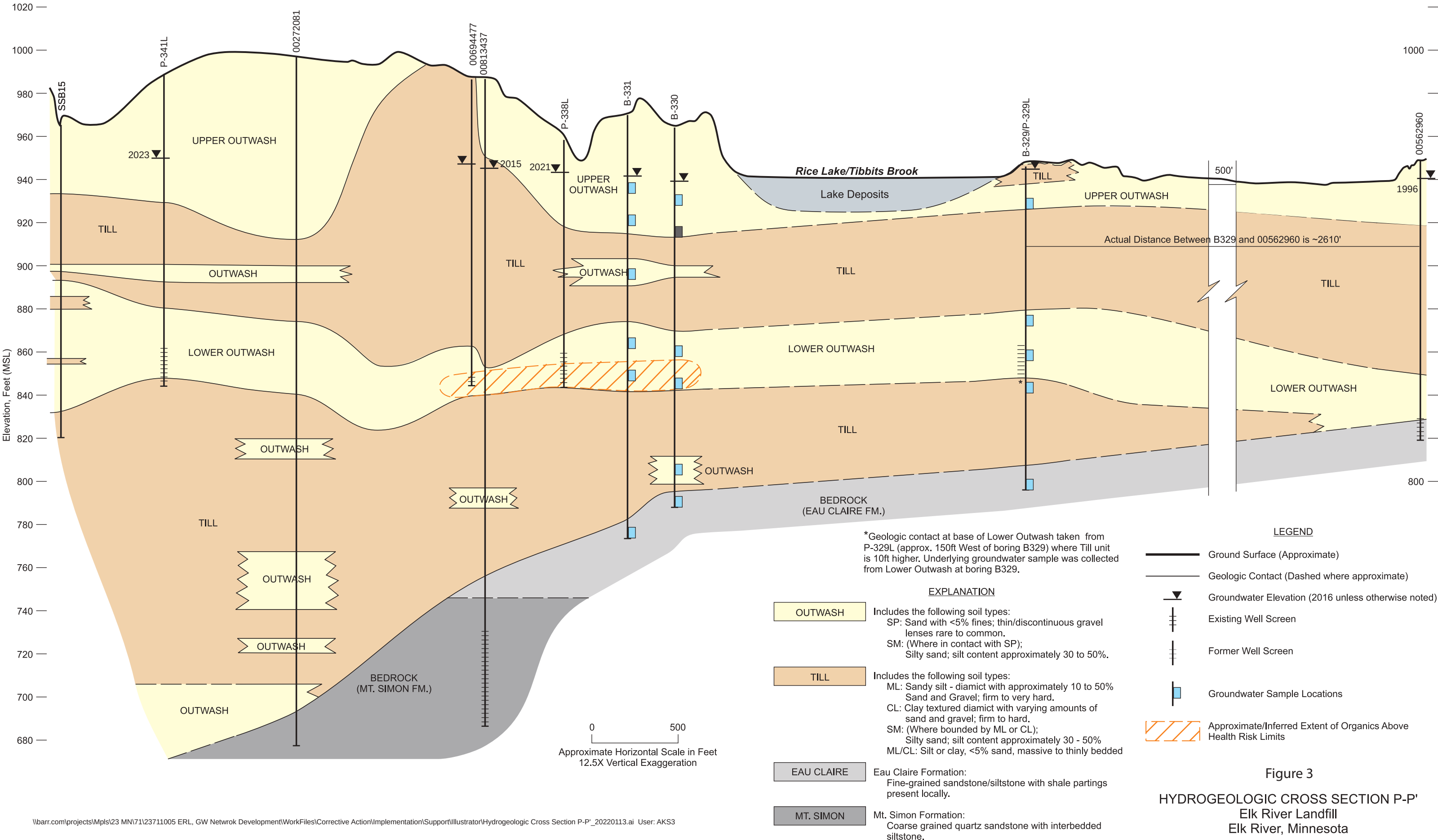


Figure 2

HYDROGEOLOGIC CROSS SECTION H'-H''
Elk River Landfill
Elk River, Minnesota

P
SOUTHEAST

P'
NORTHWEST



LEGEND

	Ground Surface (Approximate)
	Geologic Contact (Dashed where approximate)
	Groundwater Elevation (2016 unless otherwise noted)
	Existing Well Screen
	Former Well Screen
	Groundwater Sample Locations
	Groundwater Interval Purged Dry

EXPLANATION

	Includes the following soil types: SP: Sand with <5% fines; thin/discontinuous gravel lenses rare to common. SM: (Where in contact with SP); Silty sand; silt content approximately 30 to 50%.
	Includes the following soil types: ML: Sandy silt - diamict with approximately 10 to 50% Sand and Gravel; firm to very hard. CL: Clay textured diamict with varying amounts of sand and gravel; firm to hard. SM: (Where bounded by ML or CL); Silty sand; silt content approximately 30 - 50% ML/CL: Silt or clay, <5% sand, massive to thinly bedded
	Eau Claire Formation: Fine-grained sandstone/siltstone with shale partings present locally.

Figure 4

HYDROGEOLOGIC CROSS SECTION Q-Q'
Elk River Landfill
Elk River, Minnesota



Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF WELL P-338L

SHEET 1 OF 3

Project:	Elk River Landfill Groundwater Corrective Action	Surface Elevation:	958.3 ft	Top of Casing Elev.:	961.13 ft
Project No.:	23/71-1005.21	Drilling Method:	Sonic	Unique Well No.:	853139
Location:	Elk River, MN	Sampling Method:	Sonic Core		
Coordinates:	N 246,826.8 ft E 577,160.1 ft	Completion Depth:	115.0 ft		
Datum:	Sherburne County Coordinate System				

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Depth, feet	Sample Type & Recovery	Sample No.	U S C S	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0					SILTY SAND (SM): grass at surface; fine grained; yellowish brown (10YR 5/4); moist; ~15% fines.		
1		1	SM				955
5					Color grades to olive gray (5Y 4/2); few medium to coarse grained sand; few roots observed from ~7-8 feet bgs..		
2		2					950
10					POORLY GRADED SAND WITH SILT (SP-SM): fine grained with trace medium to coarse grained; grayish brown (2.5Y 5/2); moist; appears wet below 11 feet bgs; ~10% fines; roots observed at ~10.5 feet bgs.		
3		3	SP-SM				945
15					POORLY GRADED SAND (SP): fine grained with trace medium to coarse grained; brown (10YR 5/3) with strong brown (7.5YR 4/6) mottles; wet; ~5% fines.		
4			SP				
					SILTY SAND (SM): very fine to fine grained; brown (10YR 5/3); wet; ~15-20% fines.		
5			SM				
20		4			POORLY GRADED SAND (SP): fine grained with trace medium to coarse grained; brown (10YR 5/3); wet; ~5% fines.		940
			SP				
25					POORLY GRADED SAND (SP): fine to medium with trace coarse grained; brown (10YR 4/3); wet; trace fines.		935
			SP				
30		5			SILTY SAND (SM): very fine to fine grained; grayish brown (2.5Y 5/2); wet; ~20% fines.		930
			SM				
35					POORLY GRADED SAND (SP): fine grained with few to little medium to coarse grained; dark grayish brown (2.5Y 4/2); wet; subangular to subrounded; trace fine gravel at base of unit; <7% fines.		925
			SP				920
40							

Date Boring Started: 9/16/21
Date Boring Completed: 9/17/21
Logged By: KAM
Drilling Contractor: Cascade Drilling
Drill Rig: Mini-sonic

Remarks:
-Well developed more than 48 hours after grouting annular space by surging and overpumping.
Approximately 420 gallons purged.
-Final well completion occurred on 9-21-2021.

Additional data may have been collected in the field which is not included on this log.



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LOG OF WELL P-338L

SHEET 2 OF 3

Project: Elk River Landfill Groundwater Corrective Action Surface Elevation: 958.3 ft Top of Casing Elev.: 961.13 ft
Project No.: 23/71-1005.21 Drilling Method: Sonic Unique Well No.: 853139
Location: Elk River, MN Sampling Method: Sonic Core
Coordinates: N 246,826.8 ft E 577,160.1 ft Completion Depth: 115.0 ft
Datum: Sherburne County Coordinate System

Depth, feet	Sample Type & Recovery	Sample No.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
40		6	CL		SANDY LEAN CLAY (CL): ~30% fine to coarse grained sand; dark gray (5Y 4/1); moist; subangular to subrounded; trace to 5% fine gravel; medium plasticity; medium toughness.		
			SP-SM		POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM): medium to coarse grained; dark gray (5Y 4/1); wet; subangular to subrounded; ~20% fine gravel; ~10% fines.		
			CL		SANDY LEAN CLAY (CL): ~30% fine to coarse grained sand; dark gray (5Y 4/1); moist; subangular to subrounded; trace to 5% fine gravel; medium plasticity; medium toughness.		
			SP-SM		POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM): medium to coarse grained; dark gray (5Y 4/1); wet; subangular to subrounded; ~20% fine gravel; ~10% fines.		
45			CL		LEAN CLAY WITH SAND (CL): ~20% fine to coarse grained sand; very dark gray (5Y 3/1); moist; subangular to subrounded; trace fine gravel; medium plasticity; medium toughness.		
			CL		SANDY LEAN CLAY (CL): ~30% fine to coarse grained sand; dark gray (5Y 4/1); moist to wet; subangular to subrounded; ~5% fine gravel; trace coarse gravel (up to 1.5"); medium plasticity; medium toughness.		
50		7	CL				
			CL				
55			SC-CL		CLAYEY SAND TO SANDY LEAN CLAY (SC-CL): ~50% clayey fines; brown (7.5YR 4/2); moist; subangular to subrounded; ~45% fine to coarse grained sand and 5% fine gravel.		
			SM		SILTY SAND (SM): fine grained with trace medium grained; brown (10YR 4/3); moist; ~30% fines.		
			SP		POORLY GRADED SAND (SP): fine to medium with few coarse grained; brown (10YR 4/3); wet; ~5% fines.		
60		8	CL		SANDY LEAN CLAY (CL): ~30% fine to coarse grained sand; brown (7.5YR 4/2); moist; subangular to subrounded; ~30% fine to coarse grained sand and 5% fine gravel; medium plasticity; medium toughness.		
			CL		CLAYEY SAND (SC): fine to medium with some coarse grained; brown (7.5YR 4/2); moist to wet; subangular to subrounded; ~5% fine gravel; ~40% clayey fines.		
65			CL		SANDY LEAN CLAY (CL): ~30% fine to coarse grained sand; brown (7.5YR 4/2); moist; subangular to subrounded; ~5% fine gravel.		
			SC		CLAYEY SAND (SC): fine to medium with few coarse grained; brown (10YR 4/3); moist to wet; subangular to subrounded; ~5% fine gravel with trace coarse gravel (up to 3").		
70		9	CL				
			CL				
75			SC				
			SC				
80							

Date Boring Started: 9/16/21
Date Boring Completed: 9/17/21
Logged By: KAM
Drilling Contractor: Cascade Drilling
Drill Rig: Mini-sonic

Remarks:
-Well developed more than 48 hours after grouting annular space by surging and overpumping.
Approximately 420 gallons purged.
-Final well completion occurred on 9-21-2021.

Additional data may have been collected in the field which is not included on this log.

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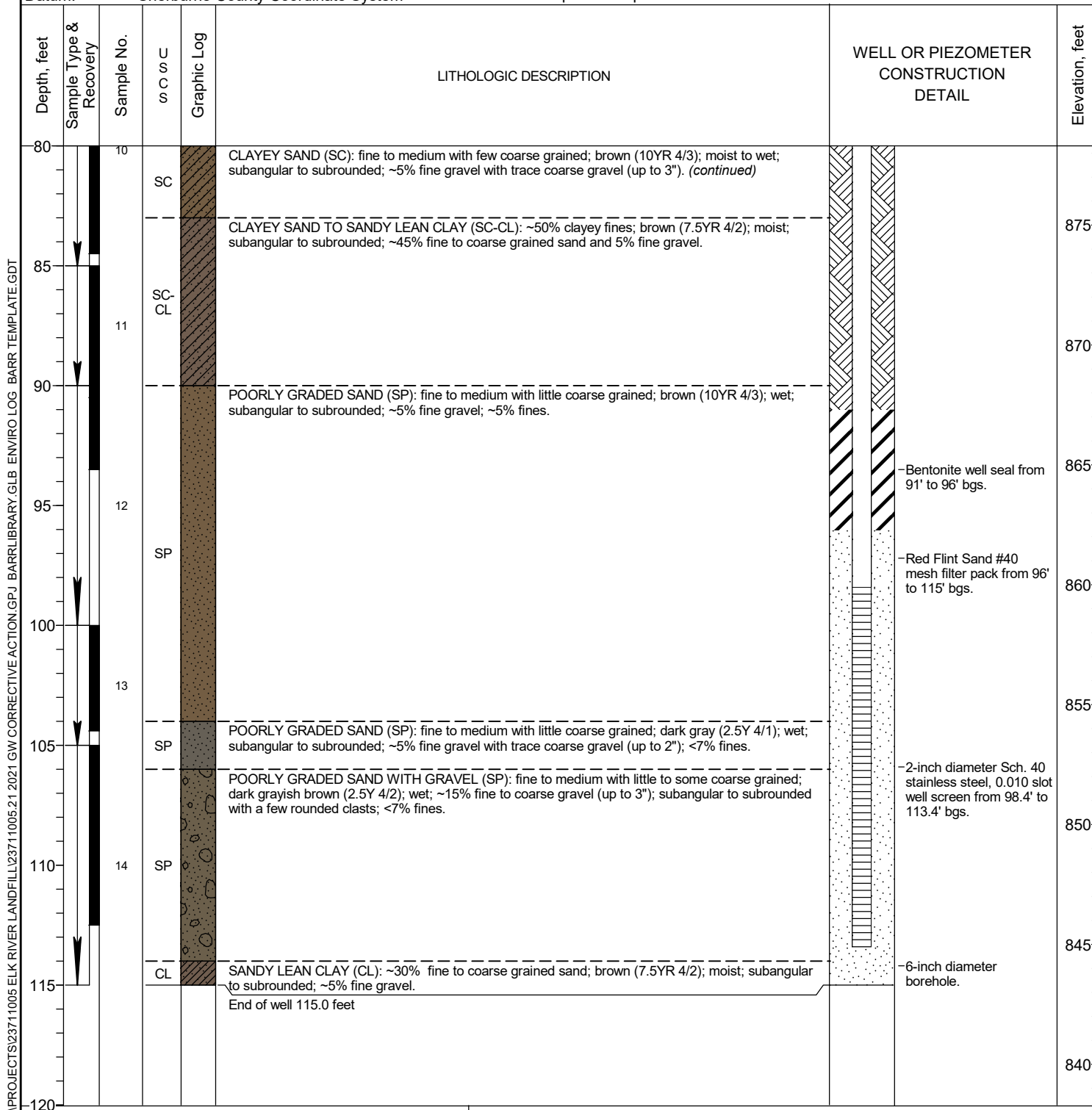


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4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF WELL P-338L

SHEET 3 OF 3

Project:	Elk River Landfill Groundwater Corrective Action	Surface Elevation:	958.3 ft	Top of Casing Elev.:	961.13 ft
Project No.:	23/71-1005.21	Drilling Method:	Sonic	Unique Well No.:	853139
Location:	Elk River, MN	Sampling Method:	Sonic Core		
Coordinates:	N 246,826.8 ft E 577,160.1 ft	Completion Depth:	115.0 ft		
Datum:	Sherburne County Coordinate System				

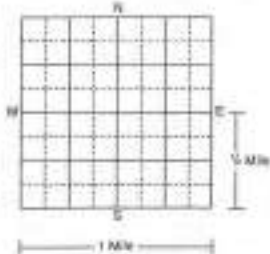


Date Boring Started: 9/16/21
Date Boring Completed: 9/17/21
Logged By: KAM
Drilling Contractor: Cascade Drilling
Drill Rig: Mini-sonic

Remarks:
-Well developed more than 48 hours after grouting annular space by surging and overpumping.
Approximately 420 gallons purged.
-Final well completion occurred on 9-21-2021.

Additional data may have been collected in the field which is not included on this log.

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WELL OR BORING LOCATION					MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING CONSTRUCTION RECORD <i>Minnesota Statutes, chapter 103J</i>		MINNESOTA UNIQUE WELL AND BORING NO. 853139	
County Name <u>Sherburne</u>					WELL/BORING DEPTH (completed) <u>114</u>		DATE WORK COMPLETED <u>9-17-21</u>	
Township Name <u>Elk River</u>	Township No. <u>33</u>	Range No. <u>26</u>	Section No. <u>4</u>	Fraction (pm. → to) <u>50 50 NW</u>	DRILLING METHOD ☐ Cable Tool ☐ Auger ☐ Other		☐ Driven ☐ Rotary ☒ Dual Rotary ☐ Rotasonic	
GPS LOCATION — decimal degrees (to four decimal places) Latitude _____ Longitude _____					DRILLING FLUID <u>N/A</u>		WELL HYDROFRACTURED? ☐ Yes ☒ No	
House Number, Street Name, City, and ZIP Code of Well Location <u>OUTLOT D, 225th CT Elk River 55330</u>					USE ☐ Domestic ☐ Noncommunity PWS ☐ Community PWS ☐ Elevator		☒ Monitoring ☐ Irrigation ☐ Dewatering ☐ Heating/Cooling ☐ Industry/Commercial ☐ Remedial	
Show exact location of well/boring in section grid with "X".  <u>SEE MAP</u>					CASING MATERIAL ☒ Steel ☐ Plastic		Drive Shaft? ☐ Yes ☒ No ☒ Threaded ☐ Welded	
PROPERTY OWNER'S NAME/COMPANY NAME <u>Ridges of Rice HOA</u> Property owner's mailing address if different than well location address indicated above. <u>12656 224th CT NW</u> <u>Elk River, MN 55330</u>					CASING Diameter <u>2</u> in. To <u>99</u> ft. Weight _____ lbs./ft. Specifications <u>SCH 40</u>		HOLE DIAM. <u>6</u> in. To <u>114</u> ft.	
					SCREEN <u>YES</u> Make <u>Johnson</u> Type <u>SS</u> Size/Gauge <u>10/10</u> Set between <u>114</u> ft. and <u>99</u> ft.		OPEN HOLE From _____ ft. To _____ ft. Diam. <u>24</u> Length <u>15'</u> Fittings <u>T&C</u>	
WELL OWNER'S NAME/COMPANY NAME <u>Elk River Landfill Inc</u> Wellboring owner's mailing address if different than property owner's address indicated above. <u>22460 HWY 169 NW</u> <u>Elk River, MN 55330</u>					STATIC WATER LEVEL <u>15</u> ft. ☒ Below ☐ Above land surface		Date measured <u>9-17-21</u> Dry hole ☐ Yes ☒ No	
					PUMPING LEVEL (below land surface) <u>N/A</u> ft. after _____ hrs. pumping _____ g.p.m.			
GEOLOGICAL MATERIALS					WELL-HEAD COMPLETION ☐ Pile/adaptor manufacturer _____ Model _____ ☒ Casing protection <u>Plastic</u> ☐ At-grade ☐ Well House ☐ Hand Pump		GROUT INFORMATION (specify bentonite, cement-sand, neat-cement, concrete, cuttings, or other) Material <u>NEAT CEMENT</u> From <u>91</u> To <u>0</u> ft. <u>15</u> ☐ Yds. ☒ Bags	
					Material _____ From _____ To _____ ft. ☐ Yds. ☐ Bags		Material _____ From _____ To _____ ft. ☐ Yds. ☐ Bags	
NEAREST KNOWN SOURCE OF CONTAMINATION Well is _____ feet _____ direction from _____ type _____ Well disinfected upon completion? ☐ Yes ☒ No					PUMP ☒ Not installed Date installed _____ Manufacturer's name _____		Model Number _____ HP _____ Volts _____	
					Length of drop pipe _____ ft. Capacity _____ g.p.m.		Type: ☐ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet ☐ _____	
REMARKS, ELEVATION, SOURCE OF DATA, etc. <u>117-21-1056</u> <u>P-338 L</u>					ABANDONED WELLS Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No		VARIANCE Was a variance granted from the MDH for this well? ☐ Yes ☒ No	
					WELL CONTRACTOR CERTIFICATION This well was drilled under my supervision and in accordance with Minnesota Rules, chapter 4725. The information contained in this report is true to the best of my knowledge. <u>CASCADE Drilling 3267</u> Licensee Business Name _____ Lic. or Reg. No. _____ <u>Bell Bury 2651 11-4-21</u> Certified Representative Signature _____ Certified Rep. No. _____ Date _____ <u>Roy Buckenbueger</u> Name of weller _____			



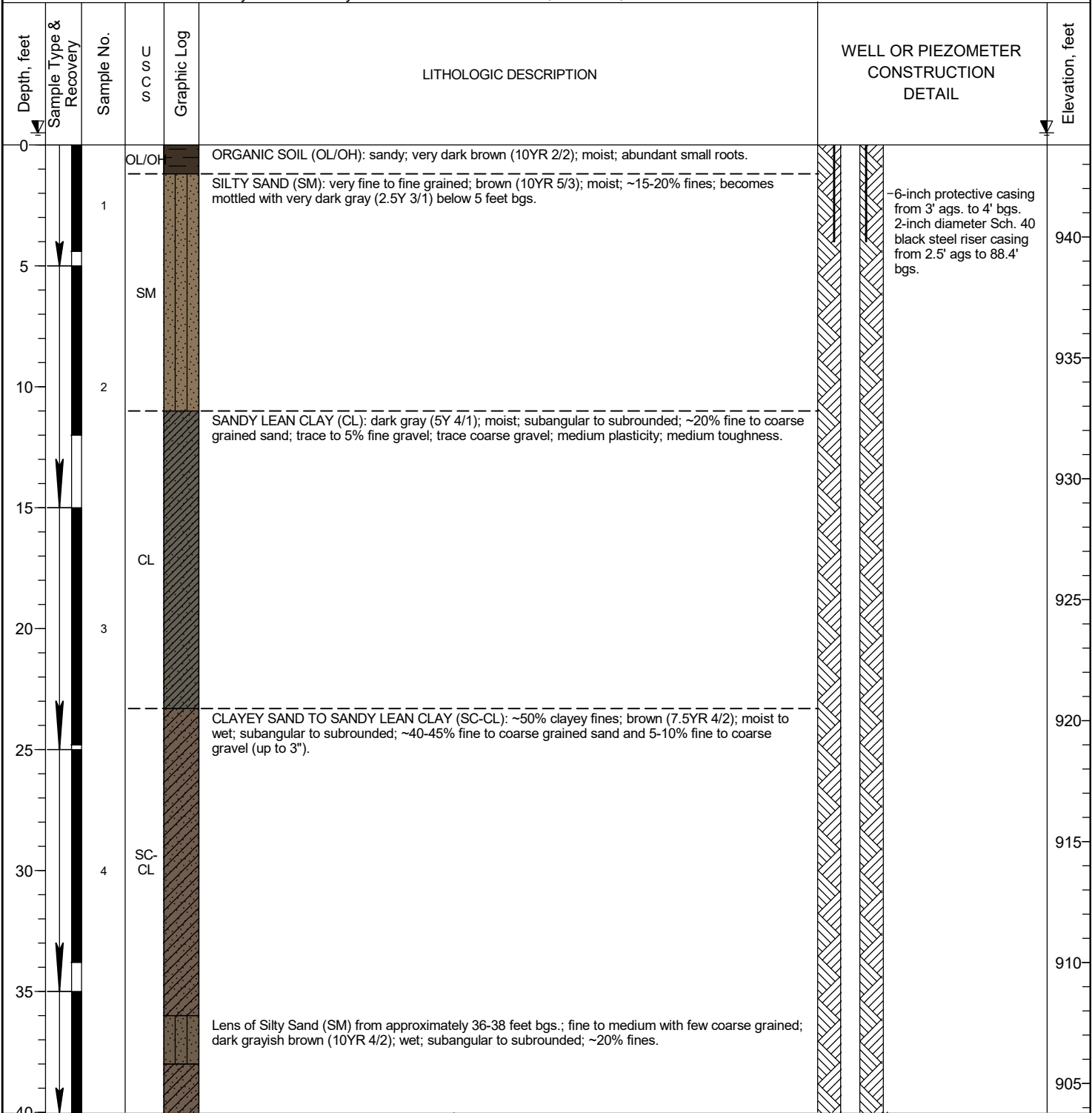
Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF WELL P-340L

SHEET 1 OF 3

Project:	Elk River Landfill Groundwater Corrective Action	Surface Elevation:	943.8 ft	Top of Casing Elev.:	946.43 ft
Project No.:	23/71-1005.21	Drilling Method:	Sonic	Unique Well No.:	853140
Location:	Elk River, MN	Sampling Method:	Sonic Core		
Coordinates:	N 250,146.2 ft E 574,958.2 ft	Completion Depth:	105.0 ft		
Datum:	Sherburne County Coordinate System				

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Date Boring Started: 9/14/21
Date Boring Completed: 9/14/21
Logged By: KAM
Drilling Contractor: Cascade Drilling
Drill Rig: Mini-sonic

Remarks:
-Well developed prior to grouting annular space by surging and overpumping. Approximately 520 gallons purged.
-Final well completion occurred on 9-21-2021.

Additional data may have been collected in the field which is not included on this log.



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LOG OF WELL P-340L

SHEET 2 OF 3

Project:	Elk River Landfill Groundwater Corrective Action	Surface Elevation:	943.8 ft	Top of Casing Elev.:	946.43 ft
Project No.:	23/71-1005.21	Drilling Method:	Sonic	Unique Well No.:	853140
Location:	Elk River, MN	Sampling Method:	Sonic Core		
Coordinates:	N 250,146.2 ft E 574,958.2 ft	Completion Depth:	105.0 ft		
Datum:	Sherburne County Coordinate System				

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Depth, feet	Sample Type & Recovery	Sample No.	U C S	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
40		5					
45					Lens of Silty Sand (SM) from approximately 43.3-44 feet bgs.; fine to medium with little coarse grained; brown (7.5YR 4/2); wet; subangular to subrounded; ~20-25% fines.		900
50		6					895
55			SM-SC		SILTY TO CLAYEY SAND (SM-SC): fine to medium with few coarse grained; brown (7.5YR 4/2); moist to wet; subangular to subrounded; ~5-10% fine gravel; trace coarse gravel; ~40% fines.		890
60			SP-SM		POORLY GRADED SAND WITH SILT (SP-SM): fine to coarse grained; dark grayish brown (10YR 4/2); wet; subangular to subrounded; ~5% fine gravel increases with depth to ~10-15%; some coarse gravel below ~57 feet bgs; ~10% fines.		885
65		7	SM		SILTY SAND (SM): fine to medium with trace coarse grained; brown (7.5YR 4/2); moist to wet; subangular to subrounded; ~5% fine gravel; ~40% fines.		880
70					Lens of Silt (ML) from approximately 64-64.4 feet bgs; brown (7.5YR 4/2); moist to wet; rapid dilatancy.		875
75		8					870
80			SP		POORLY GRADED SAND (SP): fine to medium with few coarse grained; brown (10YR 4/3); wet; subangular to subrounded; a little coarse grained sand with trace to 5% fine gravel below 101 feet bgs; coarse gravel (5-6 pieces) at base; trace fines; The 75-85' and 85-95' sample intervals fell out during extraction and were not recovered. Core barrel sample residuals recovered from these intervals are consistent with poorly graded sand as described. Driller reported heaving sands for these intervals.		865

Date Boring Started: 9/14/21
Date Boring Completed: 9/14/21
Logged By: KAM
Drilling Contractor: Cascade Drilling
Drill Rig: Mini-sonic

Remarks:
-Well developed prior to grouting annular space by surging and overpumping. Approximately 520 gallons purged.
-Final well completion occurred on 9-21-2021.

Additional data may have been collected in the field which is not included on this log.



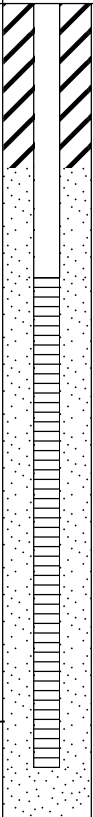
Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF WELL P-340L

SHEET 3 OF 3

Project:	Elk River Landfill Groundwater Corrective Action	Surface Elevation:	943.8 ft	Top of Casing Elev.:	946.43 ft
Project No.:	23/71-1005.21	Drilling Method:	Sonic	Unique Well No.:	853140
Location:	Elk River, MN	Sampling Method:	Sonic Core		
Coordinates:	N 250,146.2 ft E 574,958.2 ft	Completion Depth:	105.0 ft		
Datum:	Sherburne County Coordinate System				

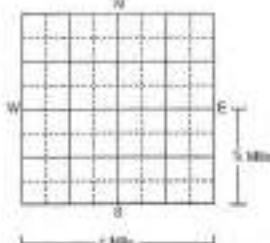
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Depth, feet	Sample Type & Recovery	Sample No.	SSC	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
80		9			POORLY GRADED SAND (SP): fine to medium with few coarse grained; brown (10YR 4/3); wet; subangular to subrounded; a little coarse grained sand with trace to 5% fine gravel below 101 feet bgs; coarse gravel (5-6 pieces) at base; trace fines; The 75-85' and 85-95' sample intervals fell out during extraction and were not recovered. Core barrel sample residuals recovered from these intervals are consistent with poorly graded sand as described. Driller reported heaving sands for these intervals. <i>(continued)</i>		860
85							
90		10	SP				855
95							850
100		11					845
105			CL		SANDY LEAN CLAY (CL): brown to dark brown (7.5YR 3.5/2); moist to wet; subangular to subrounded; ~40% fine to coarse grained sand and 5% mostly fine gravel with trace coarse gravel (up to 1.75"); medium plasticity; medium toughness.		840
					End of well 105.0 feet		
110							835
115							830
120							825

Date Boring Started: 9/14/21
Date Boring Completed: 9/14/21
Logged By: KAM
Drilling Contractor: Cascade Drilling
Drill Rig: Mini-sonic

Remarks:
-Well developed prior to grouting annular space by surging and overpumping. Approximately 520 gallons purged.
-Final well completion occurred on 9-21-2021.

Additional data may have been collected in the field which is not included on this log.

WELL OR BORING LOCATION					MINNESOTA DEPARTMENT OF HEALTH WELL AND BORING CONSTRUCTION RECORD Minnesota Statutes, chapter 103I		MINNESOTA UNIQUE WELL AND BORING NO. 853140	
County Name Sherburne					TOWNSHIP NAME Elk River		TOWNSHIP NO. 34	
Range No. 26					Section No. 33		Fraction (am. → + lg.) NW 50 50	
GPS LOCATION — decimal degrees (to four decimal places). Latitude _____ Longitude _____					WELL/BORING DEPTH (completed) 103		DATE WORK COMPLETED 9-14-21	
House Number, Street Name, City, and ZIP Code of Well Location 22460 Hwy 169, Elk River 55330					DRILLING METHOD ☐ Cable Tool ☐ Driven ☐ Dual Rotary ☐ Auger ☐ Rotary ☒ Solenoid ☐ Other		DRILLING FLUID N/A	
Show exact location of well/boring in section grid with "X". 					WELL HYDROFRACTURED? ☐ Yes ☒ No		From _____ ft. To _____ ft.	
USE ☐ Domestic ☒ Monitoring ☐ Heating/Cooling ☐ Noncommunity PWS ☒ Irrigation ☐ Industry/Commercial ☐ Community PWS ☐ Dewatering ☐ Remedial ☐ Elevator					CASING MATERIAL ☒ Steel ☐ Plastic		Drive Shoe? ☐ Yes ☒ No ☒ Threaded ☐ Welded	
CASING DIAMETER 2 in. To 88 ft. _____ lbs./ft. SC440					Weight		Specifications 6 in. To 103 ft.	
PROPERTY OWNER'S NAME/COMPANY NAME Elk River Landfill Inc					Property owner's mailing address if different than well location address indicated above. 22460 Hwy 169 NW Elk River, MN 55330		SCREEN YES Make Johnson Type SS Slot/Gauge .010 Set between 103 ft. and 88 ft. FITTINGS T+C	
WELL OWNER'S NAME/COMPANY NAME SAME					Property owner's mailing address if different than property owner's address indicated above. SAME		OPEN HOLE From _____ ft. To _____ ft.	
WELL/BORING OWNER'S MAILING ADDRESS IF DIFFERENT THAN PROPERTY OWNER'S ADDRESS INDICATED ABOVE. SAME					STATIC WATER LEVEL Date measured 9-14-21 ☒ Ground ☐ Below ☐ Above land surface Dry hole ☐ Yes ☒ No		PUMPING LEVEL (below land surface) N/A ft. after _____ hrs. pumping _____ g.p.m.	
WELLHEAD COMPLETION ☐ Pile/adapter manure ☐ Model _____ ☒ Casing protection Protop ☒ in. above grade ☐ At-grade ☐ Well House ☐ Hand Pump					GROUT INFORMATION (specify bentonite, cement sand, neat cement, concrete, outtings, or other) Material Neat cement From 81 To 0 ft. _____ Yds. ☒ Bags Material _____ From _____ To _____ ft. _____ Yds. ☐ Bags Material _____ From _____ To _____ ft. _____ Yds. ☐ Bags Driven casing seal From _____ To _____ Bags One bag = 60 lbs. cement or 90 lbs. bentonite			
GEOLOGICAL MATERIALS					NEAREST KNOWN SOURCE OF CONTAMINATION			
COLOR					Well is _____ feet _____ direction from _____ type _____			
HARDNESS OF MATERIAL					Well disinfected upon completion? ☐ Yes ☒ No			
FROM					PUMP			
TO					☒ Not installed Date installed _____			
SAND					Manufacturer's name _____			
Silty SAND					Model Number _____ HP _____ Volts _____			
SAND + silt					Length of drop pipe _____ ft. Capacity _____ g.p.m.			
SAND					Type: ☐ Submersible ☐ L.S. Turbine ☐ Reducing ☐ Jet ☐ _____			
					ABANDONED WELLS			
					Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No			
					VARIANCE			
					Was a variance granted from the MDH for this well? ☐ Yes ☒ No TNE			
					WELL CONTRACTOR CERTIFICATION			
					This well was drilled under my supervision and in accordance with Minnesota Rules, chapter 4725. The information contained in this report is true to the best of my knowledge.			
REMARKS, ELEVATION, SOURCE OF DATA, etc. 117-21-1056 P 340 L					CASCAD Drilling 3267 Licensee Business Name _____ Lic. or Reg. No. _____			
					Bull Bury 2651 11-4-21 Certified Representative Signature _____ Certified Rep. No. _____ Date _____			
					Roy Buckenbury Name of Driller _____			



Barr Engineering Co.
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF WELL P-341L

SHEET 1 OF 4

Project:	Elk River Landfill, 2023 Groundwater Corrective Action	Surface Elevation:	986.1 ft	Unique Well No.: 877298
Project No.:	23/71-1005.23	Drilling Method:	Sonic	
Location:	Elk River, MN	Sampling Method:	4" Sonic Core	
Coordinates:	N 245,319.9 ft E 578,868.8 ft	Completion Depth:	145.0 ft	
Datum:	Sherburne County Coordinate System			

Depth, feet	Sample Type & Recovery	Sample No.	U S C S	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0							985
1			SM		SILTY SAND (SM): grass and roots at surface: fine grained with trace medium to coarse grained sand and fine gravel; brown (7.5YR 4/3); moist; subangular to subrounded; approximately 20% fines decrease with depth. [topsoil].	PRO. CASING Diameter: 6" Type: Sch. 40 Steel Interval: 3' ags - 4' bgs	980
5			SP-SM		POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained with ~10-15% coarse grained fraction; trace-5% fine gravel; dark yellowish brown (10YR 4/4); moist; subangular to subrounded; approximately 10% fines. [outwash].	RISER CASING Diameter: 2" Type: Sch. 40 Steel Interval: 2.5' ags-127.5' bgs	975
10					POORLY GRADED SAND (SP): fine grained with ~10% medium and trace coarse grained sand and fine gravel; brown (10YR 5/3); moist; subangular to subrounded; approximately 5% fines. [outwash].	GROUT Type: Neat Cement Interval: 0'-120.5'	970
15						SEAL Type: Bentonite Interval: 120.5'-124.8'	965
20					20-22 feet - dark yellowish brown (10YR 4/4) lens containing ~15% coarse grained sand fraction and 10% fine gravel.	SANDPACK Type: #40 Red Flint Interval: 124.8'-142.5'	960
25			SP		26-27 feet - dark yellowish brown (10YR 4/4) lens containing ~15% coarse grained sand fraction and 10% fine gravel.	SCREEN Diameter: 2" Type: Stainless Steel Interval: 127.5'-142.5'	955
30							950
35							
40							

Date Boring Started:	6/1/23 12:30 pm	Remarks: Additional data may have been collected in the field which is not included on this log.
Date Boring Completed:	6/6/23 10:00 am	
Logged By:	KAM	
Drilling Contractor:	Cascade Drilling	
Drill Rig:	Tracked mini-sonic	

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Barr Engineering Co.
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF WELL P-341L

SHEET 2 OF 4

Project:	Elk River Landfill, 2023 Groundwater Corrective Action	Surface Elevation:	986.1 ft	Unique Well No.: 877298
Project No.:	23/71-1005.23	Drilling Method:	Sonic	
Location:	Elk River, MN	Sampling Method:	4" Sonic Core	
Coordinates:	N 245,319.9 ft E 578,868.8 ft	Completion Depth:	145.0 ft	
Datum:	Sherburne County Coordinate System			

Depth, feet	Sample Type & Recovery	Sample No.	U C S S	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
40					POORLY GRADED SAND (SP): fine to medium grained with ~10% coarse grained fraction; 5% fine gravel; dark yellowish brown (10YR 4/4); wet; subangular to subrounded; trace to 5% fines. [outwash].		945
45		6		SP		PRO. CASING Diameter: 6" Type: Sch. 40 Steel Interval: 3' ags - 4' bgs	940
50				SP	POORLY GRADED SAND WITH GRAVEL (SP): medium to coarse grained with ~20% fine grained fraction; ~15-20% fine gravel; dark yellowish brown (10YR 4/4); wet; subangular to subrounded; trace to 5% fines. [outwash].	RISER CASING Diameter: 2" Type: Sch. 40 Steel Interval: 2.5' ags-127.5' bgs	935
55		7		SP	POORLY GRADED SAND (SP): fine to medium grained with ~5% coarse grained fraction; trace fine gravel; brown (10YR 4/3); wet; subangular to subrounded; approximately 5% fines. [outwash]. 53 feet - 1" thick, brown (10YR 5/3), laminated silt lens. 54.6 feet - 1" thick, brown (10YR 5/3), laminated silt lens.	GROUT Type: Neat Cement Interval: 0'-120.5'	930
60					58 feet - 1" thick, brown (10YR 5/3), laminated silt lens.	SEAL Type: Bentonite Interval: 120.5'-124.8'	925
65		8		ML	SILT (ML): gray (5Y 5/1); moist to wet; cohesive; low plasticity; slow dilatancy; low toughness; strong HCl reaction; [lacustrine deposit].	SANDPACK Type: #40 Red Flint Interval: 124.8'-142.5'	920
70					SANDY LEAN CLAY (CL): ~30% fine to coarse grained sand; ~5-10% fine gravel; very dark gray (5Y 3/1); moist; hard; abundant carbonate gravel; medium plasticity; medium toughness; strong HCl reaction; [till]. 70-72.5 feet - dark gray (5Y 4/1) bed of poorly graded sand with silt and gravel (SP-SM); fine to medium grained with ~20% coarse grained fraction and ~15% fine gravel; ~10% fines; appears wet; abundant carbonates. [outwash lens].	SCREEN Diameter: 2" Type: Stainless Steel Interval: 127.5'-142.5'	915
75		9		CL			910
80							

Date Boring Started:	6/1/23 12:30 pm	Remarks: Additional data may have been collected in the field which is not included on this log.
Date Boring Completed:	6/6/23 10:00 am	
Logged By:	KAM	
Drilling Contractor:	Cascade Drilling	
Drill Rig:	Tracked mini-sonic	

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF WELL P-341L

SHEET 3 OF 4

Project:	Elk River Landfill, 2023 Groundwater Corrective Action	Surface Elevation:	986.1 ft	
Project No.:	23/71-1005.23	Drilling Method:	Sonic	Unique Well No.: 877298
Location:	Elk River, MN	Sampling Method:	4" Sonic Core	
Coordinates:	N 245,319.9 ft E 578,868.8 ft	Completion Depth:	145.0 ft	
Datum:	Sherburne County Coordinate System			

Depth, feet	Sample Type & Recovery	Sample No.	U C S S	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
80							905
			CL				
		10	SC		CLAYEY SAND (SC): ~55% fine to medium grained sand with ~10% coarse grained fraction; ~5% fine and trace coarse gravel; ~40% clayey fines; brown (7.5YR 4/2); moist to wet; soft; cohesive; low plasticity; low toughness; weak HCl reaction; [till].	PRO. CASING Diameter: 6" Type: Sch. 40 Steel Interval: 3' ags - 4' bgs	900
			SM		SILTY SAND (SM): fine to medium grained with ~10% coarse grained fraction; ~5% fine gravel; brown (7.5YR 4/2); wet; subangular to subrounded; approximately 15% fines [outwash].	RISER CASING Diameter: 2" Type: Sch. 40 Steel Interval: 2.5' ags-127.5' bgs	895
		11	SP		POORLY GRADED SAND (SP): fine to medium grained with ~10-15% coarse grained fraction; 5-10% fine and trace coarse gravel; brown (7.5YR 4/2); wet; subangular to subrounded; two cobbles (3" & 4") present at ~92 feet bgs; trace fines. [outwash].	GROUT Type: Neat Cement Interval: 0'-120.5'	890
			SM		SILTY SAND (SM): fine to medium grained with trace fine gravel at bottom; brown (7.5YR 4/2); wet; subangular to subrounded; approximately 40% fines. [outwash].	SEAL Type: Bentonite Interval: 120.5'-124.8'	885
					SILTY TO CLAYEY SAND WITH GRAVEL: (SM/SC); approximately 50% sand/gravel and 50% silty to clayey fines; cohesive; hard; brown (7.5YR 4/2); moist; subangular to subrounded; fine to medium grained sand with ~15% coarse grained fraction; ~15% fine and trace coarse gravel; low to medium plasticity; low toughness; weak HCl reaction; [till].	SANDPACK Type: #40 Red Flint Interval: 124.8'-142.5'	880
		12				SCREEN Diameter: 2" Type: Stainless Steel Interval: 127.5'-142.5'	875
			SP		POORLY GRADED SAND (SP): fine grained with ~15% medium to coarse grained fraction; trace fine gravel; grayish brown (2.5Y 5/2); wet; subangular to subrounded; approximately 5% fines. [outwash].		870
		13					
			SP		POORLY GRADED SAND (SP): fine to medium grained with ~10% coarse grained fraction; ~5% fine gravel; light olive brown (2.5Y 5/4); wet; subangular to subrounded; approximately 5% fines; several fining upwards sequences observed. [outwash].		
120							

Date Boring Started: 6/1/23 12:30 pm
Date Boring Completed: 6/6/23 10:00 am
Logged By: KAM
Drilling Contractor: Cascade Drilling
Drill Rig: Tracked mini-sonic

Remarks:

Additional data may have been collected in the field which is not included on this log.

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LOG OF WELL P-341L

SHEET 4 OF 4

Project:	Elk River Landfill, 2023 Groundwater Corrective Action	Surface Elevation:	986.1 ft	Unique Well No.: 877298
Project No.:	23/71-1005.23	Drilling Method:	Sonic	
Location:	Elk River, MN	Sampling Method:	4" Sonic Core	
Coordinates:	N 245,319.9 ft E 578,868.8 ft	Completion Depth:	145.0 ft	
Datum:	Sherburne County Coordinate System			

Depth, feet	Sample Type & Recovery	Sample No.	SSCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
120					POORLY GRADED SAND (SP): fine to medium grained with ~10% coarse grained fraction; ~5% fine gravel; light olive brown (2.5Y 5/4); wet; subangular to subrounded; approximately 5% fines; several fining upwards sequences observed. [outwash]. <i>(continued)</i>		865
125		14			125-127 feet - ~20% coarse grained sand fraction; ~5-10% fine and trace coarse gravel; trace fines.	PRO. CASING Diameter: 6" Type: Sch. 40 Steel Interval: 3' ags - 4' bgs	860
130			SP		131.5-132.5 feet - ~20% coarse grained sand fraction; ~5-10% fine and trace coarse gravel; trace fines.	RISER CASING Diameter: 2" Type: Sch. 40 Steel Interval: 2.5' ags-127.5' bgs	855
135		15			136-137.5 feet - a few coarse gravel pieces throughout interval.	GROUT Type: Neat Cement Interval: 0'-120.5'	850
140					140-141 feet - ~20% coarse grained sand fraction; ~5% fine and trace to 5% coarse gravel; one 3" cobble; ~5% fines; oxidized rusty brown at base.	SEAL Type: Bentonite Interval: 120.5'-124.8'	845
145		16	CL		SAND LEAN CLAY (CL): ~65% clayey fines; ~30% fine to coarse grained sand; trace to 5% fine gravel; very dark gray (5Y 3/1); moist; subangular to subrounded; very hard; abundant carbonates; medium to high plasticity; medium toughness; strong HCl reaction; [till].	SANDPACK Type: #40 Red Flint Interval: 124.8'-142.5'	
					End of well 145.0 feet	SCREEN Diameter: 2" Type: Stainless Steel Interval: 127.5'-142.5'	840
150							835
155							830
160							

Date Boring Started: 6/1/23 12:30 pm
Date Boring Completed: 6/6/23 10:00 am
Logged By: KAM
Drilling Contractor: Cascade Drilling
Drill Rig: Tracked mini-sonic

Remarks:

Additional data may have been collected in the field which is not included on this log.

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WELL OR BORING LOCATION

County Name

SHERBURNE

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING CONSTRUCTION RECORD

Minnesota Statutes, Chapter 103

MINNESOTA UNIQUE WELL
AND BORING NO.

877298

Township Name Section No. Range No. Fraction (lat. --- 30)

E1K River 33N 24W 4 NW 55SE

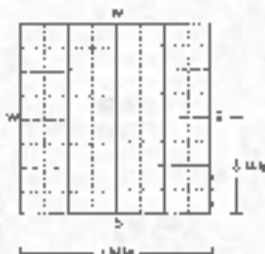
GPS LOCATION — decimal degrees (to four decimal places)

Latitude Longitude

House Number Street Name City and ZIP Code of Well Location

Rural Route (Against NW) E1K River

Show exact location of wellboring in section grid with "X"

Sketch map of wellboring location
Showing property lines,
roads, buildings, and directionSEE
MAP

PROPERTY OWNER'S NAME/COMPANY NAME

E1K River Land, LLC

Property owner's mailing address if different than well location address indicated above

22460 HWY 169 NW
E1K River, MN 55330

WELL OWNER'S NAME/COMPANY NAME

SAME

Wellboring owner's mailing address if different than property owner's address indicated above

SAME

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Top Soil	BL	S	0	6
SAND	G	S	6	31
SAND + clay	BR	M	31	34
SANDS bnd	BR	M	34	142.5

(Use a ground sheet, if needed)

REMARKS, ELEVATION, SOURCE OF DATA, etc.

117-23-1026

P-341 L

WELL IDENTIFICATION (Completed)

142-5

DATE WORK COMPLETED

6-5-23

DRILLING METHOD

☐ Cable Tool
☐ Auger
☐ Other

☐ Drive
☐ Rotary

☐ Blast
☒ Rotary

DRILLING FLUID

N/A

WELL HYDRAULIC TESTED?

From: To: Yes No

USE

☐ Domestic
☐ Noncommunity PWS
☐ Community PWS
☐ Elevation

☒ Irrigation
☐ Domestic

☐ Mining/Quarrying
☐ Industrial/Commercial
☐ Remedial

CASING MATERIAL

☒ Steel
☐ Plastic

☐ Drive Sheet
☒ Precast
☐ Other

WELL HEAD

CASING

Diameter

2 in.

122.5 ft.

100 ft.

100 ft.

100 ft.

100 ft.

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SCREEN

YES

Make

Johnson

Type

SS

Installation

NO

Set between

142.5 ft. and 122.5 ft.

STATIC WATER LEVEL

39

Date measured

6-5-23

PUMPING LEVEL (below land surface)

1.0 ft.

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WELLHEAD COMPLETION

Fluoropolymer manufacture

Casing protection

In grade

Above grade

GROUT INFORMATION (specify bentonite, cement sand, neat cement, grout, cements or other)

Material

Grout

Material

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WELL CONTRACTOR CERTIFICATION

This well was drilled under my supervision and in accordance with Minnesota Rules, chapter 4725

The information contained in this report is true to the best of my knowledge

CASCADIA Drilling 3267

Licensee Business Name

Lic. or Reg. No.

Bull Bay 2657 6/13/23

Certified Representative Signature

Certified Rep. No.

Date

Tomas W. Harrison

Name of Driller

MINN. DEPT. OF HEALTH COPY

877298



Barr Engineering Co.
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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF WELL P-342L

SHEET 1 OF 3

Project:	Elk River Landfill, 2023 Groundwater Corrective Action	Surface Elevation:	943.9 ft	
Project No.:	23/71-1005.23	Drilling Method:	Sonic	Unique Well No.: 871179
Location:	Elk River, MN	Sampling Method:	4" Sonic Core	
Coordinates:	N 246,081.0 ft E 574,891.7 ft	Completion Depth:	110.0 ft	
Datum:	Sherburne County Coordinate System			

Depth, feet	Sample Type & Recovery	Sample No.	U C S	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0					Ice, reed sedge with some organic soil. PEAT (PT): fibric grading to sapric at the base; top 3" frozen then wet; soft; [wetland deposit].		
1			PT			PRO. CASING Diameter: 6" Type: Sch. 40 Steel Interval: 3.5' ags-3.5' bgs	940
5						RISER CASING Diameter: 2" Type: Sch. 40 Steel Interval: 3' ags-85' bgs	935
10			SM		SILTY SAND (SM): fine grained with ~5% medium to coarse grained fraction; dark olive gray (5Y 3/2); wet; loose; approximately 30% fines. [fine alluvium].		
15					POORLY GRADED SAND WITH SILT (SP-SM): fine grained with trace to 5% medium and trace coarse grained fractions; dark gray (5Y 4/1); wet; approximately 10% fines. [fine alluvium/outwash].	GROUT Type: Neat Cement Interval: 0'-78'	930
20						SEAL Type: Bentonite Interval: 78'-83'	925
25			SP-SM			SANDPACK Type: #40 Red Flint Interval: 83'-110'	920
30					POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained with ~trace to 5% coarse grained fraction and ~5% gravel; gray (5Y 4/1); wet; subangular to subrounded; abundant carbonate gravel; approximately 5-10% fines. [outwash].	SCREEN Diameter: 2" Type: Stainless Steel Interval: 84.1'-99.1'	915
35					LEAN TO FAT CLAY (CL/CH): ~85% fines with ~10% fine grained sand and ~5% fine gravel; very dark gray (5Y3/1); moist; firm; high plasticity; high toughness; weak HCl reaction; [till].		910
40			CL/CH		Below ~34 feet clay becomes leaner and sand content increases to ~20% fine to coarse grained.		905

Date Boring Started:	3/3/23 8:00 am	Remarks:	Boring B342 is located approximately 21 feet west, southwest of monitoring well.
Date Boring Completed:	3/7/23 12:05 pm		
Logged By:	KAM		
Drilling Contractor:	Cascade Drilling		
Drill Rig:	Tracked mini-sonic		

Additional data may have been collected in the field which is not included on this log.

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LOG OF WELL P-342L

SHEET 2 OF 3

Project:	Elk River Landfill, 2023 Groundwater Corrective Action	Surface Elevation:	943.9 ft	
Project No.:	23/71-1005.23	Drilling Method:	Sonic	Unique Well No.: 871179
Location:	Elk River, MN	Sampling Method:	4" Sonic Core	
Coordinates:	N 246,081.0 ft E 574,891.7 ft	Completion Depth:	110.0 ft	
Datum:	Sherburne County Coordinate System			

Depth, feet	Sample Type & Recovery	Sample No.	U C S	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
40		7	CL/CH		LEAN TO FAT CLAY (CL/CH): ~85% fines with ~10% fine grained sand and ~5% fine gravel; very dark gray (5Y3/1); moist; firm; high plasticity; high toughness; weak HCl reaction; [till]. (continued)		
45					POORLY GRADED SAND (SP): fine to medium grained with ~5% coarse grained fraction; trace fine gravel; brown (10YR 4/3); wet; subangular to subrounded; approximately 5% fines. [outwash].	PRO. CASING Diameter: 6" Type: Sch. 40 Steel Interval: 3.5' ags-3.5' bgs	900
50		8	SP		50 feet - lens with ~20% coarse grained sand fraction and 25% fine to coarse gravel with two 3.5" cobbles. Below 51.5 feet - medium to coarse grained with ~15% fine grained sand fraction and trace coarse gravel.	RISER CASING Diameter: 2" Type: Sch. 40 Steel Interval: 3' ags-85' bgs	895
55			CL		SANDY LEAN CLAY (CL): ~65% fines with ~30% mostly fine sand and ~5% fine gravel; gray (5Y 4/1); moist; hard; subangular to subrounded gravel; [till].	GROUT Type: Neat Cement Interval: 0'-78'	890
			SP		POORLY GRADED SAND (SP): fine to medium grained with ~5% coarse grained fraction; trace fine gravel; grayish brown (2.5Y 5/2); wet; subangular to subrounded; approximately 5% fines. [outwash].	SEAL Type: Bentonite Interval: 78'-83'	
60		9	CL		SANDY LEAN CLAY (CL): ~65% fines with ~30% mostly fine sand and ~5% fine gravel; gray (5Y 4/1); moist; hard; a few interbedded sand stringers; subangular to subrounded gravel; [till].	SANDPACK Type: #40 Red Flint Interval: 83'-110'	885
65					POORLY GRADED SAND (SP): fine to medium grained with ~15% coarse grained fraction; ~5% fine gravel; grayish brown (2.5Y 5/2); wet; subangular to subrounded; approximately 5% fines. [outwash].	SCREEN Diameter: 2" Type: Stainless Steel Interval: 84.1'-99.1'	880
70		10	SP		66-77 feet - ~10% coarse grained sand fraction; trace to 5% fine gravel.		875
75							870
80							865

Date Boring Started:	3/3/23 8:00 am	Remarks:	Boring B342 is located approximately 21 feet west, southwest of monitoring well.
Date Boring Completed:	3/7/23 12:05 pm		
Logged By:	KAM		
Drilling Contractor:	Cascade Drilling		
Drill Rig:	Tracked mini-sonic		

Additional data may have been collected in the field which is not included on this log.

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LOG OF WELL P-342L

SHEET 3 OF 3

Project:	Elk River Landfill, 2023 Groundwater Corrective Action	Surface Elevation:	943.9 ft	Unique Well No.: 871179
Project No.:	23/71-1005.23	Drilling Method:	Sonic	
Location:	Elk River, MN	Sampling Method:	4" Sonic Core	
Coordinates:	N 246,081.0 ft E 574,891.7 ft	Completion Depth:	110.0 ft	
Datum:	Sherburne County Coordinate System			

Depth, feet	Sample Type & Recovery	Sample No.	SSC	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
80		11			POORLY GRADED SAND (SP): fine to medium grained with ~15% coarse grained fraction; ~5% fine gravel; grayish brown (2.5Y 5/2); wet; subangular to subrounded; approximately 5% fines. [outwash]. (continued) 82 feet - 0.4' thick lens of very dark gray (5Y 3/1), very hard, moist, fat clay (CH).	PRO. CASING Diameter: 6" Type: Sch. 40 Steel Interval: 3.5' ags-3.5' bgs	860
85					87.5-88.5 feet - lens of fine grained silty sand (SM) with trace fine gravel; ~20% fines; wet. 88.5 feet - 0.4' thick lens of very dark gray (5Y 3/1), hard, moist, fat clay (CH).	RISER CASING Diameter: 2" Type: Sch. 40 Steel Interval: 3' ags-85' bgs	855
90		12	SP		90.7-91.7 feet - lens of fine grained silty sand (SM) with trace fine gravel; ~20% fines; wet.	GROUT Type: Neat Cement Interval: 0'-78'	850
95					97-98.5 feet - ~20% coarse grained fraction and ~10-15% fine to coarse gravel.	SEAL Type: Bentonite Interval: 78'-83'	
100		13	SM		SILTY SAND (SM): fine grained with ~15% medium to coarse grained fraction; trace fine gravel; grayish brown (2.5Y 5/2); wet; subangular to subrounded; approximately 15% fines [outwash].	SANDPACK Type: #40 Red Flint Interval: 83'-110'	845
105					CLAYEY SAND (SC): ~60% sand and gravel, ~40% fines; fine to medium grained with ~10% coarse grained fraction; ~10% fine gravel; dark grayish brown (2.5Y 4/2); moist; subangular to subrounded gravel; firm; cohesive; low plasticity; low toughness; [till].	SCREEN Diameter: 2" Type: Stainless Steel Interval: 84.1'-99.1'	840
110		14	SC		End of well 110.0 feet		835
115							830
120							825

Date Boring Started: 3/3/23 8:00 am
Date Boring Completed: 3/7/23 12:05 pm
Logged By: KAM
Drilling Contractor: Cascade Drilling
Drill Rig: Tracked mini-sonic

Remarks: Boring B342 is located approximately 21 feet west, southwest of monitoring well.

Additional data may have been collected in the field which is not included on this log.

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Barr Engineering Co.
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LOG OF BORING B342

SHEET 1 OF 1

Project:	Elk River Landfill, 2023 Groundwater Corrective Action	Surface Elevation:	943.9 ft
Project No.:	23/71-1005.23	Drilling Method:	Sonic
Location:	Elk River, MN	Sampling Method:	Blind Drill
Coordinates:	N 246,082.2 ft E 574,870.3 ft	Completion Depth:	55.0 ft
Datum:	Sherburne County Coordinate System		

Depth, feet	Sample Type & Recovery	Sample No.	SSC	Graphic Log	LITHOLOGIC DESCRIPTION	Elevation, feet
0					Boring blind drilled for installation of a temporary well screened 45-55 ft. bgs. See Log of Well P-342L for lithology description.	940
5						935
10						930
15						925
20						920
25						915
30						910
35						905
40						900
45						895
50						890
55					End of boring 55.0 feet	885

Date Boring Started:	3/7/23 12:05 pm	Remarks:	Boring B342 is located approximately 21 feet west, southwest of monitoring well P-342L.
Date Boring Completed:	3/7/23 4:30 pm	Temporary well screen set 45-55 ft. bgs. Boring permanently sealed with neat cement grout after water sample collection.	
Logged By:	KAM	Additional data may have been collected in the field which is not included on this log.	
Drilling Contractor:	Cascade Drilling		
Drill Rig:	Tracked mini-sonic		

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Appendix D

Groundwater Monitoring Data (2021-2023)

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type				P-17C 7/13/2021 N	P-17C 10/20/2021 N FD		P-17C 4/14/2022 N	P-17C 5/10/2022 N	P-17C 7/14/2022 N	P-17C 11/03/2022 N	P-17C 7/24/2023 N	P-22L 4/22/2021 N	P-22L 7/12/2021 N	P-22L 10/20/2021 N	P-22L 4/13/2022 N	P-22L 5/10/2022 N	P-22L 7/14/2022 N	P-22L 11/02/2022 N	P-22L 7/24/2023 N	P-29C 4/21/2021 N	P-29C 7/12/2021 N	P-29C 10/15/2021 N	
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																			
Effective Date			11/13/2023	07/23/2015																			
Exceedance Key			Bold	<u>Underline</u>																			
Volatile Organic Compounds																							
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U J4	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	--	< 0.500 U	< 0.500 U	< 0.500 U H	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	--	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	--	< 0.750 U	< 0.750 U	< 0.750 U H	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	--	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	4.68	3.66	4.79
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U	< 1.00 U C3	< 1.00 U C3	--	< 1.00 U	< 1.00 U J3	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	--	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U C4 J4	< 1.00 U	< 1.00 U C4 H	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	--	< 1.00 U C4 J4	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4
1,2,4-Trimethylbenzene	NA	ug/l	30 HRL23	25.0	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dibromo-3-chloropropane (DBCP)	NA	ug/l		0.05	< 1.00 U	< 1.00 U C3	< 1.00 U C3	--	< 1.00 U C3	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	--	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3
1,1-Dibromoethane (EDB)	NA	ug/l	0.03 HRL23 (1)	0.001	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichlorobenzene	NA	ug/l	600 HRL93	150.0	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethane	NA	ug/l	1 HRL13 (1)	<u>0.25</u>	< 0.250 U	< 0.250 U	< 0.250 U	--	< 0.250 U	< 0.250 U	< 0.250 U H	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	--	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U C5	< 0.250 U	< 0.250 U
1,2-Dichloropropene, cis	NA	ug/l	6 HRL18 (1)	12.5	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	0.286	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethylene, trans	NA	ug/l	9 HRL23 (1)	10.0	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloropropane	NA	ug/l	3 HRL23 (1)	1.25	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3,5-Trimethylbenzene	NA	ug/l	30 HRL23 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropene, cis	NA	ug/l	2 DCP HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	--	< 0.500 U	< 0.500 U	< 0.500 U H	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	--	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,3-Dichloropropene, trans	NA	ug/l	2 DCP HRL94		< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,4-Dichlorobenzene	NA	ug/l	50 HRL23	<u>2.5</u>	<u>2.54</u>	<u>2.39</u>	<u>2.45</u>	--	<u>2.10</u>	<u>2.63</u>	<u>2.44 H</u>	<u>2.16</u>	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
2,2-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U J4	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Acetone	NA	ug/l	3000 HRL23 (1)	1000	< 10.0 U C5	< 10.0 U C3	< 10.0 U C3	--	< 10.0 U	< 10.0 U C5 J4	< 10.0 U H	< 10.0 U C5	< 10.0 U J4	< 10.0 U C3	< 10.0 U C3	--	< 10.0 U	< 10.0 U J4	< 10.0 U	< 10.0 U	< 10.0 U J4	< 10.0 U C3	< 10.0 U
Allyl chloride	NA	ug/l	30 HRL94	7.5	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Benzene	NA	ug/l	2 HRL09 (1)	<u>0.5</u>	<u>1.09</u>	<u>1.14</u>	<u>1.05</u>	--	<u>0.889</u>	<u>1.07</u>	<u>0.963 H</u>	<u>1.08</u>	< 0.500 U	< 0.500 U	< 0.500 U	--	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U C5 J4
Bromobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromochloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromodichloromethane	NA	ug/l	3 HRL23 (1)	1.5	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromoform	NA	ug/l	40 HRL93	10.0	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U C3	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U J3 H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, sec	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, tert	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U
Carbon tetrachloride	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	--	< 0.250 U	< 0.250 U	< 0.250 U H	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	--	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U
Chlorobenzene	NA	ug/l	100 HRL93	25.0	4.09	3.66	3.53	--	2.38	3.33	3.13 H	4.03	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Chlorodibromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Chloroethane	NA	ug/l	ND RAA16		< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U H	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Chloroform	NA	ug/l	20 HRL18																				

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type					P-17C 7/13/2021 N	P-17C 10/20/2021 N FD		P-17C 4/14/2022 N	P-17C 5/10/2022 N	P-17C 7/14/2022 N	P-17C 11/03/2022 N	P-17C 7/24/2023 N	P-22L 4/22/2021 N	P-22L 7/12/2021 N	P-22L 10/20/2021 N	P-22L 4/13/2022 N	P-22L 5/10/2022 N	P-22L 7/14/2022 N	P-22L 11/02/2022 N	P-22L 7/24/2023 N	P-29C 4/21/2021 N	P-29C 7/12/2021 N	P-29C 10/15/2021 N
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table 11/13/2023	Elk River Groundwater Limits Table - SW-74 07/23/2015																			
Effective Date																							
Exceedance Key			Bold	<u>Underline</u>																			
General Parameters																							
Alkalinity, total, as CaCO3	NA	mg/l			1000	--	--	1100	--	1050	1070	1090	277	246	--	154	--	162	126	187	--	477	--
Anions	NA	meq/l			31.4	--	--	--	--	34.3	--	30.2	6.66	6.20	--	--	--	--	--	5.34	--	11.6	--
Carbon, total organic	NA	mg/l			68.7	--	--	40.0	--	54.0	50.4	41.4	--	< 1.00 U	--	1.86	--	1.48 B	3.16	< 1.00 U	--	--	--
Cations	NA	meq/l			33.3	--	--	--	--	32.5	--	28.0	10.4	5.90	--	--	--	--	--	5.22	--	11.3	--
Chloride	NA	mg/l			400	--	--	423	--	466	434	297	33.3	36.6	--	38.1	--	41.9	36.1	33.5	--	53.8	--
Dissolved oxygen, field test kit					--	--	--	5	--	4	4	--	--	--	--	--	--	< 1	< 1	--	--	--	--
Dissolved oxygen, field YSI	NA	mg/l			4.3	6	--	5.7	4.3	5.0	15.2	2.4	1.3	0.8	0.7	0.5	0.6	0.4	0.7	1.1	1.1	1.4	3
Ethane	NA	mg/l			0.0011	--	--	0.0012	--	0.00095 J	0.00084 J	< 0.00017 U	--	< 0.0010	--	< 0.0010 U	--	0.00024 J	< 0.00017 U	< 0.00017 U	--	--	--
Ethylene	NA	mg/l			< 0.0010	--	--	< 0.0010 U	--	< 0.00024 U	< 0.00024 U	< 0.00024 U	--	< 0.0010	--	< 0.0010 U	--	< 0.00024 U	< 0.00024 U	< 0.00024 U	--	--	--
Iron, ferrous, FE II, field	NA	mg/l			13.5	--	--	3.3 >	--	12.0	2.03	> 3.30	--	0.50	--	--	--	12.0	0.07	0.05	--	--	--
Manganese II, field	NA	mg/l			300	--	--	--	--	--	0.167	0.361	--	1.1	--	--	--	--	0.008	0.150	--	--	--
Methane	NA	mg/l			1.9	--	--	0.88	--	1.1	0.93	0.74	--	0.22	--	2.1	--	0.29	0.26	0.0026 J	--	--	--
Nitrogen, ammonia, as N	NA	mg/l			30.0	--	--	--	--	7.62	--	38.6	< 0.100 U	< 0.100 U	--	--	--	--	--	< 0.100 U	--	< 0.100 U	--
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	< 0.100 U	< 0.100 U	--	--	--	--	--	--	--	--	--
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		< 1.00 U	--	--	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	--	< 1.00 U	--	< 1.00 U	< 1.00 U T8	< 1.00 U	--	--	--
pH, field	NA	pH units			6.4	6.54	--	6.63	6.71	6.63	6.70	6.51	6.4	7.5	7.44	7.89	7.93	8.55	9.03	7.72	7.17	7.69	6.6
Redox (oxidation potential), field	NA	mV			-37	-129.4	--	-85	-97	-111	-151	-82	-29	33	-99.6	-114	-88	-97	-40	-123	89.4	129.3	40
Solids, total dissolved	NA	mg/l			1770	--	--	--	--	1690	--	1610	315	319 Q	--	--	--	--	--	292 B	--	591 Q	--
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	77.8 J3	180 J3	--	--	--	--	--	--	--	--	--
Specific conductance @ 25 °C, field	NA	umhos/cm			3117	3221	--	3165	3295	3399	3317	2350	720	522	294	218	365	485	345	504	1028	274	1040
Sulfate, as SO4	NA	mg/l			< 5.00 U	--	--	< 5.00 U	--	5.33	< 5.00 U	< 5.00 U	8.60	17.6	--	< 5.00 U	--	23.6	< 5.00 U	31.2	--	25.0	--
Sulfide, as S ²⁻	NA	mg/l			0.08	--	--	0.10	--	0.15	0.03	0.05	--	0.81	--	--	--	0.65	0.01	0.02	--	--	--
Temperature, field	NA	deg C			16.1	15.3	--	13.8	19.3	15.6	16.1	16.1	11.5	13	11.1	9.3	10.1	13.5	10.4	11.4	10.9	14.5	12.7
Turbidity, field	NA	NTU			37.3	28.3	--	14.9	15	29.9	22.2	23.7	13.1	19.7	17.1	17.5	19.5	11.9	5.3	4.8	11.8	14.3	7.3
Metals																							
Arsenic	Dissolved	ug/l		<u>2.5</u>	<u>23.4</u>	--	--	--	--	<u>23.3</u>	--	<u>21.2</u>	< 2.00 U	< 2.00 U	--	--	--	--	--	< 2.00 U	--	< 2.00 U	--
Boron	Dissolved	ug/l	500 RAA17	<u>250.0</u>	4030	--	--	--	--	3410	--	5100	< 200 U	< 200 U	--	--	--	--	--	< 200 U	--	< 200 U	--
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	< 2.00 U	< 2.00 U	--	--	--	--	--	--	--	--	--
Calcium	Dissolved	mg/l			162	--	--	--	--	161	--	132	73.1	58.1	--	--	--	--	--	50.1	--	143	--
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	< 4.00 U	--	--	--	--	< 4.00 U	--	< 4.00 U	< 4.00 U	< 4.00 U	--	--	--	--	--	< 4.00 U	--	< 4.00 U	--
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	< 10.0 U	< 10.0 U	--	--	--	--	--	--	--	--	--
Iron	Dissolved	ug/l			15300	--	--	--	--	14100	--	13400	97900	206	--	--	--	--	--	< 100 U	--	1100	--
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	< 10.0 U	< 10.0 U	--	--	--	--	--	--	--	--	--
Magnesium	Dissolved	mg/l			105	--	--	--	--	102	--	89.2	34.8	32.9	--	--	--	--	--	30.3	--	46.1	--
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	475	72.1	--	--	--	--	--	--	--	--	--
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	< 0.200 U	< 0.200 U	--	--	--	--	--	--	--	--	--
Potassium	Dissolved	mg/l			22.3	--	--	--	--	27.4	--	28.1	4.35	3.04	--	--	--	--	--	1.66	--	2.73	--
Sodium	Dissolved	mg/l			355	--	--	--	--	340	--	296	4.95	4.54	--	--	--	--	--	4	--	5.09	--
Zinc	Dissolved	ug/l	2000 HRL94	500.0	11.8	--	--	--	--	< 10.0 U	--	12.1	20.8	< 10.0 U	--	--	--	--	--	< 10.0 U	--	< 10.0 U	--

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

					Location	P-29C	P-29C	P-29C	P-29C	P-29C	P-29C	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D

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Initial Performance Evaluation Report
Elk River Landfill

Location				P-29C	P-29C	P-29C	P-29C	P-29C	P-29C	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-29D	P-301C	P-301C	P-301C	P-301C	
Date				4/11/2022	7/12/2022	10/27/2022	4/18/2023	7/18/2023	10/20/2023	4/21/2021	7/12/2021	10/15/2021	4/11/2022	7/12/2022	10/27/2022	4/18/2023	7/18/2023	10/20/2023	4/22/2021	7/12/2021	10/15/2021	4/11/2022	
Sample Type				N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																			
Effective Date			11/13/2023	07/23/2015																			
Exceedance Key			Bold	Underline																			
General Parameters																							
Alkalinity, total, as CaCO3	NA	mg/l			--	457	--	--	469	--	--	195	--	--	176	--	--	180	--	--	511	--	--
Anions	NA	meq/l			--	9.14	--	--	11.9	--	--	3.95	--	--	3.52	--	--	3.64	--	--	11.0	--	--
Carbon, total organic	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Cations	NA	meq/l			--	11.7	--	--	12.0	--	--	3.57	--	--	3.65	--	--	3.38	--	--	13.6	--	--
Chloride	NA	mg/l			--	63.9	--	--	70.4	--	--	< 1.00 U	--	--	< 1.00 U	--	--	< 1.00 U	--	--	26.7	--	--
Dissolved oxygen, field test kit					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Dissolved oxygen, field YSI	NA	mg/l			1.6	0.9	1.9	0.2	1.5	0.6	0.3	0.2	0.8	0.5	0.4	0.8	0.2	0.7	0.2	1.3	0.5	2.1	0.3
Ethane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylene	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron, ferrous, FE II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, ammonia, as N	NA	mg/l			--	0.459	--	--	< 0.100 U	--	--	0.152	--	--	0.564	--	--	< 0.100 U	--	--	< 0.100 U	--	--
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
pH, field	NA	pH units			7.22	7.24	7.30	7.19	6.79	7.22	8.46	8.2	7.15	8.68	8.25	8.37	8.25	7.53	8.27	7.69	7.29	6.52	7.43
Redox (oxidation potential), field	NA	mV			-96	-82	-49	-109	-73	-105	-140.5	117.9	31	-190	-98	-90	-141	-77	-134	-116.3	94.8	101	-113
Solids, total dissolved	NA	mg/l			--	576	--	--	625	--	--	181 Q	--	--	191	--	--	179	--	--	736 Q	--	--
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Specific conductance @ 25 °C, field	NA	umhos/cm			1113	959	947	1186	1035	998	311	317	337	322	340	315	305	323	316	863	378	1143	1016
Sulfate, as SO4	NA	mg/l			--	26.2	--	--	26.7	--	--	< 5.00 U	--	--	< 5.00 U	--	--	< 5.00 U	--	--	140	--	--
Sulfide, as S ²⁻	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Temperature, field	NA	deg C			11.7	12.8	11.1	11.0	12.1	12	10.4	12.3	11.7	11.5	11.9	11.9	10.5	12.0	12.1	11.4	11.7	10.7	10.5
Turbidity, field	NA	NTU			32.4	29.9	25.5	19.1	44.5	15.9	2.5	6.7	2	6.7	8.0	5.9	4.5	7.1	2.3	43.3	8.5	12.1	10.3
Metals																							
Arsenic	Dissolved	ug/l		<u>2.5</u>	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	<u>5.21</u>	--	--
Boron	Dissolved	ug/l	500 RAA17	<u>250.0</u>	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calcium	Dissolved	mg/l			--	149	--	--	147	--	--	41.5	--	--	44.7	--	--	38.5	--	--	149	--	--
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	Dissolved	ug/l			--	1420	--	--	2660	--	--	119	--	--	295	--	--	138	--	--	890	--	--
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	Dissolved	mg/l			--	46.1	--	--	47.1	--	--	15.3	--	--	14.3	--	--	14.7	--	--	69.5	--	--
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	Dissolved	mg/l			--	2.87	--	--	3.64	--	--	1.29	--	--	1.24	--	--	1.36	--	--	2.52	--	--
Sodium	Dissolved	mg/l			--	9.31	--	--	12.8	--	--	4.48	--	--	4.64	--	--	4.74	--	--	7.23	--	--
Zinc	Dissolved	ug/l	2000 HRL94	500.0	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

				Location Date	P-301C 7/12/2022	P-301C 11/01/2022	P-301C 4/18/2023	P-301C 7/19/2023	P-301C 10/20/2023	P-301L 4/23/2021	P-301L 7/13/2021	P-301L 10/15/2021	P-301L 4/11/2022	P-301L 7/12/2022	P-301L 11/01/2022	P-301L 4/18/2023	P-301L 7/19/2023	P-301L 10/20/2023	P-302C 4/22/2021	P-302C 7/12/2021	P-302C 10/15/2021	P-302C 4/14/2022	P-302C 7/14/2022
Sample Type				N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																			
Effective Date			11/13/2023	07/23/2015																			
Exceedance Key			Bold	<u>Underline</u>																			
Volatile Organic Compounds																							
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	1.04	1.05	1.04
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C4
1,2,4-Trimethylbenzene	NA	ug/l	30 HRL23	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dibromo-3-chloropropane (DBCP)	NA	ug/l		0.05	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U
1,2-Dibromoethane (EDB)	NA	ug/l	0.03 HRL23 (1)	0.001	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichlorobenzene	NA	ug/l	600 HRL93	150.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethane	NA	ug/l	1 HRL13 (1)	<u>0.25</u>	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U J4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	<u>0.629 C5 J4</u>	<u>0.388</u>	<u>0.659 C5</u>	<u>0.721</u>	<u>0.568</u>
1,2-Dichloroethylene, cis	NA	ug/l	6 HRL18 (1)	12.5	< 1.00 U	< 1.00 U	< 0.100 U	< 0.100 U	< 0.100 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	0.140	< 0.100 U	0.148	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethylene, trans	NA	ug/l	9 HRL23 (1)	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloropropane	NA	ug/l	3 HRL23 (1)	1.25	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3,5-Trimethylbenzene	NA	ug/l	30 HRL23 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropene, cis	NA	ug/l	2 DCP HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,3-Dichloropropene, trans	NA	ug/l	2 DCP HRL94		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,4-Dichlorobenzene	NA	ug/l	50 HRL23	<u>2.5</u>	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
2,2-Dichloropropane	NA	ug/l			< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Acetone	NA	ug/l	3000 HRL23 (1)	1000	< 10.0 U C5 J4	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U	< 10.0 U J4
Allyl chloride	NA	ug/l	30 HRL94	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Benzene	NA	ug/l	2 HRL09 (1)	<u>0.5</u>	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U C5 J4	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U C5 J4	< 0.500 U
Bromobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromochloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromodichloromethane	NA	ug/l	3 HRL23 (1)	1.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromoform	NA	ug/l	40 HRL93	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U
Bromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, sec	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, tert	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Carbon tetrachloride	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U
Chlorobenzene	NA	ug/l	100 HRL93	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	&		

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type					P-301C 7/12/2022 N	P-301C 11/01/2022 N	P-301C 4/18/2023 N	P-301C 7/19/2023 N	P-301C 10/20/2023 N	P-301L 4/23/2021 N	P-301L 7/13/2021 N	P-301L 10/15/2021 N	P-301L 4/11/2022 N	P-301L 7/12/2022 N	P-301L 11/01/2022 N	P-301L 4/18/2023 N	P-301L 7/19/2023 N	P-301L 10/20/2023 N	P-302C 4/22/2021 N	P-302C 7/12/2021 N	P-302C 10/15/2021 N	P-302C 4/14/2022 N	P-302C 7/14/2022 N
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table 11/13/2023	Elk River Groundwater Limits Table - SW-74 07/23/2015																			
Effective Date																							
Exceedance Key			Bold	<u>Underline</u>																			
General Parameters																							
Alkalinity, total, as CaCO3	NA	mg/l			521	--	--	531	--	--	308	--	--	281	--	--	326	--	--	844	--	710	705
Anions	NA	meq/l			14.3	--	--	13.7	--	--	7.65	--	--	7.34	--	--	7.74	--	--	23.0	--	--	22.0
Carbon, total organic	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19.7	--	23.3	23.9
Cations	NA	meq/l			14.7	--	--	13.2	--	--	7.37	--	--	7.42	--	--	7.41	--	--	21.8	--	--	23.0
Chloride	NA	mg/l			27.2	--	--	25.3	--	--	38.6	--	--	46.7	--	--	33.0	--	--	196	--	292	281
Dissolved oxygen, field test kit					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.4	1
Dissolved oxygen, field YSI	NA	mg/l			0.5	2.8	0.8	0.6	1	0.5	0.5	0.9	0.8	0.9	0.7	0.5	0.7	0.8	1.5	2.0	2.5	0.5	1.3
Ethane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0045	--	< 0.0010 U	0.00090 J
Ethylene	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.0010	--	< 0.0010 U	< 0.00024 U
Iron, ferrous, FE II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.2	--	0.94	5.8
Manganese II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.8	--	--	--
Methane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.56	--	21	32
Nitrogen, ammonia, as N	NA	mg/l			0.408	--	--	< 0.100 U	--	--	< 0.100 U	--	--	0.285	--	--	< 0.100 U	--	--	< 0.100 U	--	--	< 0.100 U
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 1.00 U	--	< 1.00 U	< 1.00 U
pH, field	NA	pH units			7.42	7.40	7.30	7.15	7.21	7.5	7.52	7.93	8.2	7.77	7.46	7.45	7.25	7.36	7.11	6.75	6.71	7.11	7.27
Redox (oxidation potential), field	NA	mV			-69	-99	-85	-58	-65	35.2	175.8	93	-107	-67	-64	-79	-67	-70	-122.8	33	78	-130	-92
Solids, total dissolved	NA	mg/l			752	--	--	680	--	--	383	--	--	371	--	--	400	--	--	1160 Q	--	--	< 10.0 U
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Specific conductance @ 25 °C, field	NA	umhos/cm			1234	1152	1185	1153	1195	664	311	624	609	771	694	684	699	719	1878	1811	7700	1992	2107
Sulfate, as SO4	NA	mg/l			149	--	--	115	--	--	19.8	--	--	19.2	--	--	14.1	--	--	28.7	--	7.06	13.4
Sulfide, as S ²⁻	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.18	--	0.11	0.30
Temperature, field	NA	deg C			11.0	11.0	10.0	15.3	15.3	9.6	11.2	10.1	11.8	12.5	10.2	10.1	10.7	10.7	13.5	13.9	13.1	12.3	13.7
Turbidity, field	NA	NTU			19.3	4.2	5.7	6.5	7.2	1.6	2.4	6	2.8	4.7	1.9	1.7	4.0	2.1	18.1	51.3	3.6	4.0	37.1
Metals																							
Arsenic	Dissolved	ug/l		2.5	4.95	--	--	4.72	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	9.74	--	--	10.3
Boron	Dissolved	ug/l	500 RAA17	250.0	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	597	--	--	799
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calcium	Dissolved	mg/l			168	--	--	148	--	--	91.8	--	--	93.6	--	--	92.4	--	--	172	--	--	177
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	Dissolved	ug/l			1360	--	--	1420	--	--	221	--	--	260	--	--	232	--	--	13600	--	--	14000
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	Dissolved	mg/l			71	--	--	65.8	--	--	30.5	--	--	30.2	--	--	30.4	--	--	125	--	--	124
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	Dissolved	mg/l			2.56	--	--	2.67	--	--	2.55	--	--	2.17	--	--	2.42	--	--	4.96	--	--	5.34
Sodium	Dissolved	mg/l			7.54	--	--	8	--	--	4.84	--	--	4.64	--	--	5.23	--	--	55.1	--	--	77
Zinc	Dissolved	ug/l	2000 HRL94	500.0	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type					P-302C 11/03/2022 N	P-302C 4/24/2023 N	P-302C 7/20/2023 N	P-302C 10/18/2023 N	P-304C 4/22/2021 N	P-304C 7/12/2021 N	P-304C 10/15/2021 N	P-304C 4/14/2022 N	P-304C 7/14/2022 N	P-304C 11/03/2022 N	P-304C 4/24/2023 N	P-304C 7/20/2023 N	P-304C 10/18/2023 N	P-305C 4/21/2021 N	P-305C 7/12/2021 N	P-305C 10/15/2021 N	P-305C 4/11/2022 N	P-305C 7/13/2022 N
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74 07/23/2015																		
Effective Date			11/13/2023																			
Exceedance Key			Bold	<u>Underline</u>																		
Volatile Organic Compounds																						
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U C3	< 0.500 UH	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 UH	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	1.00	2.50	< 1.00 UH	< 1.00 U	1.71	1.12	1.37	< 1.00 U	< 1.00 U	< 1.00 U	1.08	< 1.00 U	< 1.00 U	< 1.00 U	1.21	1.65	1.21	< 1.00 U
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U C4	< 1.00 U C3	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C4
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U	< 1.00 U C3	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U C4
1,2,4-Trimethylbenzene	NA	ug/l	30 HRL23	25.0	< 1.00 U	< 1.00 U C3	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dibromo-3-chloropropane (DBCP)	NA	ug/l		0.05	< 1.00 U	< 1.00 U C3	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U
1,2-Dibromoethane (EDB)	NA	ug/l	0.03 HRL23 (1)	0.001	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichlorobenzene	NA	ug/l	600 HRL93	150.0	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethane	NA	ug/l	1 HRL13 (1)	<u>0.25</u>	<u>0.536</u>	< 0.250 U	<u>0.498 H</u>	<u>0.466</u>	< 0.250 U J4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U J4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U
1,2-Dichloropropene, cis	NA	ug/l	6 HRL18 (1)	12.5	< 1.00 U	< 0.100 U	0.192 H	0.209	1.12	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 0.100 U	0.543	0.757	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethylene, trans	NA	ug/l	9 HRL23 (1)	10.0	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloropropane	NA	ug/l	3 HRL23 (1)	1.25	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3,5-Trimethylbenzene	NA	ug/l	30 HRL23 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropene, cis	NA	ug/l	2 DCP HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 UH	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,3-Dichloropropene, trans	NA	ug/l	2 DCP HRL94		< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,4-Dichlorobenzene	NA	ug/l	50 HRL23	<u>2.5</u>	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
2,2-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3
Acetone	NA	ug/l	3000 HRL23 (1)	1000	< 10.0 U	< 10.0 U	< 10.0 UH	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U	< 10.0 U	< 10.0 U J4	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U J4
Allyl chloride	NA	ug/l	30 HRL94	7.5	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Benzene	NA	ug/l	2 HRL09 (1)	<u>0.5</u>	< 0.500 U	< 0.500 U	< 0.500 UH	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U C5 J4	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U C5 J4	< 0.500 U	< 0.500 U
Bromobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromochloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromodichloromethane	NA	ug/l	3 HRL23 (1)	1.5	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromoform	NA	ug/l	40 HRL93	10.0	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U
Bromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U J3	< 1.00 U C3	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene	NA	ug/l			< 1.00 U	< 1.00 U C3	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, sec	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, tert	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U
Carbon tetrachloride	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 UH	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U
Chlorobenzene	NA	ug/l	100 HRL93	25.0	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Chlorodibromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Chloroethane	NA	ug/l	ND RAA16		< 1.00 U	< 1.00 U	< 1.00 UH	< 1.00 U	1.71 C5	<												

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type					P-302C 11/03/2022 N	P-302C 4/24/2023 N	P-302C 7/20/2023 N	P-302C 10/18/2023 N	P-304C 4/22/2021 N	P-304C 7/12/2021 N	P-304C 10/15/2021 N	P-304C 4/14/2022 N	P-304C 7/14/2022 N	P-304C 11/03/2022 N	P-304C 4/24/2023 N	P-304C 7/20/2023 N	P-304C 10/18/2023 N	P-305C 4/21/2021 N	P-305C 7/12/2021 N	P-305C 10/15/2021 N	P-305C 4/11/2022 N	P-305C 7/13/2022 N
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table 11/13/2023	Elk River Groundwater Limits Table - SW-74 07/23/2015																		
Effective Date																						
Exceedance Key			Bold	<u>Underline</u>																		
General Parameters																						
Alkalinity, total, as CaCO3	NA	mg/l			709	750	748	791	--	872	--	521	643	693	747	688	737	--	382	--	--	293
Anions	NA	meq/l			--	--	21.5	--	--	19.2	--	--	14.3	--	--	15.5	--	--	9.83	--	--	7.56
Carbon, total organic	NA	mg/l			23.3	22.7	18.4	18.9	--	9.93	--	4.82	7.17	6.84	7.56	6.71	8.82	--	--	--	--	--
Cations	NA	meq/l			--	--	21.5	--	--	17.2	--	--	14.7	--	--	15.5	--	--	9.29	--	--	7.63
Chloride	NA	mg/l			284	269	212 E	208	--	45.1	--	21.0	30.5	34.6	37.3	32.5	39.9	--	72.5	--	--	53.8
Dissolved oxygen, field test kit					2	< 1	--	--	--	--	--	0	5	2	< 1	--	--	--	--	--	--	--
Dissolved oxygen, field YSI	NA	mg/l			1.5	0.1	0.6	0.5	2.2	4.0	3.4	0.1	6.3	26	0.1	0.5	0.5	1.5	1.2	3.4	0.6	1.7
Ethane	NA	mg/l			0.00090 J	0.00079 HJ	< 0.0034 U	< 0.0450 U	--	< 0.0010	--	< 0.0010 U	0.00026 J	0.00038 J	0.00042 HJ	< 0.0034 U	< 0.0450 U	--	--	--	--	--
Ethylene	NA	mg/l			< 0.00024 U	< 0.00024 UH	< 0.0048 U	< 0.0396 U	--	< 0.0010	--	< 0.0010 U	< 0.00024 U	< 0.00024 U	< 0.00024 UH	< 0.0048 U	< 0.0396 U	--	--	--	--	--
Iron, ferrous, FE II, field	NA	mg/l			2.49	> 3.30	> 3.30	2.75	--	2.99	--	> 3.3	1.84	1.05	> 3.30	> 3.30	3.12	--	--	--	--	--
Manganese II, field	NA	mg/l			0.147	0.123	0.222	0.126	--	10.0	--	--	--	0.571	0.654	0.586	0.556	--	--	--	--	--
Methane	NA	mg/l			20	25 EH	34	27.0 1b	--	0.083	--	0.83	0.18	0.11	0.72 H	0.071 J	0.204 1b	--	--	--	--	--
Nitrogen, ammonia, as N	NA	mg/l			--	--	< 0.100 U	--	--	< 0.100 U	--	--	0.205 P1	--	--	< 0.100 U	--	--	< 0.100 U	--	--	0.493
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	--	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	--	--	--	--
pH, field	NA	pH units			7.13	7.07	6.87	7.03	6.76	6.7	6.32	7.06	6.95	6.76	6.69	6.49	6.55	7.69	7.53	6.85	7.51	7.89
Redox (oxidation potential), field	NA	mV			-142	-117	-111	-77	-64.5	77	93	-93	-10	-55	-65	-55	-54	-79.1	116.8	73	-151	-178
Solids, total dissolved	NA	mg/l			--	--	1100	--	--	904 Q	--	--	743	--	--	749	--	--	484 Q	--	--	382
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Specific conductance @ 25 °C, field	NA	umhos/cm			1949	1872	1500	1715	1483	1535	1787	1003	1319	1292	1309	1112	977	556	327	950	719	679
Sulfate, as SO4	NA	mg/l			13.7	17.6	26.4	24.6	--	22.2	--	19.0	28.5	29.4	40.0	38.4	34.1	--	7.73	--	--	8.65
Sulfide, as S ²⁻	NA	mg/l			0.02	0.02	0.03	0.02	--	0.50	--	> 0.80	0.40	0.14	0.06	0.04	0.02	--	--	--	--	--
Temperature, field	NA	deg C			13.4	13.5	13.6	13.2	9.9	10.8	10.9	9.7	13.7	10.5	9.8	10.6	10.6	11.5	12.7	12.5	12.4	12.7
Turbidity, field	NA	NTU			4.2	4	17.9	2.5	27.1	12.9	9.6	193	23.4	12.8	9	13.1	8.3	4.9	5.7	6	7.9	22.9
Metals																						
Arsenic	Dissolved	ug/l		2.5	--	--	<u>10.5</u>	--	--	<u>2.72</u>	--	--	<u>3.36</u>	--	--	<u>2.61</u>	--	--	<u>6.29</u>	--	--	<u>5.71</u>
Boron	Dissolved	ug/l	500 RAA17	<u>250.0</u>	--	--	720	--	--	609	--	--	402	--	--	363	--	--	333	--	--	206
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calcium	Dissolved	mg/l			--	--	163	--	--	187	--	--	159	--	--	171 O1 V	--	--	74.8	--	--	59.7
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	Dissolved	ug/l			--	--	13200	--	--	4560	--	--	3880	--	--	6200 O1	--	--	3160	--	--	2850
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	Dissolved	mg/l			--	--	116	--	--	68.8	--	--	61.4	--	--	62.2	--	--	52.2	--	--	44.2
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	Dissolved	mg/l			--	--	5.54	--	--	2.28	--	--	2.17	--	--	2.31	--	--	2.32	--	--	2.14
Sodium	Dissolved	mg/l			--	--	74	--	--	44.9	--	--	35	--	--	35 O1	--	--	25	--	--	19.7
Zinc	Dissolved	ug/l	2000 HRL94	500.0	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U

Table D1 Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023) Initial Performance Evaluation Report Elk River Landfill																							
Location Date Sample Type				P-305C 11/01/2022 N	P-305C 4/18/2023 N	P-305C 7/19/2023 N	P-305C 10/20/2023 N	P-308C 7/13/2021 N	P-308C 7/13/2022 N	P-308C 7/19/2023 N	P-308L 7/13/2021 N	P-308L 10/20/2021 N	P-308L 4/14/2022 N	P-308L 7/14/2022 N	P-308L 11/03/2022 N	P-308L 4/24/2023 N	P-308L 7/24/2023 N	P-309C 7/12/2021 N	P-309C 7/13/2022 N	P-309C 7/19/2023 N	P-311D 4/23/2021 N	P-311D 7/15/2021 N	
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74 07/23/2015																			
Effective Date			11/13/2023																				
Exceedance Key			Bold	<u>Underline</u>																			
Volatile Organic Compounds																							
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	1.53	< 1.00 U	1.10	< 1.00 U	< 1.00 U	< 1.00 U	9.13	1.75	13.3	12.0	1.60	9.48	9.48	4.70	6.36	4.49	< 1.00 U	< 1.00 U	
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U C4	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U J4	< 1.00 U	
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U C4	< 1.00 U J4	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U J4	< 1.00 U	
1,2,4-Trimethylbenzene	NA	ug/l	30 HRL23	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dibromo-3-chloropropane (DBCP)	NA	ug/l		0.05	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dibromoethane (EDB)	NA	ug/l	0.03 HRL23 (1)	0.001	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dichlorobenzene	NA	ug/l	600 HRL93	150.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dichloroethane	NA	ug/l	1 HRL13 (1)	<u>0.25</u>	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U C5	< 0.250 U	< 0.250 U	<u>0.319</u>	<u>0.379</u>	< 0.250 U	< 0.250 U	<u>0.250</u>	< 0.250 U	<u>0.371</u>	<u>0.282 C5</u>	< 0.250 U J4	< 0.250 U	
1,2-Dichloroethylene, cis	NA	ug/l	6 HRL18 (1)	12.5	< 1.00 U	< 0.100 U	0.166	0.282	< 1.00 U	< 1.00 U	< 0.100 U	2.13	1.07	2.36	2.37	< 1.00 U	< 0.100 U	1.83	1.92	2.91	1.36	< 1.00 U	
1,2-Dichloroethylene, trans	NA	ug/l	9 HRL23 (1)	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dichloropropane	NA	ug/l	3 HRL23 (1)	1.25	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,3,5-Trimethylbenzene	NA	ug/l	30 HRL23 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,3-Dichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,3-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,3-Dichloropropene, cis	NA	ug/l	2 DCP HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	
1,3-Dichloropropene, trans	NA	ug/l	2 DCP HRL94		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,4-Dichlorobenzene	NA	ug/l	50 HRL23	<u>2.5</u>	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
2,2-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	
Acetone	NA	ug/l	3000 HRL23 (1)	1000	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U C5	< 10.0 U C5 J4	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U	< 10.0 U C5 J4	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U J4	< 10.0 U	< 10.0 U J4	
Allyl chloride	NA	ug/l	30 HRL94	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Benzene	NA	ug/l	2 HRL09 (1)	<u>0.5</u>	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	<u>1.27</u>	<u>1.19</u>	<u>0.860</u>	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	
Bromobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Bromochloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Bromodichloromethane	NA	ug/l	3 HRL23 (1)	1.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Bromoform	NA	ug/l	40 HRL93	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Bromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Butylbenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Butylbenzene, sec	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Butylbenzene, tert	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Carbon tetrachloride	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	
Chlorobenzene	NA	ug/l	100 HRL93	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	1.62	1.64	1.46	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Chlorodibromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Chloroethane	NA	ug/l																					

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type					P-305C 11/01/2022 N	P-305C 4/18/2023 N	P-305C 7/19/2023 N	P-305C 10/20/2023 N	P-308C 7/13/2021 N	P-308C 7/13/2022 N	P-308C 7/19/2023 N	P-308L 7/13/2021 N	P-308L 10/20/2021 N	P-308L 4/14/2022 N	P-308L 7/14/2022 N	P-308L 11/03/2022 N	P-308L 4/24/2023 N	P-308L 7/24/2023 N	P-309C 7/12/2021 N	P-309C 7/13/2022 N	P-309C 7/19/2023 N	P-311D 4/23/2021 N	P-311D 7/15/2021 N
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table 11/13/2023	Elk River Groundwater Limits Table - SW-74 07/23/2015																			
Effective Date																							
Exceedance Key			Bold	<u>Underline</u>																			
General Parameters																							
Alkalinity, total, as CaCO3	NA	mg/l			--	--	353	--	1210	1080	1100	640	--	603	610	337	609	592	636	649	699	--	190
Anions	NA	meq/l			--	--	9.61	--	24.3	35.5	35.3	--	--	--	14.5	--	--	13.1	20.8	20.9	22.8	--	3.88
Carbon, total organic	NA	mg/l			--	--	--	--	--	--	--	5.42	--	3.43	4.81	2.08	3.61 H	3.84	--	--	--	--	--
Cations	NA	meq/l			--	--	9.31	--	39.9	35.7	35.2	--	--	--	15.0	--	--	13.3	19.5	21.0	22.1	--	3.71
Chloride	NA	mg/l			--	--	87.0	--	603	487	470	75.8	--	54.0	68.2	41.7	45.6	39.8	278	272	308	--	< 1.00 U
Dissolved oxygen, field test kit					--	--	--	--	--	--	--	--	--	0.6	4	< 1	< 1	--	--	--	--	--	--
Dissolved oxygen, field YSI	NA	mg/l			3.3	0.5	0.9	0.5	8.3	2.0	1.8	3.5	0.9	0.4	3.6	0.8	0.1	0.8	1.5	1.0	0.9	0.3	0.8
Ethane	NA	mg/l			--	--	--	--	--	--	--	< 0.0010	--	< 0.0010 U	0.00035 J	< 0.00017 U	0.00048 HJ	< 0.00017 U	--	--	--	--	--
Ethylene	NA	mg/l			--	--	--	--	--	--	--	< 0.0010	--	< 0.0010 U	< 0.00024 U	< 0.00024 U	< 0.00024 UH	< 0.00024 U	--	--	--	--	--
Iron, ferrous, FE II, field	NA	mg/l			--	--	--	--	--	--	--	2.00	--	1.49	1.19	1.50	1.00	> 3.30	--	--	--	--	--
Manganese II, field	NA	mg/l			--	--	--	--	--	--	--	12.0	--	--	--	0.052	0.257	0.304	--	--	--	--	--
Methane	NA	mg/l			--	--	--	--	--	--	--	0.57	--	1.2	0.92	2.8	0.91 H	1.3	--	--	--	--	--
Nitrogen, ammonia, as N	NA	mg/l			--	--	< 0.100 U	--	3.71	3.71	3.84	--	--	--	0.178	--	--	< 0.100 U	0.161	0.128	< 0.100 U	--	0.114
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		--	--	--	--	--	--	--	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	--	--	--	--
pH, field	NA	pH units			7.35	7.79	7.15	7.48	6.67	6.78	6.51	6.87	6.98	7.25	7.02	7.76	6.97	6.97	6.95	6.95	6.66	7.65	7.49
Redox (oxidation potential), field	NA	mV			-138	-150	-57	-99	183.8	-92	-90	-65	-148.3	-96	-86	-177	-155	-117	117	-106	-91	-47.7	111
Solids, total dissolved	NA	mg/l			--	--	512	--	2180	1670 J3	1960	--	--	--	728	--	--	647 B	1080	1030	1240	--	184
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Specific conductance @ 25 °C, field	NA	umhos/cm			947	493	845	873	84	3349	3227	1277	840	1211	1302	788	776	1083	82	2025	2129	334	345
Sulfate, as SO4	NA	mg/l			--	--	5.33	--	< 5.00 U	6.02	< 5.00 U	15.1	--	17.1	19.1	< 5.00 U	13.6	8.66	9.47	13.2	8.24	--	< 5.00 U
Sulfide, as S ²⁻	NA	mg/l			--	--	--	--	--	--	--	0.08	--	0.08	0.75	0.04	> 0.80	0.06	--	--	--	--	--
Temperature, field	NA	deg C			12.8	12.2	13.1	13	16.1	16.5	16.2	24.5	13.8	7.1	18.2	15.5	14.4	18.6	14	14.0	14.2	8.7	9.2
Turbidity, field	NA	NTU			4.0	24.3	4.9	19.9	4.4	9.0	7.9	47.3	13	17.3	8.9	4.9	19.1	7.5	28.4	39.2	35.3	1	1.2
Metals																							
Arsenic	Dissolved	ug/l		<u>2.5</u>	--	--	<u>5.95</u>	--	<u>32.7</u>	<u>34.5</u>	<u>33.0</u>	--	--	--	< 2.00 U	--	--	< 2.00 U	<u>28.4</u>	<u>30.9</u>	<u>32.6</u>	--	< 2.00 U
Boron	Dissolved	ug/l	500 RAA17	<u>250.0</u>	--	--	<u>450</u>	--	<u>3380</u>	<u>3210</u>	<u>3310</u>	--	--	--	< 200 U	--	--	< 200 U	<u>1300</u>	<u>1340</u>	<u>1470</u>	--	< 200 U
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calcium	Dissolved	mg/l			--	--	71.0	--	176	157	148	--	--	--	179	--	--	133	164	178	176	--	45.2
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	--	--	< 4.00 U	--	< 4.00 U	< 4.00 U	< 4.00 U	--	--	--	< 4.00 U	--	--	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	--	< 4.00 U
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	Dissolved	ug/l			--	--	3520	--	15400	13800	13400	--	--	--	735	--	--	9860	9250	13400	16800	--	1450
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	Dissolved	mg/l			--	--	51.8	--	127	106	100	--	--	--	68.2	--	--	67.1	81.7	82.9	82.6	--	14.1
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	Dissolved	mg/l			--	--	2.47	--	9.67	9.24	9.74	--	--	--	3.28	--	--	3.72	5.09	5.37	5.8	--	1.61
Sodium	Dissolved	mg/l			--	--	30.2	--	457	425	433	--	--	--	7.87	--	--	17.3	95.9	108	133	--	4.64
Zinc	Dissolved	ug/l	2000 HRL94	500.0	--	--	< 10.0 U	--	< 10.0 U	< 10.0 U	< 10.0 U	--	--	--	< 10.0 U	--	--	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	--	< 10.0 U

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

				Location	P-311D	P-311D	P-311D	P-311D	P-311D	P-311D	P-311D	P-311L	P-311L	P-311L	P-311L	P-311L	P-311L	P-311L	P-311L	P-311L	P-311L	
				Date	10/20/2021	5/10/2022	7/13/2022	10/31/2022	4/18/2023	7/19/2023	10/20/2023	4/23/2021	7/13/2021	10/20/2021	2/07/2022	4/11/2022	7/13/2022	9/07/2022	10/31/2022	4/18/2023	7/19/2023	10/20/2023
				Sample Type	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																		
Effective Date			11/13/2023	07/23/2015																		
Exceedance Key			Bold	<u>Underline</u>																		
Volatile Organic Compounds																						
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	2.41	1.95	2.02	1.70	1.03	1.35	< 1.00 U	1.41	1.59	1.30	
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U C4 J4	< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U C3	
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U	< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3	
1,2,4-Trimethylbenzene	NA	ug/l	30 HRL23	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dibromo-3-chloropropane (DBCP)	NA	ug/l		0.05	< 1.00 U C3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dibromoethane (EDB)	NA	ug/l	0.03 HRL23 (1)	0.001	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dichlorobenzene	NA	ug/l	600 HRL93	150.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dichloroethane	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U J4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	
1,2-Dichloroethylene, cis	NA	ug/l	6 HRL18 (1)	12.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 0.100 U	< 0.100 U	< 0.100 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 0.100 U	< 0.100 U	< 0.100 U	
1,2-Dichloroethylene, trans	NA	ug/l	9 HRL23 (1)	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dichloropropane	NA	ug/l	3 HRL23 (1)	1.25	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,3,5-Trimethylbenzene	NA	ug/l	30 HRL23 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,3-Dichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,3-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,3-Dichloropropene, cis	NA	ug/l	2 DCP HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	
1,3-Dichloropropene, trans	NA	ug/l	2 DCP HRL94		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,4-Dichlorobenzene	NA	ug/l	50 HRL23	<u>2.5</u>	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
2,2-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	
Acetone	NA	ug/l	3000 HRL23 (1)	1000	< 10.0 U C3	< 10.0 U	< 10.0 U C5 J4	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U	< 10.0 U C5 J4	< 10.0 U J3 J4	< 10.0 U	< 10.0 U	< 10.0 U	
Allyl chloride	NA	ug/l	30 HRL94	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Benzene	NA	ug/l	2 HRL09 (1)	<u>0.5</u>	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	
Bromobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Bromochloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Bromodichloromethane	NA	ug/l	3 HRL23 (1)	1.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Bromoform	NA	ug/l	40 HRL93	10.0	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Bromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Butylbenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Butylbenzene, sec	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Butylbenzene, tert	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Carbon tetrachloride	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	
Chlorobenzene	NA	ug/l	100 HRL93	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Chlorodibromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Chloroethane	NA	ug/l	ND RAA16		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Chloroform	NA	ug/l	20 HRL18	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Chloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	<				

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type					P-311D 10/20/2021 N	P-311D 5/10/2022 N	P-311D 7/13/2022 N	P-311D 10/31/2022 N	P-311D 4/18/2023 N	P-311D 7/19/2023 N	P-311D 10/20/2023 N	P-311L 4/23/2021 N	P-311L 7/13/2021 N	P-311L 10/20/2021 N	P-311L 2/07/2022 N	P-311L 4/11/2022 N	P-311L 7/13/2022 N	P-311L 9/07/2022 N	P-311L 10/31/2022 N	P-311L 4/18/2023 N	P-311L 7/19/2023 N	P-311L 10/20/2023 N
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table 11/13/2023	Elk River Groundwater Limits Table - SW-74 07/23/2015																		
Effective Date																						
Exceedance Key			Bold	<u>Underline</u>																		
General Parameters																						
Alkalinity, total, as CaCO3	NA	mg/l			--	--	177	--	--	190	--	--	351	--	--	--	360	--	--	--	389	--
Anions	NA	meq/l			--	--	3.63	--	--	3.85	--	--	8.27	--	--	--	8.64	--	--	--	9.14	--
Carbon, total organic	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cations	NA	meq/l			--	--	3.66	--	--	3.61	--	--	8.00	--	--	--	8.96	--	--	--	8.84	--
Chloride	NA	mg/l			--	--	< 1.00 U	--	--	< 1.00 U	--	--	26.3	--	--	--	34.5	--	--	--	34.9	--
Dissolved oxygen, field test kit					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dissolved oxygen, field YSI	NA	mg/l			0.6	0.7	1.0	0.7	0.3	1.3	0.7	0.7	0.5	0.9	1.1	1.1	0.8	1.2	1.4	0.6	1.0	0.9
Ethane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylene	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron, ferrous, FE II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, ammonia, as N	NA	mg/l			--	--	0.536	--	--	< 0.100 U	--	--	< 0.100 U	--	--	--	0.443	--	--	--	< 0.100 U	--
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
pH, field	NA	pH units			6.66	7.61	7.60	7.50	7.54	7.62	7.6	7.5	7.36	6.78	7.39	7.65	7.55	7.47	7.36	7.39	7.48	7.38
Redox (oxidation potential), field	NA	mV			-121.9	-125	15	--	-92	-27	-80	84.5	163.8	1	-64	-50	-25	55	-21	-78	-45	-50
Solids, total dissolved	NA	mg/l			--	--	184	--	--	182 J3	--	--	408	--	--	--	448	--	--	--	465	--
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Specific conductance @ 25 °C, field	NA	umhos/cm			338	347	383	364	335	359	350	696	88	725	730	783	829	859	789	777	811	805
Sulfate, as SO4	NA	mg/l			--	--	< 5.00 U	--	--	< 5.00 U	--	--	24.4	--	--	--	22.9	--	--	--	18.1	--
Sulfide, as S ²⁻	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Temperature, field	NA	deg C			8.7	9.6	10.0	10.6	9.0	9.3	9	8.4	10.2	9.4	8.3	10.1	10.2	10.7	10.4	9.0	9.2	9.2
Turbidity, field	NA	NTU			7.1	1.2	0.9	0.9	0.7	1.5	0.9	47.1	29.5	35.5	38.3	43.3	91.1	81.1	41.1	37.7	56.1	4.03
Metals																						
Arsenic	Dissolved	ug/l		<u>2.5</u>	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	--	< 2.00 U	--	--	--	< 2.00 U	--
Boron	Dissolved	ug/l	500 RAA17	<u>250.0</u>	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	--	< 200 U	--	--	--	< 200 U	--
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calcium	Dissolved	mg/l			--	--	46.2	--	--	45.2	--	--	101	--	--	--	111	--	--	--	111	--
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	--	< 4.00 U	--	--	--	< 4.00 U	--
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	Dissolved	ug/l			--	--	1230	--	--	1260	--	--	802	--	--	--	9370	--	--	--	937	--
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	Dissolved	mg/l			--	--	13.2	--	--	13.1	--	--	32.3	--	--	--	34	--	--	--	35.6	--
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	Dissolved	mg/l			--	--	1.23	--	--	1.29	--	--	1.7	--	--	--	1.83	--	--	--	1.86	--
Sodium	Dissolved	mg/l			--	--	4.41	--	--	4.51	--	--	4.89	--	--	--	5.79	--	--	--	6.51	--
Zinc	Dissolved	ug/l	2000 HRL94	500.0	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	--	26.5	--	--	--	< 10.0 U	--

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type				P-313C 4/21/2021 N	P-313C 7/13/2021 N	P-313C 10/19/2021 N	P-313C 4/14/2022 N	P-313C 7/14/2022 N	P-313C 11/02/2022 N	P-313C 4/24/2023 N	P-313C 7/20/2023 N	P-313C 10/17/2023 N	P-314C 4/22/2021 N	P-314C 7/15/2021 N	P-314C 10/19/2021 N	P-314C 4/11/2022 N	P-314C 7/12/2022 N	P-314C 10/27/2022 N	P-314C 4/18/2023 N	P-314C 7/18/2023 N	P-314C 10/17/2023 N	P-315L 4/22/2021 N
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table 11/13/2023	Elk River Groundwater Limits Table - SW-74 07/23/2015																		
Effective Date																						
Exceedance Key			Bold	<u>Underline</u>																		
Volatile Organic Compounds																						
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	3.89	4.20	3.10	2.26	3.43	3.05	2.63	4.74	2.55	6.06	3.83	3.85	3.29	2.84	2.79	1.67	1.99	1.89
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C4	< 1.00 U C4	< 1.00 U C4	< 1.00 U J4	< 1.00 U C3	< 1.00 U C3
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U
1,2,4-Trimethylbenzene	NA	ug/l	30 HRL23	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dibromo-3-chloropropane (DBCP)	NA	ug/l		0.05	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dibromoethane (EDB)	NA	ug/l	0.03 HRL23 (1)	0.001	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichlorobenzene	NA	ug/l	600 HRL93	150.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethane	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U C5 J4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	0.298 C5 J4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U
1,2-Dichloroethylene, cis	NA	ug/l	6 HRL18 (1)	12.5	1.17	1.47	1.18	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	1.62	0.615	2.22	1.63	1.62	< 1.00 U	< 1.00 U	< 1.00 U	0.418	0.459
1,2-Dichloroethylene, trans	NA	ug/l	9 HRL23 (1)	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloropropane	NA	ug/l	3 HRL23 (1)	1.25	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3,5-Trimethylbenzene	NA	ug/l	30 HRL23 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropene, cis	NA	ug/l	2 DCP HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,3-Dichloropropene, trans	NA	ug/l	2 DCP HRL94		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,4-Dichlorobenzene	NA	ug/l	50 HRL23	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
2,2-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Acetone	NA	ug/l	3000 HRL23 (1)	1000	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U	< 10.0 U C5 J4	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U	< 10.0 U C5 J4	< 10.0 U C3	< 10.0 U	< 10.0 U C5 J4	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U J4
Allyl chloride	NA	ug/l	30 HRL94	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Benzene	NA	ug/l	2 HRL09 (1)	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
Bromobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U
Bromochloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromodichloromethane	NA	ug/l	3 HRL23 (1)	1.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromoform	NA	ug/l	40 HRL93	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, sec	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, tert	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Carbon tetrachloride	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U
Chlorobenzene	NA	ug/l	100 HRL93	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Chlorodibromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Chloroethane	NA	ug/l	ND RAA16		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C5	< 1.00 U	<						

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type					P-313C 4/21/2021 N	P-313C 7/13/2021 N	P-313C 10/19/2021 N	P-313C 4/14/2022 N	P-313C 7/14/2022 N	P-313C 11/02/2022 N	P-313C 4/24/2023 N	P-313C 7/20/2023 N	P-313C 10/17/2023 N	P-314C 4/22/2021 N	P-314C 7/15/2021 N	P-314C 10/19/2021 N	P-314C 4/11/2022 N	P-314C 7/12/2022 N	P-314C 10/27/2022 N	P-314C 4/18/2023 N	P-314C 7/18/2023 N	P-314C 10/17/2023 N	P-315L 4/22/2021 N
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																			
Effective Date			11/13/2023	07/23/2015																			
Exceedance Key			Bold	Underline																			
General Parameters																							
Alkalinity, total, as CaCO3	NA	mg/l			--	749	--	586	545	561	562	568	547	--	776	--	--	667	--	--	707	--	194
Anions	NA	meq/l			--	17.6	--	--	13.3	--	--	14.0	--	--	17.8	--	--	16.0	--	--	16.3	--	3.95
Carbon, total organic	NA	mg/l			--	6.33	--	3.82	4.26	2.88	3.72	4.13	3.62	--	--	--	--	--	--	--	--	--	
Cations	NA	meq/l			--	17.1	--	--	13.7	--	--	14.6	--	--	17.8	--	--	16.2	--	--	15.8	--	3.87
Chloride	NA	mg/l			--	83.9	--	67.6	68.2	71.9	70.6	79.9	74.0	--	62.0	--	--	41.6	--	--	37.5	--	< 1.00 U
Dissolved oxygen, field test kit					--	--		1.8	1	< 1	< 1	--	--		--	--	--	--	--	--	--	--	--
Dissolved oxygen, field YSI	NA	mg/l			0.9	1.6	2.1	2.3	1.5	0.8	0.5	0.9	0.6	1.5	1.7	2.8	0.8	1.9	2.0	0.4	0.9	0.7	0.9
Ethane	NA	mg/l			--	< 0.0010	--	< 0.0010 U	0.00037 J	0.00065 J	0.00042 HJ	< 0.0034 U	--	--	--	--	--	--	--	--	--	--	--
Ethylene	NA	mg/l			--	< 0.0010	--	< 0.0010 U	< 0.00024 U	< 0.00024 U	< 0.00024 UH	< 0.0048 U	--	--	--	--	--	--	--	--	--	--	--
Iron, ferrous, FE II, field	NA	mg/l			--	2.60	--	0.63	2.50	2.19	0.94	1.41	0.80	--	--	--	--	--	--	--	--	--	--
Manganese II, field	NA	mg/l			--	16.0	--	--	--	0.506	0.161	0.151	0.222	--	--	--	--	--	--	--	--	--	--
Methane	NA	mg/l			--	0.91	--	0.24	0.59	0.5	0.38 H	0.26	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, ammonia, as N	NA	mg/l			--	< 0.100 U	--	--	0.239	--	--	< 0.100 U	--	--	< 0.100 U	--	--	0.552	--	--	< 0.100 U	--	< 0.100 U
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.100 U
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		--	< 1.00 U	--	< 1.00 U Q	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	--	--	--	--	--	--	--	--	--
pH, field	NA	pH units			6.85	6.97	6.56	6.78	7.05	7.01	7.06	6.89	6.83	6.8	6.91	7.02	6.76	6.74	6.82	6.67	6.43	6.64	7.05
Redox (oxidation potential), field	NA	mV			-5.8	54	-44.2	-36	-30	-100	-93	-12	-47	152.3	-1.8	-85.5	-61	-52	-52	-78	-41	-42	95
Solids, total dissolved	NA	mg/l			--	860	--	--	696	--	--	685	--	--	852	--	--	810	--	--	840	--	193
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.50
Specific conductance @ 25 °C, field	NA	umhos/cm			1271	1413	1292	1256	1400	1101	815	1099	1014	1475	1465	1473	1362	1403	1352	1340	1363	1319	349
Sulfate, as SO4	NA	mg/l			--	12.6	--	25.0	24.3	28.4	25.0	19.7	25.2	--	25.4	--	--	70.7	--	--	51.8	--	< 5.00 U
Sulfide, as S ²⁻	NA	mg/l			--	0.72	--	0.02	0.30	> 0.80	0.59	0.30	0.29	--	--	--	--	--	--	--	--	--	--
Temperature, field	NA	deg C			8.6	11.8	9.4	6.6	12.5	9.8	8.3	13	9.2	8.5	12	10.8	8.4	9.2	9.0	8.4	9.5	9.2	11.2
Turbidity, field	NA	NTU			6.3	37.9	15.6	11.3	67.2	69.5	3.4	21.9	8.2	17.8	23.5	35.8	7.4	20.1	17.1	1.1	17.3	1.5	23.3
Metals																							
Arsenic	Dissolved	ug/l		2.5	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	2.78
Boron	Dissolved	ug/l	500 RAA17	250.0	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	< 200 U
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 2.00 U
Calcium	Dissolved	mg/l			--	202	--	--	159	--	--	175	--	--	209	--	--	201	--	--	193	--	37.7
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	< 4.00 U
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 10.0 U
Iron	Dissolved	ug/l			--	3520	--	--	2900	--	--	4880	--	--	12100	--	--	3930	--	--	5930	--	1420
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 10.0 U
Magnesium	Dissolved	mg/l			--	70.4	--	--	58.6	--	--	64	--	--	77.3	--	--	65.1	--	--	63.3	--	14.2
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.200 U
Potassium	Dissolved	mg/l			--	3.12	--	--	2.62	--	--	2.43	--	--	3.09	--	--	2.75	--	--	2.83	--	2.78
Sodium	Dissolved	mg/l			--	24.2	--	--	17.7	--	--	9.09	--	--	11.8	--	--	13.7	--	--	14.5	--	15.9
Zinc	Dissolved	ug/l	2000 HRL94	500.0	--	< 10.0 U	--	--	< 10.0 U	--	--	11.2	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	< 10.0 U

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

				Location	P-315L	P-315L	P-315L	P-315L	P-315L	P-315L	315-OWA	315-OWA	315-OWA	P-320C	P-320C	P-320C	P-320C	P-320C	P-320C	P-320C	P-320C	P-320C	P-320C
				Date	7/15/2021	10/20/2021	4/12/2022	7/12/2022	4/18/2023	7/18/2023	7/15/2021	7/12/2022	7/18/2023	4/21/2021	7/12/2021	10/19/2021	4/11/2022	7/12/2022	10/27/2022	4/18/2023	7/18/2023	10/20/2023	4/21/2021
				Sample Type	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
				MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																		
				11/13/2023	07/23/2015																		
				Exceedance Key	<u>Underline</u>																		
Volatile Organic Compounds																							
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	1.03
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U C4	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U C4	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3	<

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type				P-315L 7/15/2021 N	P-315L 10/20/2021 N	P-315L 4/12/2022 N	P-315L 7/12/2022 N	P-315L 4/18/2023 N	P-315L 7/18/2023 N	315-OWA 7/15/2021 N	315-OWA 7/12/2022 N	315-OWA 7/18/2023 N	P-320C 4/21/2021 N	P-320C 7/12/2021 N	P-320C 10/19/2021 N	P-320C 4/11/2022 N	P-320C 7/12/2022 N	P-320C 10/27/2022 N	P-320C 4/18/2023 N	P-320C 7/18/2023 N	P-320C 10/20/2023 N	P-320C2 4/21/2021 N	
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																			
Effective Date			11/13/2023	07/23/2015																			
Exceedance Key			Bold	Underline																			
General Parameters																							
Alkalinity, total, as CaCO3	NA	mg/l			200	--	--	186	--	193	39.8	38.7	54.8	--	501	--	--	432	--	--	234	--	--
Anions	NA	meq/l			4.09	--	--	3.72	--	3.88	0.975	1.03	1.41	--	13.5	--	--	8.64	--	--	7.09	--	--
Carbon, total organic	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Cations	NA	meq/l			3.92	--	--	3.77	--	3.68	0.987	1.23	1.50	--	12.7	--	--	12.0	--	--	5.29	--	--
Chloride	NA	mg/l			< 1.00 U	--	--	< 1.00 U	--	< 1.00 U	2.51	3.15	3.49	--	99.1	--	--	95.2	--	--	82.4	--	--
Dissolved oxygen, field test kit					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Dissolved oxygen, field YSI	NA	mg/l			1.2	0.5	0.5	1.9	0.8	1.5	4.8	6.0	5.9	2.8	0.9	5	1.6	1.0	2.1	0.4	0.9	0.4	2.5
Ethane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Ethylene	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Iron, ferrous, FE II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Manganese II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Methane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Nitrogen, ammonia, as N	NA	mg/l			0.125	--	--	0.297	--	< 0.100 U	< 0.100 U	0.216	< 0.100 U	--	< 0.100 U	--	--	0.268	--	--	< 0.100 U	--	--
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
pH, field	NA	pH units			6.73	7.21	7.39	7.33	7.30	7.05	6.33	7.50	6.45	7.28	7.09	6.73	7.35	7.32	7.32	7.24	6.93	7.16	7.39
Redox (oxidation potential), field	NA	mV			131.8	-178.5	-111	88	-35	-43	186.8	45	--	128	182.9	-68.5	-113	-74	-90	-121	-49	-103	-39.8
Solids, total dissolved	NA	mg/l			199	--	--	183	--	200	80.0	89.0 B	104	--	680 Q	--	--	584	--	--	383	--	--
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Specific conductance @ 25 °C, field	NA	umhos/cm			376	354	365	352	355	449	99	198	190	1137	372	1135	1100	1038	1089	1049	1013	1050	931
Sulfate, as SO4	NA	mg/l			< 5.00 U	--	--	< 5.00 U	--	< 5.00 U	5.19	8.00	10.5	--	32.8	--	--	21.1	--	--	< 5.00 U	--	--
Sulfide, as S²	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Temperature, field	NA	deg C			9	8.5	8.7	10.5	10.0	12.2	7.6	10.9	10.9	9.6	11.3	11.4	10.4	15.0	10.6	10.0	14.8	11.4	10.2
Turbidity, field	NA	NTU			18.4	12.9	11	20.3	16.3	19.5	115	147	101	0.8	4.7	5.2	21.5	21.3	17.7	6.1	27.3	4.1	3.6
Metals																							
Arsenic	Dissolved	ug/l		2.5	2.78	--	--	2.29	--	2.63	< 2.00 U	< 2.00 U	< 2.00 U	--	7.23	--	--	< 2.00 U	--	--	< 2.00 U	--	--
Boron	Dissolved	ug/l	500 RAA17	250.0	< 200 U	--	--	< 200 U	--	< 200 U	< 200 U	< 200 U	< 200 U	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Calcium	Dissolved	mg/l			36.9	--	--	37.5	--	38.6	10.6	12.1	17.5	--	153	--	--	142	--	--	32.9	--	--
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	< 4.00 U	--	--	< 4.00 U	--	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Iron	Dissolved	ug/l			1130	--	--	353	--	171	153	4510	118	--	1630	--	--	665	--	--	2270	--	--
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Magnesium	Dissolved	mg/l			14.2	--	--	13.6	--	12.7	3.13	3.31	4.82	--	53.4	--	--	53.8	--	--	39.1	--	--
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Potassium	Dissolved	mg/l			3.07	--	--	2.38	--	2.14	3.04	2.87	3.84	--	2.52	--	--	3.09	--	--	2.53	--	--
Sodium	Dissolved	mg/l			18.1	--	--	16.3	--	14.9	2.74	2.66	2.98	--	12.1	--	--	7.72	--	--	6.5	--	--
Zinc	Dissolved	ug/l	2000 HRL94	500.0	< 10.0 U	--	--	< 10.0 U	--	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--

Table D1 Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023) Initial Performance Evaluation Report Elk River Landfill																							
Location Date Sample Type				P-320C2 7/12/2021 N	P-320C2 10/19/2021 N	P-320C2 4/11/2022 N	P-320C2 7/12/2022 N	P-320C2 10/27/2022 N	P-320C2 4/18/2023 N	P-320C2 7/18/2023 N	P-320C2 10/20/2023 N	P-320L 4/21/2021 N	P-320L 7/12/2021 N	P-320L 10/19/2021 N	P-320L 4/11/2022 N	P-320L 7/12/2022 N	P-320L 10/27/2022 N	P-320L 4/18/2023 N	P-320L 7/18/2023 N	P-320L 10/20/2023 N	P-321L 4/21/2021 N	P-321L 7/12/2021 N	
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																			
Effective Date			11/13/2023	07/23/2015																			
Exceedance Key			Bold	Underline																			
General Parameters																							
Alkalinity, total, as CaCO3	NA	mg/l			411	--	--	435	--	--	418	--	--	436	--	--	262	--	--	390	--	--	450
Anions	NA	meq/l			10.8	--	--	11.4	--	--	10.8	--	--	10.3	--	--	6.90	--	--	9.35	--	--	12.2
Carbon, total organic	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.60	
Cations	NA	meq/l			10.3	--	--	11.4	--	--	7.91	--	--	9.69	--	--	8.80	--	--	8.70	--	--	11.9
Chloride	NA	mg/l			76.6	--	--	54.4	--	--	72.1	--	--	39.0	--	--	45.2	--	--	42.4	--	--	94.1
Dissolved oxygen, field test kit					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Dissolved oxygen, field YSI	NA	mg/l			0.5	0.8	1.7	1.5	2.4	0.2	0.7	0.8	1.7	0.9	0.8	1.1	1.4	0.8	0.3	1.0	0.7	1.3	2.6
Ethane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.0010	
Ethylene	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.0010	
Iron, ferrous, FE II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.90	
Manganese II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.1	
Methane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.38	
Nitrogen, ammonia, as N	NA	mg/l			< 0.100 U	--	--	0.312	--	--	< 0.100 U	--	--	< 0.100 U	--	--	0.516	--	--	< 0.100 U	--	--	< 0.100 U
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 1.00 U	
pH, field	NA	pH units			7.35	6.92	7.29	7.50	7.28	7.17	6.98	7.24	7.27	7.26	6.87	7.31	7.36	7.36	7.17	6.62	7.29	7.23	6.4
Redox (oxidation potential), field	NA	mV			157	-136.7	-110	-62	-77	-84	-55	-99	4.6	161.7	-107.5	-98	-45	-49	-65	-30	-66	-69	91
Solids, total dissolved	NA	mg/l			552 Q	--	--	588	--	--	585	--	--	507 Q	--	--	335	--	--	479	--	--	651
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Specific conductance @ 25 °C, field	NA	umhos/cm			357	1006	1123	1130	1057	1050	1103	940	853	867	905	895	831	835	828	697	837	972	1046
Sulfate, as SO4	NA	mg/l			19.8	--	--	56.1	--	--	19.5	--	--	24.0	--	--	18.7	--	--	16.9	--	--	28.8
Sulfide, as S²-	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.08	
Temperature, field	NA	deg C			11.9	11.9	10.4	15.3	10.6	10.0	14.9	11.8	10.1	12	12	10.2	14.8	11.3	10.2	15.5	11.7	10.7	11.9
Turbidity, field	NA	NTU			3.8	6.6	3.7	53.2	43.3	4.3	63.2	3	3.6	26.5	24.6	17	90.3	29.9	9.2	79.3	6.1	1.5	2.0
Metals																							
Arsenic	Dissolved	ug/l		2.5	< 2.00 U	--	--	5.26	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U
Boron	Dissolved	ug/l	500 RAA17	250.0	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Calcium	Dissolved	mg/l			126	--	--	140	--	--	81.2	--	--	123	--	--	106	--	--	107	--	--	141
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Iron	Dissolved	ug/l			370	--	--	2600	--	--	4110	--	--	1360	--	--	2150	--	--	3710	--	--	810
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Magnesium	Dissolved	mg/l			44.2	--	--	48.2	--	--	40.6	--	--	39.6	--	--	38.5	--	--	35.6	--	--	50.1
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Potassium	Dissolved	mg/l			2.73	--	--	2.31	--	--	2.42	--	--	2.36	--	--	2.44	--	--	2.73	--	--	2.94
Sodium	Dissolved	mg/l			8.09	--	--	7.64	--	--	6.99	--	--	4.45	--	--	4.53	--	--	4.81	--	--	14.1
Zinc	Dissolved	ug/l	2000 HRL94	500.0	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location					P-321L	P-321L	P-321L	P-321L	P-321L	P-321L	P-321L	P-321L	P-322L	P-322L	P-322L	P-322L	P-322L	P-322L	P-322L	P-322L	P-323L	P-323L	P-323L
Date					10/19/2021	4/14/2022	7/15/2022	11/03/2022	4/24/2023	7/20/2023	10/18/2023	4/22/2021	7/15/2021	10/19/2021	4/11/2022	7/12/2022	10/27/2022	4/18/2023	7/18/2023	10/17/2023	4/21/2021	7/12/2021	10/19/2021
Sample Type					N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																			
Effective Date																							
Exceedance Key			Bold	Underline																			
Volatile Organic Compounds																							
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U C3	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U J3	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	2.89	2.91	3.33	2.67	2.21	2.56	1.90	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	10.6	7.84	8.19
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U C4
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U C4
1,2,4-Trimethylbenzene	NA	ug/l	30 HRL23	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dibromo-3-chloropropane (DBCP)	NA	ug/l		0.05	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dibromoethane (EDB)	NA	ug/l	0.03 HRL23 (1)	0.001	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichlorobenzene	NA	ug/l	600 HRL93	150.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethane	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U J4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	0.662 C5 J4	0.390	0.472
1,2-Dichloroethylene, cis	NA	ug/l	6 HRL18 (1)	12.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	0.322	0.336	0.379	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 0.100 U	< 0.100 U	5.58	5.96
1,2-Dichloroethylene, trans	NA	ug/l	9 HRL23 (1)	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloropropane	NA	ug/l	3 HRL23 (1)	1.25	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3,5-Trimethylbenzene	NA	ug/l	30 HRL23 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropene, cis	NA	ug/l	2 DCP HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,3-Dichloropropene, trans	NA	ug/l	2 DCP HRL94		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,4-Dichlorobenzene	NA	ug/l	50 HRL23	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
2,2-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Acetone	NA	ug/l	3000 HRL23 (1)	1000	< 10.0 U C5	< 10.0 U	< 10.0 U J4	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U J4	< 10.0 U C5	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U	< 10.0 U C3	< 10.0 U	< 10.0 U C3	< 10.0 U C5
Allyl chloride	NA	ug/l	30 HRL94	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Benzene	NA	ug/l	2 HRL09 (1)	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
Bromobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromochloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromodichloromethane	NA	ug/l	3 HRL23 (1)	1.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromoform	NA	ug/l	40 HRL93	10.0	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3
Butylbenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, sec	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, tert	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Carbon tetrachloride	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U
Chlorobenzene	NA	ug/l	100 HRL93	25.0																			

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type					P-321L 10/19/2021 N	P-321L 4/14/2022 N	P-321L 7/15/2022 N	P-321L 11/03/2022 N	P-321L 4/24/2023 N	P-321L 7/20/2023 N	P-321L 10/18/2023 N	P-322L 4/22/2021 N	P-322L 7/15/2021 N	P-322L 10/19/2021 N	P-322L 4/11/2022 N	P-322L 7/12/2022 N	P-322L 10/27/2022 N	P-322L 4/18/2023 N	P-322L 7/18/2023 N	P-322L 10/17/2023 N	P-323L 4/21/2021 N	P-323L 7/12/2021 N	P-323L 10/19/2021 N
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table 11/13/2023	Elk River Groundwater Limits Table - SW-74 07/23/2015																			
Effective Date																							
Exceedance Key			Bold	<u>Underline</u>																			
General Parameters																							
Alkalinity, total, as CaCO3	NA	mg/l			--	431	392	391	420	413	413	--	328	--	--	330	--	--	430	--	--	797	--
Anions	NA	meq/l			--	--	9.95	--	--	10.7	--	--	7.20	--	--	7.44	--	--	9.90	--	--	19.0	--
Carbon, total organic	NA	mg/l			--	3.84	2.20 B	2.06	2.76 B	2.20	2.32	--	--	--	--	--	--	--	--	--	--	5.24	--
Cations	NA	meq/l			--	--	9.94	--	--	10.6	--	--	7.08	--	--	7.48	--	--	9.61	--	--	17.9	--
Chloride	NA	mg/l			--	76.8	51.7	57.7	69.2	63.3	65.1	--	12.5	--	--	18.9	--	--	35.7	--	--	93.3	--
Dissolved oxygen, field test kit					--	0.6	3	< 1	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dissolved oxygen, field YSI	NA	mg/l			0.3	1.1	3.2	0.8	0.3	0.9	0.7	0.5	0.8	0.7	0.1	1.0	0.9	0.4	0.9	0.8	0.7	3.8	1.1
Ethane	NA	mg/l			--	< 0.0010 U	0.00017 J	< 0.00017 U	0.00039 HJ	< 0.0034 U	< 0.0450 U	--	--	--	--	--	--	--	--	--	--	< 0.0010	--
Ethylene	NA	mg/l			--	< 0.0010 U	< 0.00024 U	< 0.00024 U	< 0.00024 UH	< 0.0048 U	< 0.0396 U	--	--	--	--	--	--	--	--	--	--	< 0.0010	--
Iron, ferrous, FE II, field	NA	mg/l			--	0.72	0.80	1.04	2.13	1.19	0.81	--	--	--	--	--	--	--	--	--	--	1.52	--
Manganese II, field	NA	mg/l			--	--	--	0.212	0.270	0.250	0.219	--	--	--	--	--	--	--	--	--	--	11.8	--
Methane	NA	mg/l			--	0.45	0.5	0.38	0.19 H	0.24	0.199 1b	--	--	--	--	--	--	--	--	--	--	0.067	--
Nitrogen, ammonia, as N	NA	mg/l			--	--	0.148	--	--	< 0.100 U	--	--	< 0.100 U	--	--	0.403	--	--	< 0.100 U	--	--	< 0.100 U	--
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		--	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	--	--	--	--	--	--	--	--	--	< 1.00 U	--
pH, field	NA	pH units			6.85	7.23	7.25	7.18	7.24	6.99	7.13	7.43	7.5	7.08	8.13	7.81	7.80	7.60	6.95	7.16	6.76	6.35	6.49
Redox (oxidation potential), field	NA	mV			-100.7	-98	-20	-50	-71	-78	-54	-106	-1.2	-77.7	-234	-25	-19.5	-150	-46	-72	-41.6	104	-81.9
Solids, total dissolved	NA	mg/l			--	--	558	--	--	556	--	--	360	--	--	353	--	--	497	--	--	922	--
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Specific conductance @ 25 °C, field	NA	umhos/cm			995	1052	970	910	935	576	759	781	288	815	413	692	623	752	875	993	1571	1470	1549
Sulfate, as SO4	NA	mg/l			--	28.9	31.2	29.1	31.5	32.6	33.2	--	14.6	--	--	15.1	--	--	14.4	--	--	23.3	--
Sulfide, as S ²⁻	NA	mg/l			--	0.07	0.07	0.16	0.10	0.07	0.07	--	--	--	--	--	--	--	--	--	--	0.35	--
Temperature, field	NA	deg C			11.7	11.2	12	12.0	11.9	12.1	11.9	8.2	13.6	9.8	7.6	15.0	8.8	8.5	9.8	10.5	8.7	10.5	10.4
Turbidity, field	NA	NTU			3.6	3.2	2.6	4.0	3.5	2	2.5	2.1	5.3	19.1	15.7	5.4	11.9	19.7	13.5	4	63.5	9.3	12.1
Metals																							
Arsenic	Dissolved	ug/l		<u>2.5</u>	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--
Boron	Dissolved	ug/l	500 RAA17	<u>250.0</u>	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	<u>290</u>	--
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calcium	Dissolved	mg/l			--	--	119	--	--	128	--	--	79.0	--	--	78.0	--	--	112	--	--	196	--
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	Dissolved	ug/l			--	--	626	--	--	800	--	--	2720	--	--	1010	--	--	1650	--	--	3010	--
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	Dissolved	mg/l			--	--	41	--	--	46	--	--	34.2	--	--	39.9	--	--	44.4	--	--	71.4 V	--
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	Dissolved	mg/l			--	--	2.86	--	--	2.91	--	--	1.89	--	--	1.97	--	--	2.07	--	--	3.8	--
Sodium	Dissolved	mg/l			--	--	12.8	--	--	8.86	--	--	4.09	--	--	5.05	--	--	5.19	--	--	45.8	--
Zinc	Dissolved	ug/l	2000 HRL94	500.0	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

				Location	P-323L	P-323L	P-323L	P-323L	P-323L	P-323L	P-324L	P-324L	P-324L	P-324L	P-324L	P-324L	P-324L	P-324L	P-324L	P-325L	P-325L	P-325L	P-325L
				Date	4/14/2022	7/15/2022	11/03/2022	4/24/2023	7/20/2023	10/18/2023	4/22/2021	7/15/2021	10/19/2021	4/11/2022	7/12/2022	10/27/2022	4/18/2023	7/18/2023	10/20/2023	4/22/2021	7/13/2021	10/15/2021	4/13/2022
				Sample Type	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																			
Effective Date			11/13/2023	07/23/2015																			
Exceedance Key			Bold	Underline																			
Volatile Organic Compounds																							
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U C3	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U J3	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	7.67	7.67	7.27	6.71	6.50	5.59	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	7.87	6.70	7.88	4.88
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U
1,1-Dichloropropene	NA	ug/l			< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U C4
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U J4	< 1.00 U C4
1,2,4-Trimethylbenzene	NA	ug/l	30 HRL23	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dibromo-3-chloropropane (DBCP)	NA	ug/l		0.05	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U
1,2-Dibromoethane (EDB)	NA	ug/l	0.03 HRL23 (1)	0.001	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichlorobenzene	NA	ug/l	600 HRL93	150.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethane	NA	ug/l	1 HRL13 (1)	0.25	0.433	0.364	0.376	0.351	0.374	0.337	< 0.250 U J4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	0.336 C5 J4	< 0.250 U	< 0.250 U
1,2-Dichloroethylene, cis	NA	ug/l	6 HRL18 (1)	12.5	4.86	4.47	4.31	3.14	3.18	2.97	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 0.100 U	< 0.100 U	< 0.100 U	2.04	1.96	2.19
1,2-Dichloroethylene, trans	NA	ug/l	9 HRL23 (1)	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloropropane	NA	ug/l	3 HRL23 (1)	1.25	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3,5-Trimethylbenzene	NA	ug/l	30 HRL23 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropene, cis	NA	ug/l	2 DCP HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,3-Dichloropropene, trans	NA	ug/l	2 DCP HRL94		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,4-Dichlorobenzene	NA	ug/l	50 HRL23	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
2,2-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Acetone	NA	ug/l	3000 HRL23 (1)	1000	< 10.0 U	< 10.0 U C5 J4	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U C5 J4	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U
Allyl chloride	NA	ug/l	30 HRL94	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Benzene	NA	ug/l	2 HRL09 (1)	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U C5 J4	< 0.500 U
Bromobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromochloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromodichloromethane	NA	ug/l	3 HRL23 (1)	1.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4
Bromoform	NA	ug/l	40 HRL93	10.0	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3
Bromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, sec	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, tert	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Carbon tetrachloride	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U
Chlorobenzene	NA	ug/l	100 HRL93	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type					P-323L 4/14/2022 N	P-323L 7/15/2022 N	P-323L 11/03/2022 N	P-323L 4/24/2023 N	P-323L 7/20/2023 N	P-323L 10/18/2023 N	P-324L 4/22/2021 N	P-324L 7/15/2021 N	P-324L 10/19/2021 N	P-324L 4/11/2022 N	P-324L 7/12/2022 N	P-324L 10/27/2022 N	P-324L 4/18/2023 N	P-324L 7/18/2023 N	P-324L 10/20/2023 N	P-325L 4/22/2021 N	P-325L 7/13/2021 N	P-325L 10/15/2021 N	P-325L 4/13/2022 N
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table 11/13/2023	Elk River Groundwater Limits Table - SW-74 07/23/2015																			
Effective Date																							
Exceedance Key			Bold	<u>Underline</u>																			
General Parameters																							
Alkalinity, total, as CaCO3	NA	mg/l			705	700	699	730	680	696	--	315	--	--	297	--	--	290	--	--	642	--	622
Anions	NA	meq/l			--	17.5	--	--	17.4	--	--	6.85	--	--	6.70	--	--	6.76	--	--	17.0	--	--
Carbon, total organic	NA	mg/l			5.22	6.93	5.27	6.36	6.19	6.65	--	--	--	--	--	--	--	--	--	--	9.81	--	7.11
Cations	NA	meq/l			--	17.7	--	--	17.4	--	--	7.57	--	--	6.76	--	--	6.85	--	--	16.2	--	--
Chloride	NA	mg/l			92.9	107	112	115	118	122	--	18.9	--	--	27.0	--	--	34.1	--	--	128	--	108
Dissolved oxygen, field test kit					0	4	2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5
Dissolved oxygen, field YSI	NA	mg/l			0.1	4	2.8	0.1	0.9	0.6	0.6	0.8	0.2	1.3	0.8	0.7	0.2	0.8	0.5	1	4.8	0.8	0.5
Ethane	NA	mg/l			< 0.0010 U	0.00039 J	0.00054 J	0.00078 HJ	< 0.0034 U	< 0.0450 U	--	--	--	--	--	--	--	--	--	--	< 0.0010	--	< 0.0010 U
Ethylene	NA	mg/l			< 0.0010 U	< 0.00024 U	< 0.00024 U	< 0.00024 UH	< 0.0048 U	< 0.0396 U	--	--	--	--	--	--	--	--	--	--	< 0.0010	--	< 0.0010 U
Iron, ferrous, FE II, field	NA	mg/l			1.35	2.45	1.99	1.63	1.95	2.58	--	--	--	--	--	--	--	--	--	--	1.45	--	--
Manganese II, field	NA	mg/l			--	--	0.506	0.500	0.452	0.490	--	--	--	--	--	--	--	--	--	--	10.9	--	--
Methane	NA	mg/l			0.076	0.063	0.066	0.058 H	0.058 J	0.223	--	--	--	--	--	--	--	--	--	--	0.17	--	1.1
Nitrogen, ammonia, as N	NA	mg/l			--	0.178	--	--	< 0.100 U	--	--	< 0.100 U	--	--	0.548 J3	--	--	< 0.100 U	--	--	< 0.100 U	--	--
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	--	--	--	--	--	--	--	--	--	< 1.00 U	--	< 1.00 U
pH, field	NA	pH units			6.79	6.73	6.77	6.8	6.59	6.64	7.76	7.77	7.15	7.88	7.82	7.48	7.62	6.86	7.18	7.05	6.9	6.99	7.53
Redox (oxidation potential), field	NA	mV			-61	-62	-57	-64	-58	-5	-161.2	59.7	-197.4	-212	-115	-124	-167	-78	-125	62	30	-96	-86
Solids, total dissolved	NA	mg/l			--	906	--	--	832	--	--	324	--	--	318	--	--	319	--	--	844	--	--
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Specific conductance @ 25 °C, field	NA	umhos/cm			1629	1606	1528	1163	960	1532	566	291	597	552	646	590	645	633	720	1413	1425	1415	1209
Sulfate, as SO4	NA	mg/l			22.7	24.8	20.3	20.6	22.7	22.5	--	< 5.00 U	--	--	< 5.00 U P1	--	--	< 5.00 U	--	--	25.0	--	23.0
Sulfide, as S ²⁻	NA	mg/l			0.80 >	0.29	0.27	> 0.80	0.18	0.28	--	--	--	--	--	--	--	--	--	--	0.06	--	--
Temperature, field	NA	deg C			9.4	10.1	10.1	9.8	10.3	10.3	8.9	9.5	9.6	8.9	9.9	9.4	8.8	10.3	10.5	8.2	13.3	8.5	7.5
Turbidity, field	NA	NTU			90	50.2	--	167	12.6	6.2	28.4	23.1	17.3	18	36.1	19.0	53.7	87	21.1	4.1	6.6	7.7	8.3
Metals																							
Arsenic	Dissolved	ug/l		<u>2.5</u>	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--
Boron	Dissolved	ug/l	500 RAA17	<u>250.0</u>	--	<u>256</u>	--	--	<u>286</u>	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	<u>291</u>	--	--
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calcium	Dissolved	mg/l			--	199	--	--	187	--	--	56.0	--	--	41.3	--	--	49.8	--	--	184	--	--
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	Dissolved	ug/l			--	2880	--	--	2970	--	--	2150	--	--	3940	--	--	7690	--	--	2130	--	--
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	Dissolved	mg/l			--	73.2	--	--	73.1	--	--	52	--	--	49.4	--	--	44.3	--	--	66.4	--	--
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	Dissolved	mg/l			--	3.96	--	--	3.77	--	--	2.78	--	--	2.44	--	--	2.47	--	--	3.01	--	--
Sodium	Dissolved	mg/l			--	35.4	--	--	42	--	--	7.93	--	--	9.89	--	--	8.65	--	--	33.1	--	--
Zinc	Dissolved	ug/l	2000 HRL94	500.0	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location				P-325L	P-325L	P-325L	P-325L	P-325L	P-326L	P-326L	P-326L	P-326L	P-326L	P-326L	P-326L	P-326L	P-327L	P-327L	P-327L	P-327L		
Date				7/14/2022	11/02/2022	4/24/2023	7/20/2023	10/17/2023	5/27/2021	7/13/2021	10/15/2021	4/13/2022	7/14/2022	11/02/2022	4/24/2023	7/20/2023	10/17/2023	7/14/2021	10/18/2021	10/18/2021	7/13/2022	
Sample Type				N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																		
Effective Date			11/13/2023	07/23/2015																		
Exceedance Key			Bold	<u>Underline</u>																		
Volatile Organic Compounds																						
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U C3	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	8.43	7.29	6.17	6.91	4.08	5.55	5.06	5.53	7.94	5.71	5.13	4.46	3.54	5.75	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U J4	< 1.00 U	
1,2,4-Trimethylbenzene	NA	ug/l	30 HRL23	25.0	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dibromo-3-chloropropane (DBCP)	NA	ug/l		0.05	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U	
1,2-Dibromoethane (EDB)	NA	ug/l	0.03 HRL23 (1)	0.001	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dichlorobenzene	NA	ug/l	600 HRL93	150.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dichloroethane	NA	ug/l	1 HRL13 (1)	<u>0.25</u>	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	<u>0.250</u>	< 0.250 U	< 0.250 U	< 0.250 U	<u>0.273</u>	<u>0.258</u>	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	
1,2-Dichloroethylene, cis	NA	ug/l	6 HRL18 (1)	12.5	1.74	1.57	1.40	1.69	1.61	1.63	2.02	2.29	1.82	2.21	1.99	< 0.100 U	0.675	1.54	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dichloroethylene, trans	NA	ug/l	9 HRL23 (1)	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,2-Dichloropropane	NA	ug/l	3 HRL23 (1)	1.25	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,3,5-Trimethylbenzene	NA	ug/l	30 HRL23 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,3-Dichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,3-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,3-Dichloropropene, cis	NA	ug/l	2 DCP HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	
1,3-Dichloropropene, trans	NA	ug/l	2 DCP HRL94		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
1,4-Dichlorobenzene	NA	ug/l	50 HRL23	<u>2.5</u>	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
2,2-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Acetone	NA	ug/l	3000 HRL23 (1)	1000	< 10.0 U C5 J4	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U J4	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U C5 J4	< 10.0 U	< 10.0 U	< 10.0 U J4	
Allyl chloride	NA	ug/l	30 HRL94	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Benzene	NA	ug/l	2 HRL09 (1)	<u>0.5</u>	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U C5 J4	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U J4	< 0.500 U J4	< 0.500 U	
Bromobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Bromochloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Bromodichloromethane	NA	ug/l	3 HRL23 (1)	1.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Bromoform	NA	ug/l	40 HRL93	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Bromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U J3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Butylbenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Butylbenzene, sec	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Butylbenzene, tert	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Carbon tetrachloride	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	
Chlorobenzene	NA	ug/l	100 HRL93	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Chlorodibromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Chloroethane	NA	ug/l	ND RAA16		< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Chloroform	NA	ug/l	20 HRL18	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	
Chloromethane	NA	ug/l			< 1.																	

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location					P-325L	P-325L	P-325L	P-325L	P-325L	P-326L	P-326L	P-326L	P-326L	P-326L	P-326L	P-326L	P-326L	P-326L	P-327L	P-327L	P-327L	P-327L
Date					7/14/2022	11/02/2022	4/24/2023	7/20/2023	10/17/2023	5/27/2021	7/13/2021	10/15/2021	4/13/2022	7/14/2022	11/02/2022	4/24/2023	7/20/2023	10/17/2023	7/14/2021	10/18/2021	10/18/2021	7/13/2022
Sample Type					N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																		
Effective Date			11/13/2023	07/23/2015																		
Exceedance Key			Bold	Underline																		
General Parameters																						
Alkalinity, total, as CaCO3	NA	mg/l			562	596	642	624	621	--	643	--	589	625	613	610	623	645	203	198	206	191
Anions	NA	meq/l			14.5	--	--	16.8	--	--	14.7	--	--	14.7	--	--	14.5	--	4.63	4.91	4.68	4.22
Carbon, total organic	NA	mg/l			7.72	6.88	9.67	9.51	8.44	--	3.25	--	2.37	3.53	2.43	3.21	2.77	2.65	--	--	--	--
Cations	NA	meq/l			15.3	--	--	16.9	--	--	14.8	--	--	15.0	--	--	14.3	--	4.48	4.93	4.63	4.36
Chloride	NA	mg/l			95.6	104	131	138	117	--	53.7	--	47.8	60.9	58.3	56.9	58.1	59.0	14.3	23.1	13.6	10.3
Dissolved oxygen, field test kit					5	2	< 1	--	--	--	--	--	2.5	6	9	1	--	--	--	--	--	--
Dissolved oxygen, field YSI	NA	mg/l			5.3	1.9	0.2	1.5	0.8	4.8	5.8	3.1	2.5	6.5	3.5	1.3	2.3	3.3	0.9	0.7	0.3	1.3
Ethane	NA	mg/l			0.00088 J	0.00067 J	0.00082 HJ	0.0063 J	--	--	< 0.0010	--	< 0.0010 U	0.00028 J	0.00051 J	0.00038 HJ	< 0.0034 U	--	--	--	--	--
Ethylene	NA	mg/l			< 0.00024 U	< 0.00024 U	< 0.00024 UH	0.0093 J	--	--	< 0.0010	--	< 0.0010 U	< 0.00024 U	< 0.00024 U	< 0.00024 UH	< 0.0048 U	--	--	--	--	--
Iron, ferrous, FE II, field	NA	mg/l			1.25	0.99	1.76	1.51	1.64	--	2.61	--	--	2.72	1.24	2.15	1.80	2.04	--	--	--	--
Manganese II, field	NA	mg/l			--	0.333	0.346	0.300	0.279	--	12.0	--	--	--	0.199	0.327	0.350	0.299	--	--	--	--
Methane	NA	mg/l			1.6	1.1	0.56 H	0.74	--	--	0.73	--	0.32	0.3	0.27	0.19 H	0.16	--	--	--	--	--
Nitrogen, ammonia, as N	NA	mg/l			0.146	--	--	< 0.100 U	--	--	< 0.100 U	--	--	0.108	--	--	< 0.100 U	--	0.202	0.205	0.233	0.505
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	--	--	--
pH, field	NA	pH units			7.14	7.19	7.73	6.88	7.5	7.21	6.76	7.48	7.43	7.20	7.19	7.17	6.87	7.45	8.76	7.47	7.55	8.50
Redox (oxidation potential), field	NA	mV			-82	-67	-73	-35	-24	163.4	60	-149	-121	-110	-88	-36	-39	-31	-127.6	-210.6	-212.6	-189
Solids, total dissolved	NA	mg/l			709	--	--	842	--	--	687	--	--	724	--	--	700 J3	--	238	267	237	216
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Specific conductance @ 25 °C, field	NA	umhos/cm			1473	1365	1485	1499	1405	1138	1021	924	1172	1345	1251	1245	1283	1275	386	415	453	391
Sulfate, as SO4	NA	mg/l			29.4	28.1	24.6	18.6	25.4	--	15.0	--	< 5.00 U	22.2	27.3	22.1	17.5	25.3	8.24	14.3	8.62	5.13
Sulfide, as S ²⁻	NA	mg/l			0.13	ND	0.02	0.02	BDL	--	0.04	--	--	0.05	ND	0.03	0.02	BDL	--	--	--	--
Temperature, field	NA	deg C			13.5	12.8	7.7	9.6	8.2	10.7	14.2	10.6	4.5	16.0	15.0	6.9	15	8.8	8.8	9.3	9.2	8.9
Turbidity, field	NA	NTU			5.8	5.5	4	3.2	3.3	150	5.5	6.5	8	5.0	4.2	6.3	4.1	7	10.2	7.8	5.4	11.3
Metals																						
Arsenic	Dissolved	ug/l		2.5	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	3.08	2.48	3.40	3.37
Boron	Dissolved	ug/l	500 RAA17	250.0	< 200 U	--	--	362	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	< 200 U	< 1000 U	< 1000 U	< 200 U
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calcium	Dissolved	mg/l			177	--	--	187	--	--	178	--	--	179 V	--	--	163	--	46.8	57.0	53.8	50.8
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	Dissolved	ug/l			1360	--	--	1980	--	--	8480	--	--	5670	--	--	9590	--	1570	1890	2340	1510
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	Dissolved	mg/l			66.7	--	--	67.7	--	--	63.3	--	--	65.1	--	--	59.5	--	17.8	20.8	18.6	17.1
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	Dissolved	mg/l			2.87	--	--	3.26	--	--	2.34	--	--	2.49	--	--	2.79	--	8.68	1.52	1.65	2.32
Sodium	Dissolved	mg/l			18.4	--	--	42.6	--	--	8.61	--	--	9.99	--	--	20.1	--	9.29	6.27	6.49	6.99
Zinc	Dissolved	ug/l	2000 HRL94	500.0	< 10.0 U	--	--	< 10.0 U	--	--	16.0	--	--	13.4	--	--	< 10.0 U	--	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

				Location	P-327L	P-327L	P-328L	P-328L	P-328L	P-329L	P-329L	P-329L	P-329L	P-329L	P-329L	P-329L	P-329L	P-329L	P-329L	P-333L	P-333L	P-333L	P-333L	P-333L
				Date	10/31/2022	7/19/2023	7/15/2021	7/13/2022	7/21/2023	4/23/2021	7/14/2021	10/20/2021	4/11/2022	7/13/2022	10/31/2022	4/19/2023	7/21/2023	10/20/2023	4/23/2021	7/15/2021	4/11/2022	7/13/2022	5/15/2023	
				Sample Type	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																				
Effective Date			11/13/2023	07/23/2015																				
Exceedance Key			Bold	Underline																				
Volatile Organic Compounds																								
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U J3	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U C4	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C4	< 1.00 U C3	< 1.00 U C3
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C4	< 1.00 U C3	< 1.00 U C3
1,2,4-Trimethylbenzene	NA	ug/l	30 HRL23	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3
1,2-Dibromo-3-chloropropane (DBCP)	NA	ug/l		0.05	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U C3	< 1.00 U C3
1,2-Dibromoethane (EDB)	NA	ug/l	0.03 HRL23 (1)	0.001	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichlorobenzene	NA	ug/l	600 HRL93	150.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethane	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U J4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U J4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U
1,2-Dichloroethylene, cis	NA	ug/l	6 HRL18 (1)	12.5	< 1.00 U	< 0.100 U	< 1.00 U	< 1.00 U	< 0.100 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 0.100 U	< 0.100 U	< 0.100 U	< 0.100 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 0.100 U
1,2-Dichloroethylene, trans	NA	ug/l	9 HRL23 (1)	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloropropane	NA	ug/l	3 HRL23 (1)	1.25	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3,5-Trimethylbenzene	NA	ug/l	30 HRL23 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3
1,3-Dichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropene, cis	NA	ug/l	2 DCP HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,3-Dichloropropene, trans	NA	ug/l	2 DCP HRL94		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,4-Dichlorobenzene	NA	ug/l	50 HRL23	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
2,2-Dichloropropane	NA	ug/l			< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U C3	< 1.00 U	< 1.00 U
Acetone	NA	ug/l	3000 HRL23 (1)	1000	< 10.0 U	< 10.0 U	< 10.0 U J4	< 10.0 U C5 J4	< 10.0 U J3	< 10.0 U	< 10.0 U J4	< 10.0 U C5	< 10.0 U	< 10.0 U C5 J4	< 10.0 U	< 10.0 U	< 10.0 U J3	< 10.0 U	< 10.0 U	< 10.0 U C5 J4	< 10.0 U	< 10.0 U C5 J4	< 10.0 U	< 10.0 U
Allyl chloride	NA	ug/l	30 HRL94	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Benzene	NA	ug/l	2 HRL09 (1)	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
Bromobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromochloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromodichloromethane	NA	ug/l	3 HRL23 (1)	1.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromoform	NA	ug/l	40 HRL93	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U C3	< 1.00 U C3
Bromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3
Butylbenzene, sec	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, tert	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location				P-327L	P-327L	P-328L	P-328L	P-328L	P-329L	P-329L	P-329L	P-329L	P-329L	P-329L	P-329L	P-329L	P-329L	P-333L	P-333L	P-333L	P-333L	P-333L	
Date				10/31/2022	7/19/2023	7/15/2021	7/13/2022	7/21/2023	4/23/2021	7/14/2021	10/20/2021	4/11/2022	7/13/2022	10/31/2022	4/19/2023	7/21/2023	10/20/2023	4/23/2021	7/15/2021	4/11/2022	7/13/2022	5/15/2023	
Sample Type				N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																			
Effective Date			11/13/2023	07/23/2015																			
Exceedance Key			Bold	Underline																			
General Parameters																							
Alkalinity, total, as CaCO3	NA	mg/l			--	214	211	198	201	--	208	--	--	193	--	--	198	--	--	201	--	187	--
Anions	NA	meq/l			--	4.67	4.68	4.47	4.55	--	4.50	--	--	4.23	--	--	4.32	--	--	4.37	--	4.16	--
Carbon, total organic	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Cations	NA	meq/l			--	4.35	4.52	4.56	4.46	--	4.32	--	--	4.25	--	--	4.25	--	--	4.35	--	4.27	--
Chloride	NA	mg/l			--	10.1	5.62	6.67	7.05	--	2.57	--	--	3.08	--	--	2.93	--	--	2.10	--	2.74	--
Dissolved oxygen, field test kit					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Dissolved oxygen, field YSI	NA	mg/l			0.4	0.9	1.1	1.0	0.9	0.6	0.9	2.8	0.5	0.8	0.6	0.3	0.5	0.4	0.4	0.6	2.5	1.3	1.2
Ethane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylene	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron, ferrous, FE II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, ammonia, as N	NA	mg/l			--	0.378	0.230	0.491	0.236	--	< 0.100 U	--	--	0.293	--	--	< 0.100 U	--	--	< 0.100 U	--	< 0.100 U	--
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
pH, field	NA	pH units			7.80	6.9	8.06	7.99	7.62	7.86	8.21	7.95	7.93	7.98	7.82	7.87	7.72	7.65	7.73	7.7	7.76	7.80	7.48
Redox (oxidation potential), field	NA	mV			-132	-95	0.7	-23	-65	-43.2	55	-216	-119	-123	-106	-88	-125	-81	-7.3	6.1	-110	-30	-19
Solids, total dissolved	NA	mg/l			--	217	238	233	238	--	223	--	--	222	--	--	223	--	--	226	--	207	--
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Specific conductance @ 25 °C, field	NA	umhos/cm			402	350	398	434	384	394	390	390	369	402	386	387	389	393	380	153	413	400	398
Sulfate, as SO4	NA	mg/l			--	5.88	14.2	15.4	16.7	--	12.8	--	--	13.7	--	--	13.9	--	--	13.9	--	16.5	--
Sulfide, as S ²⁻	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Temperature, field	NA	deg C			8.4	9.9	9.5	10.1	8.9	7.6	9.3	8.4	7.4	8.5	9.0	7.8	8.5	8.8	7.5	11.9	9.9	12.5	12
Turbidity, field	NA	NTU			5.5	22.1	16.9	25.2	10.1	78.2	19.6	12.1	7.93	17.1	26.9	21.3	12.9	12.1	1.3	4.8	1.3	5.5	5
Metals																							
Arsenic	Dissolved	ug/l		2.5	--	3.27	< 2.00 U	< 2.00 U	< 2.00 U	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	< 2.00 U	--
Boron	Dissolved	ug/l	500 RAA17	250.0	--	< 200 U	< 200 U	< 200 U	< 200 U	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	< 200 U	--
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calcium	Dissolved	mg/l			--	50.3	53.8	55.8	53.0	--	51.1	--	--	51.9	--	--	48.8	--	--	52.7	--	53.7	--
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	--	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	< 4.00 U	--
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	Dissolved	ug/l			--	2120	1190	870	1020	--	980	--	--	470	--	--	603	--	--	2220	--	736	--
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	Dissolved	mg/l			--	16.9	17.8	17.7	18.2	--	17.6	--	--	16.4	--	--	18.1	--	--	17.5	--	16.9	--
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	Dissolved	mg/l			--	2.75	1.77	1.45	1.41	--	1.73	--	--	1.42	--	--	1.78	--	--	1.57	--	1.31	--
Sodium	Dissolved	mg/l			--	6.98	6.43	5.76	5.59	--	5.45	--	--	5.91	--	--	5.79	--	--	3.78	--	3.21	--
Zinc	Dissolved	ug/l	2000 HRL94	500.0	--	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--	< 10.0 U	--

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

				Location	P-333L	P-334L	P-334L	P-334L	P-334L	P-334L	P-334L	P-334L	P-334L	P-334L	P-335L	P-335L	P-335L	P-335L	P-335L	P-335L	P-335L	P-335L	P-335L
				Date	8/10/2023	4/23/2021	7/13/2021	10/20/2021	4/13/2022	7/15/2022	11/02/2022	4/24/2023	7/24/2023	10/18/2023	4/23/2021	7/15/2021	10/20/2021	4/11/2022	7/13/2022	10/31/2022	4/19/2023	7/21/2023	10/20/2023
				Sample Type	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																			
Effective Date			11/13/2023	07/23/2015																			
Exceedance Key			Bold	Underline																			
Volatile Organic Compounds																							
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U C3	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U J3	< 0.500 U	< 0.500 U	< 0.500 U
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	< 1.00 U	1.39	1.27	1.45	2.10	2.39	2.48	2.79	3.30	2.68	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U C3
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location				P-333L	P-334L	P-334L	P-334L	P-334L	P-334L	P-334L	P-334L	P-334L	P-334L	P-335L	P-335L	P-335L	P-335L	P-335L	P-335L	P-335L	P-335L	P-335L	
Date				8/10/2023	4/23/2021	7/13/2021	10/20/2021	4/13/2022	7/15/2022	11/02/2022	4/24/2023	7/24/2023	10/18/2023	4/23/2021	7/15/2021	10/20/2021	4/11/2022	7/13/2022	10/31/2022	4/19/2023	7/21/2023	10/20/2023	
Sample Type				N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																			
Effective Date			11/13/2023	07/23/2015																			
Exceedance Key			Bold	Underline																			
General Parameters																							
Alkalinity, total, as CaCO3	NA	mg/l			201	--	268	--	271	258	269	285	275	281	--	210	--	--	189	--	--	187	--
Anions	NA	meq/l			4.34	--	6.05	--	--	5.94	--	--	6.33	--	--	4.56	--	--	4.22	--	--	4.15	--
Carbon, total organic	NA	mg/l			--	--	1.10	--	1.16	1.50 B	< 1.00 U	1.03 B	1.33 B	1.43	--	--	--	--	--	--	--	--	
Cations	NA	meq/l			4.91	--	5.82	--	--	6.21	--	--	6.11	--	--	4.37	--	--	4.33	--	--	4.04	--
Chloride	NA	mg/l			2.94	--	11.1	--	14.2	14.0	16.5	16.9	16.7	17.9	--	2.91	--	--	3.81	--	--	3.67	--
Dissolved oxygen, field test kit					--	--	--	--	--	1	< 1	< 1	--	--	--	--	--	--	--	--	--	--	
Dissolved oxygen, field YSI	NA	mg/l			0.9	0.5	0.9	2	1	1.5	0.8	0.2	0.7	0.3	1.7	1.6	2.2	0.7	1.7	1.1	0.3	1.7	1.2
Ethane	NA	mg/l			--	--	< 0.0010	--	< 0.0010 U	0.00050 J	0.00021 J	0.00042 HJ	0.00035 J	< 0.0450	--	--	--	--	--	--	--	--	
Ethylene	NA	mg/l			--	--	< 0.0010	--	< 0.0010 U	0.00033 J	< 0.00024 U	0.00024 HJ	< 0.00024 U	< 0.0396 U	--	--	--	--	--	--	--	--	
Iron, ferrous, FE II, field	NA	mg/l			--	--	0.90	--	--	0.55	0.15	0.21	0.33	0.39	--	--	--	--	--	--	--	--	
Manganese II, field	NA	mg/l			--	--	50.0	--	--	--	0.079	0.107	0.189	0.180	--	--	--	--	--	--	--	--	
Methane	NA	mg/l			--	--	0.5	--	0.85	1.1	0.93	0.73 H	0.92	1.120 1b	--	--	--	--	--	--	--	--	
Nitrogen, ammonia, as N	NA	mg/l			0.115 B	--	< 0.100 U	--	--	0.230	--	--	< 0.100 U	--	--	< 0.100 U	--	--	0.192	--	--	< 0.100 U	--
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		--	--	< 1.00 U	--	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	--	--	--	--	--	--	--	--	
pH, field	NA	pH units			7.65	7.79	7.32	7.81	7.9	7.58	7.42	7.7	7.35	7.74	7.18	7	7.25	7.62	7.03	6.93	6.90	6.93	7.03
Redox (oxidation potential), field	NA	mV			-60	-40.3	77	-183	-153	-14	-67	-88	-39	-69	-22.8	77	-101	-111	-68	-33	-67	-66	-62
Solids, total dissolved	NA	mg/l			227	--	306	--	--	340	--	--	334 B	--	--	234	--	--	226	--	--	222	--
Solids, total suspended	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Specific conductance @ 25 °C, field	NA	umhos/cm			411	516	488	547	482	605	561	560	454	583	406	386	241	407	382	381	382	385	339
Sulfate, as SO4	NA	mg/l			11.6	--	18.3	--	18.4	18.8	20.1	18.5	17.8	19.5	--	13.9	--	--	16.3	--	--	14.6	--
Sulfide, as S ²⁻	NA	mg/l			--	--	0.10	--	--	0.18	0.45	0.33	0.28	0.23	--	--	--	--	--	--	--	--	
Temperature, field	NA	deg C			11.8	8.6	9.5	9.6	9	9.8	9.6	8.5	9.1	9	9.5	11.3	10	10.1	10.5	12.0	9.9	10.5	10.6
Turbidity, field	NA	NTU			27.3	28.9	41.1	18.9	30.3	21.1	7.1	5	20.7	4.1	30.6	10.1	13.2	16.1	21.1	10.2	9.9	12.1	8.5
Metals																							
Arsenic	Dissolved	ug/l		2.5	< 2.00 U	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U	--
Boron	Dissolved	ug/l	500 RAA17	250.0	< 200 U	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--	--	< 200 U	--
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Calcium	Dissolved	mg/l			54.7 O1	--	71.2	--	--	76.4	--	--	73.9	--	--	52.6	--	--	53.5	--	--	47.9	--
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	6.77	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U	--
Copper	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Iron	Dissolved	ug/l			6570	--	159	--	--	167	--	--	258	--	--	880	--	--	562	--	--	404	--
Lead	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Magnesium	Dissolved	mg/l			21.5	--	25.4	--	--	26.7	--	--	27.1	--	--	18.3	--	--	17.5	--	--	17.3	--
Manganese	Dissolved	ug/l	100 HRL23		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Mercury	Dissolved	ug/l			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Potassium	Dissolved	mg/l			1.32	--	1.55	--	--	1.66	--	--	1.58	--	--	1.46	--	--	1.31	--	--	1.3	--
Sodium	Dissolved	mg/l			3.44	--	3.15	--	--	3.49	--	--	3.15	--	--	3.87	--	--	3.86	--	--	3.99	--
Zinc	Dissolved	ug/l	2000 HRL94	500.0	54.3	--	< 10.0 U	--	--	< 10.0 U	--	--	17.7	--	--	< 10.0 U	--	--	< 10.0 U	--	--	< 10.0 U	--

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location					P-337L	P-337L	P-337L	P-337L	P-337L	P-338L	P-338L	P-338L	P-338L	P-338L	P-338L	P-338L	P-338L	P-340L	P-340L	P-340L	P-340L	P-340L
Date					4/22/2021	7/15/2021	10/20/2021	7/13/2022	7/20/2023	10/22/2021	4/12/2022	5/10/2022	7/15/2022	11/02/2022	4/24/2023	7/24/2023	10/18/2023	10/22/2021	4/12/2022	5/10/2022	7/15/2022	11/02/2022
Sample Type					N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																		
Effective Date			11/13/2023	07/23/2015																		
Exceedance Key			Bold	Underline																		
Volatile Organic Compounds																						
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U Q	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U C3	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U Q	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	1.41	< 1.00 U	< 1.00 U	< 1.00 U	7.36	7.13	8.00	9.67	7.90	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U J3	< 1.00 U Q	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U C4 J4	< 1.00 U C4 J4	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4 J4	< 1.00 U C4 J4	< 1.00 U C4	< 1.00 U C4
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U C4	< 1.00 U C4	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C4	< 1.00 U C4	< 1.00 U C4
1,2,4-Trimethylbenzene	NA	ug/l	30 HRL23	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dibromo-3-chloropropane (DBCP)	NA	ug/l		0.05	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U Q	< 1.00 U C3	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U C3	< 1.00 U
1,2-Dibromoethane (EDB)	NA	ug/l	0.03 HRL23 (1)	0.001	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichlorobenzene	NA	ug/l	600 HRL93	150.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethane	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U Q	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U
1,2-Dichloroethylene, cis	NA	ug/l	6 HRL18 (1)	12.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 0.100 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	0.465	0.706	0.784	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethylene, trans	NA	ug/l	9 HRL23 (1)	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloropropane	NA	ug/l	3 HRL23 (1)	1.25	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3,5-Trimethylbenzene	NA	ug/l	30 HRL23 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropene, cis	NA	ug/l	2 DCP HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U Q	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,3-Dichloropropene, trans	NA	ug/l	2 DCP HRL94		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,4-Dichlorobenzene	NA	ug/l	50 HRL23	<u>2.5</u>	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
2,2-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U
Acetone	NA	ug/l	3000 HRL23 (1)	1000	< 10.0 U J4	< 10.0 U C5 J4	< 10.0 U C3	< 10.0 U C5 J4	10.9 C5 Q	< 10.0 U C3	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U C5 J4	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U C3	< 10.0 U	< 10.0 U
Allyl chloride	NA	ug/l	30 HRL94	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Benzene	NA	ug/l	2 HRL09 (1)	<u>0.5</u>	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U Q	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
Bromobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromochloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromodichloromethane	NA	ug/l	3 HRL23 (1)	1.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromoform	NA	ug/l	40 HRL93	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U
Bromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U J3
Butylbenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, sec	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U
Butylbenzene, tert	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Carbon tetrachloride	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U Q	< 0.250 U	< 0.250 U J4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U J4	< 0.250 U	< 0.250 U
Chlorobenzene	NA	ug/l	100 HRL93	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Chlorodibromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Chloroethane	NA	ug/l	ND RAA16		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	<									

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location				P-337L	P-337L	P-337L	P-337L	P-337L	P-338L	P-338L	P-338L	P-338L	P-338L	P-338L	P-338L	P-338L	P-340L	P-340L	P-340L	P-340L	P-340L	
Date				4/22/2021	7/15/2021	10/20/2021	7/13/2022	7/20/2023	10/22/2021	4/12/2022	5/10/2022	7/15/2022	11/02/2022	4/24/2023	7/24/2023	10/18/2023	10/22/2021	4/12/2022	5/10/2022	7/15/2022	11/02/2022	
Sample Type				N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74																		
Effective Date			11/13/2023	07/23/2015																		
Exceedance Key			Bold	Underline																		
General Parameters																						
Alkalinity, total, as CaCO3	NA	mg/l			206	456	--	199	198	252	255	--	363	401	436	428	455	112	203	--	188	193
Anions	NA	meq/l			4.86	10.3	--	4.90	4.99	5.72	5.59	--	8.36	--	--	9.97	--	2.70	4.49	--	4.15	--
Carbon, total organic	NA	mg/l			--	--	--	--	--	--	16.6	--	4.36 B	1.42 B	2.32	2.72	2.91	--	< 1.00 U	--	1.15 B	< 1.00 U
Cations	NA	meq/l			4.98	10.7	--	4.84	4.84	6.67	5.30	--	8.92	--	--	9.92	--	2.79	4.02	--	4.65	--
Chloride	NA	mg/l			5.79	15.3	--	8.36	9.16	14.1	11.6	--	29.3	32.6	37.6	37.9	41.2	5.48	4.99	--	3.37	3.53
Dissolved oxygen, field test kit					--	--	--	--	--	--	--	--	1	< 1	< 1	--	--	--	--	--	< 1	< 1
Dissolved oxygen, field YSI	NA	mg/l			0.6	0.9	0.7	0.5	0.5	1.3	0.2	0.2	1.8	0.7	0.2	0.7	0.6	0.9	10.2	0.4	0.5	0.8
Ethane	NA	mg/l			--	--	--	--	--	--	--	--	0.00078 J	0.00089 J	0.00092 HJ	0.00058 J	< 0.0450 U	--	--	--	< 0.00017 U	< 0.00017 U
Ethylene	NA	mg/l			--	--	--	--	--	--	--	--	0.00032 J	< 0.00024 U	< 0.00024 UH	< 0.00024 U	< 0.0396 U	--	--	--	< 0.00024 U	< 0.00024 U
Iron, ferrous, FE II, field	NA	mg/l			--	--	--	--	--	--	--	--	1.54	0.95	1.36	2.13	2.21	--	--	--	1.50	1.04
Manganese II, field	NA	mg/l			--	--	--	--	--	--	--	--	--	0.080	0.147	0.238	0.222	--	--	--	--	0.166
Methane	NA	mg/l			--	--	--	--	--	--	--	--	1.4	1.3	1.3 H	1.4	1.720 1b	--	--	--	0.0059	0.024
Nitrogen, ammonia, as N	NA	mg/l			< 0.100 U	< 0.100 U	--	0.254	< 0.100 U	< 0.100 U	0.151	--	0.205	--	--	< 0.100 U	--	0.139	< 0.100 U	--	0.287	--
Nitrogen, nitrate + nitrite, as N	NA	mg/l			< 0.100 U	--	--	--	--	< 0.100 U	< 0.100 U	--	< 0.100 U	--	--	--	--	< 0.100 U	< 0.100 U	--	< 0.100 U	--
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		--	--	--	--	--	--	--	--	< 1.00 U	< 1.00 U Q	< 1.00 U	< 1.00 U	< 1.00 U	--	--	--	< 1.00 U	< 1.00 U
pH, field	NA	pH units			7.18	7.32	8.28	8.35	7.55	7.39	7.85	7.73	7.37	7.63	7.56	7.25	7.52	7.31	7.98	7.99	7.98	7.91
Redox (oxidation potential), field	NA	mV			-85	33	-199	-35	-47	-145	-187	-165	-99	-185	-98	-87	-77	-248.4	173	-152	-99	-104
Solids, total dissolved	NA	mg/l			257	563	--	266	278	297	278	--	448	--	--	505 B	--	132	203	--	230	--
Solids, total suspended	NA	mg/l			4.10	--	--	--	--	--	17.4	18.4	--	10.2 Q	--	--	--	24.8	< 4.00 U	--	12.7 Q	--
Specific conductance @ 25 °C, field	NA	umhos/cm			429	417	370	312	346	513	475	485	785	812	755	808	880	254	398	373	417	430
Sulfate, as SO4	NA	mg/l			28.0	34.4	--	32.9	37.0	13.3	7.99	--	13.8	18.8	16.9	16.9	18.1	14.9	14.0	--	14.7	16.8
Sulfide, as S ²⁻	NA	mg/l			--	--	--	--	--	--	--	--	0.26	> 0.80	0.05	0.04	0.07	--	--	--	0.11	0.09
Temperature, field	NA	deg C			9.7	10.5	9.7	10.3	10.1	12.5	9.5	10.2	10.4	10.5	8.8	10.0	9.7	9.4	6.5	8.9	18.5	12.0
Turbidity, field	NA	NTU			31.7	2	2.1	43.3	67	21	23.1	21.1	22.3	5.8	4.1	7.9	3.3	22.5	0.8	0.7	19.7	23.4
Metals																						
Arsenic	Dissolved	ug/l		<u>2.5</u>	< 2.00 U	< 2.00 U	--	< 2.00 U	< 2.00 U	< 2.00 U	< 2.00 U	--	< 2.00 U	--	--	< 2.00 U	--	< 2.00 U	< 2.00 U	--	< 2.00 U	--
Boron	Dissolved	ug/l	500 RAA17	<u>250.0</u>	< 200 U	< 200 U	--	< 200 U	< 200 U	< 200 U	<u>394</u>	--	< 200 U	--	--	< 200 U	--	< 200 U	< 200 U	--	< 200 U	--
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		< 2.00 U	--	--	--	--	< 2.00 U	< 2.00 U	--	< 2.00 U	--	--	--	--	< 2.00 U	< 2.00 U	--	< 2.00 U	--
Calcium	Dissolved	mg/l			60.6	135	--	57.9	56.7	81.0	61.7	--	110 V	--	--	117	--	24.1	51.5	--	52.0	--
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	< 4.00 U	< 4.00 U	--	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	--	< 4.00 U	--	--	< 4.00 U	--	< 4.00 U	< 4.00 U	--	< 4.00 U	--
Copper	Dissolved	ug/l			< 10.0 U	--	--	--	--	< 10.0 U	< 10.0 U	--	< 10.0 U	--	--	--	--	< 10.0 U	< 10.0 U	--	< 10.0 U	--
Iron	Dissolved	ug/l			1420	< 100 U	--	1140	457	4060	< 100 U	--	4720	--	--	1630	--	2140	< 100 U	--	8580	--
Lead	Dissolved	ug/l			< 10.0 U	--	--	--	--	< 10.0 U	< 10.0 U	--	< 10.0 U	--	--	--	--	< 10.0 U	< 10.0 U	--	< 10.0 U	--
Magnesium	Dissolved	mg/l			21.1	43.8	--	21.1	22.2	26.5	21.8	--	36.5	--	--	46.3	--	14.7	17.4	--	18.1	--
Manganese	Dissolved	ug/l	100 HRL23		460	--	--	--	--	411	331	--	431	--	--	--	--	207	276	--	351	--
Mercury	Dissolved	ug/l			< 0.200 U	--	--	--	--	< 0.200 U	< 0.200 U	--	< 0.200 U	--	--	--	--	< 0.200 U	< 0.200 U	--	< 0.200 U	--
Potassium	Dissolved	mg/l			1.25	1.67	--	1.34	1.36	2.15	4.95	--	1.96	--	--	1.87	--	1.65	1.44	--	1.45	--
Sodium	Dissolved	mg/l			2.78	7.2	--	3.3	3.08	5.36	6.69	--	4.20	--	--	4.15	--	5.86	5.14	--	4.68	--
Zinc	Dissolved	ug/l	2000 HRL94	500.0	< 10.0 U	< 10.0 U	--	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	--	< 10.0 U	--	--	< 10.0 U	--	10.3	< 10.0 U	--	14.6	--

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location				P-340L	P-341L	P-341L	P-342L	P-342L	P694477	P694477	P694477	P694477	P694477	P694477	P694477	P694477	P694477
Date				8/10/2023	8/10/2023	10/17/2023	5/15/2023	8/10/2023	4/23/2021	7/14/2021	10/20/2021	4/12/2022	7/13/2022	11/01/2022	4/21/2023	7/21/2023	10/20/2023
Sample Type				N	N	N	N	N	N	N	N	N	N	N	N	N	N
Parameter	Total or Dissolved	Units	MDH Human Health-Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74													
Effective Date																	
Exceedance Key			Bold	<u>Underline</u>													
Volatile Organic Compounds																	
1,1,1,2-Tetrachloroethane	NA	ug/l	70 HRL93	17.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,1-Trichloroethane	NA	ug/l	5000 HRL18 (1)	2250.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1,2,2-Tetrachloroethane	NA	ug/l	2 HRL94	0.5	< 0.500 U	< 0.500 U J4	< 0.500 U	< 0.500 U	< 0.500 U J4	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,1,2-Trichloroethane	NA	ug/l	3 HRL93	0.75	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U	< 0.750 U
1,1-Dichloroethane	NA	ug/l	80 RAA16 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	1.73	1.64	1.52	1.88	1.00	2.09	2.44	2.67
1,1-Dichloroethylene	NA	ug/l	200 HRL23	50.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,1-Dichloropropene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,3-Trichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U C3
1,2,3-Trichloropropane	NA	ug/l	0.003 HRL13 (1)	0.00075	< 1.00 U	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2,4-Trichlorobenzene	NA	ug/l	4 HRL13 (1)	1.0	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U C4	< 1.00 U	< 1.00 U C3
1,2,4-Trimethylbenzene	NA	ug/l	30 HRL23	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dibromo-3-chloropropane (DBCP)	NA	ug/l		0.05	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dibromoethane (EDB)	NA	ug/l	0.03 HRL23 (1)	0.001	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichlorobenzene	NA	ug/l	600 HRL93	150.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloroethane	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U J4	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U
1,2-Dichloroethylene, cis	NA	ug/l	6 HRL18 (1)	12.5	< 0.100 U	< 0.100 U	< 0.100 U	< 0.100 U	< 0.100 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 0.100 U	< 0.100 U
1,2-Dichloroethylene, trans	NA	ug/l	9 HRL23 (1)	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,2-Dichloropropane	NA	ug/l	3 HRL23 (1)	1.25	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3,5-Trimethylbenzene	NA	ug/l	30 HRL23 (1)	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichlorobenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,3-Dichloropropene, cis	NA	ug/l	2 DCP HRL94	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
1,3-Dichloropropene, trans	NA	ug/l	2 DCP HRL94		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
1,4-Dichlorobenzene	NA	ug/l	50 HRL23	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
2,2-Dichloropropane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Acetone	NA	ug/l	3000 HRL23 (1)	1000	< 10.0 U	< 10.0 U J3 J4	< 10.0 U C3	< 10.0 U	< 10.0 U J3 J4	< 10.0 U	< 10.0 U J4	< 10.0 U C3	< 10.0 U J4	< 10.0 U	< 10.0 U	< 10.0 U J3	< 10.0 U
Allyl chloride	NA	ug/l	30 HRL94	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Benzene	NA	ug/l	2 HRL09 (1)	0.5	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
Bromobenzene	NA	ug/l			< 1.00 U J4	< 1.00 U	< 1.00 U J4	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromochloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromodichloromethane	NA	ug/l	3 HRL23 (1)	1.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromoform	NA	ug/l	40 HRL93	10.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Bromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, sec	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Butylbenzene, tert	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Carbon tetrachloride	NA	ug/l	1 HRL13 (1)	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U
Chlorobenzene	NA	ug/l	100 HRL93	25.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Chlorodibromomethane	NA	ug/l	10 HRL93	2.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Chloroethane	NA	ug/l	ND RAA16		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U
Chloroform	NA	ug/l	20 HRL18	7.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Chloromethane	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U C3
Chlorotoluene, o	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U J3	< 1.00 U	< 1.00 U
Chlorotoluene, p	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Cumene (isopropyl benzene)	NA	ug/l	300 HRL93	75.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U C3	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Cymene p- (toluene isopropyl p-)	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Dibromomethane (methylene bromide)	NA	ug/l			< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Dichlorodifluoromethane (Freon-12)	NA	ug/l	500 RAA17 (1)	175.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	2.57	2.59	2.08	2.04	1.05	2.61 C3	2.47	2.12
Dichlorofluoromethane (Freon-21)	NA	ug/l	20 RAA17		< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	3.84	3.71	4.23	3.89	1.97	4.15	3.74	4.77
Ethyl benzene	NA	ug/l	40 HRL23	12.5	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U
Ethyl ether	NA	ug/l	200 RAA16 (1)	50.0	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	< 1.00 U	7.66	7.11	6.33	8.57	4.43	8.19	9.40	7.67
Hexachlorobutadiene	NA	ug/l	1 HRL93	0.25	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U C3	< 0.250 U	< 0.250 U	< 0.250 U	< 0.250 U J3	< 0.250 U
Methyl ethyl ketone (2-butanone)	NA	ug/l	4000 HRL94	1000.0	< 10.0 U												

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits (2021-2023)
Initial Performance Evaluation Report
Elk River Landfill

Location Date Sample Type				P-340L 8/10/2023 N	P-341L 8/10/2023 N	P-341L 10/17/2023 N	P-342L 5/15/2023 N	P-342L 8/10/2023 N	P694477 4/23/2021 N	P694477 7/14/2021 N	P694477 10/20/2021 N	P694477 4/12/2022 N	P694477 7/13/2022 N	P694477 11/01/2022 N	P694477 4/21/2023 N	P694477 7/21/2023 N	P694477 10/20/2023 N
Parameter	Total or Dissolved	Units	MDH Human Health- Based Water Guidance Table	Elk River Groundwater Limits Table - SW-74													
Effective Date			11/13/2023	07/23/2015													
Exceedance Key			Bold	<u>Underline</u>													
General Parameters																	
Alkalinity, total, as CaCO3	NA	mg/l			193	266	274	188	187	--	348	--	--	316	--	--	372
Anions	NA	meq/l			4.21	6.33	6.77	4.02	4.01	--	7.83	--	--	6.99	--	--	8.29
Carbon, total organic	NA	mg/l			--	2.15 B	< 1.00 U	--	1.19 B	--	--	--	--	--	--	--	--
Cations	NA	meq/l			4.45	7.19	6.53	3.90	4.16	--	7.61	--	--	7.16	--	--	8.14
Chloride	NA	mg/l			3.85	22.2	27.6	1.04	1.04	--	14.4	--	--	15.0	--	--	17.6
Dissolved oxygen, field test kit					--	--	--	--	--	--	--	--	--	--	--	--	--
Dissolved oxygen, field YSI	NA	mg/l			0.7	1.7	0.8	0.7	0.8	0.3	0.8	2.1	0.7	1.2	0.6	0.1	0.3
Ethane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylene	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--
Iron, ferrous, FE II, field	NA	mg/l			1.00	2.59	2.60	--	0.37	--	--	--	--	--	--	--	--
Manganese II, field	NA	mg/l			0.189	0.293	0.290	--	0.293	--	--	--	--	--	--	--	--
Methane	NA	mg/l			--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen, ammonia, as N	NA	mg/l			0.143 B	0.102	< 0.100 U	< 0.100 U	< 0.100 U	--	< 0.100 U	--	--	0.403 J5	--	--	< 0.100 U
Nitrogen, nitrate + nitrite, as N	NA	mg/l			--	0.679	< 0.100 U	< 0.100 U	< 0.100 U	--	--	--	--	--	--	--	--
Nitrogen, nitrate, as N	NA	mg/l	10 HRLMCL		--	0.272	< 1.00 U	--	< 0.100 U	--	--	--	--	--	--	--	--
pH, field	NA	pH units			7.80	6.23	7.16	7.52	7.70	7.28	6.75	7.43	7.09	8.01	7.98	7.16	7.17
Redox (oxidation potential), field	NA	mV			-43	-45	-72	-45	-59	-95	-50	-99	28	-55	-195	-155	-194
Solids, total dissolved	NA	mg/l			229	365	339 B	209	206	--	408	--	--	341	--	--	433
Solids, total suspended	NA	mg/l			--	125	22.5	63.3	60.4	--	--	--	--	--	--	--	--
Specific conductance @ 25 °C, field	NA	umhos/cm			400	621	626	413	390	634	652	599	527	641	622	720	743
Sulfate, as SO4	NA	mg/l			12.0	18.4	24.7	10.7	11.5 J6	--	22.4	--	--	11.7	--	--	17.3
Sulfide, as S ²⁻	NA	mg/l			0.06	0.02	0.14	--	0.07	--	--	--	--	--	--	--	--
Temperature, field	NA	deg C			11.9	12.2	11.4	12.0	12.0	10.2	10.4	10.8	9.6	10.9	10.5	9.9	4.0
Turbidity, field	NA	NTU			12.3	43.1	207	50.0	27.2	3	7.9	11.1	14.2	5.1	1.2	0.8	3.0
Metals																	
Arsenic	Dissolved	ug/l		<u>2.5</u>	< 2.00 U	< 2.00 U	< 2.00 U	< 2.00 U	< 2.00 U	--	< 2.00 U	--	--	< 2.00 U	--	--	< 2.00 U
Boron	Dissolved	ug/l	500 RAA17	<u>250.0</u>	< 200 U	< 200 U	< 200 U	< 200 U	< 200 U	--	< 200 U	--	--	< 200 U	--	--	< 200 U
Cadmium	Dissolved	ug/l	0.5 HRL15 (1)		--	< 2.00 U	< 2.00 U	< 2.00 U	< 2.00 U	--	--	--	--	--	--	--	--
Calcium	Dissolved	mg/l			51.8	86.1	78.7	45.4 O1	47.0	--	92.6	--	--	87.6	--	--	97.6
Chromium	Dissolved	ug/l	100 CR HRL93	25.0	< 4.00 U	< 4.00 U	< 4.00 U	< 4.00 U	4.84	--	< 4.00 U	--	--	< 4.00 U	--	--	< 4.00 U
Copper	Dissolved	ug/l			--	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	--	--	--	--	--	--	--	--
Iron	Dissolved	ug/l			395	438	< 100 U	< 100 U	< 100 U	--	774	--	--	4200	--	--	2170
Lead	Dissolved	ug/l			--	< 10.0 U	< 10.0 U	< 10.0 U	< 10.0 U	--	--	--	--	--	--	--	--
Magnesium	Dissolved	mg/l			19.5	31.5	29.4	17.8	19.9	--	32.9	--	--	29.3	--	--	35.9
Manganese	Dissolved	ug/l	100 HRL23		--	768	240	193 O1	170	--	--	--	--	--	--	--	--
Mercury	Dissolved	ug/l			--	< 0.200 U	< 0.200 U	< 0.200 U	0.348	--	--	--	--	--	--	--	--
Potassium	Dissolved	mg/l			1.31	3.16	2.60 B	1.56	1.77	--	1.97	--	--	1.56	--	--	1.64
Sodium	Dissolved	mg/l			4.69	4.11	3.87	2.87	3.05	--	4.6	--	--	4.3	--	--	4.42
Zinc	Dissolved	ug/l	2000 HRL94	500.0	16.9	46.6	< 10.0 U	< 10.0 U	43.8	--	< 10.0 U	--	--	25.2	--	--	< 10.0 U

Table D1
Groundwater Data Compared to Groundwater-Based Intervention Limits
Elk River Landfill
Elk River, Minnesota

Barr Standard Footnotes and Qualifiers

--	Not analyzed/Not available.
>	Greater than.
¹	Non-compliance well
BDL	Below detection limit.
J-	The result is an estimated quantity and may be biased low.
U	The analyte was analyzed for, but was not detected.

Laboratory Qualifiers

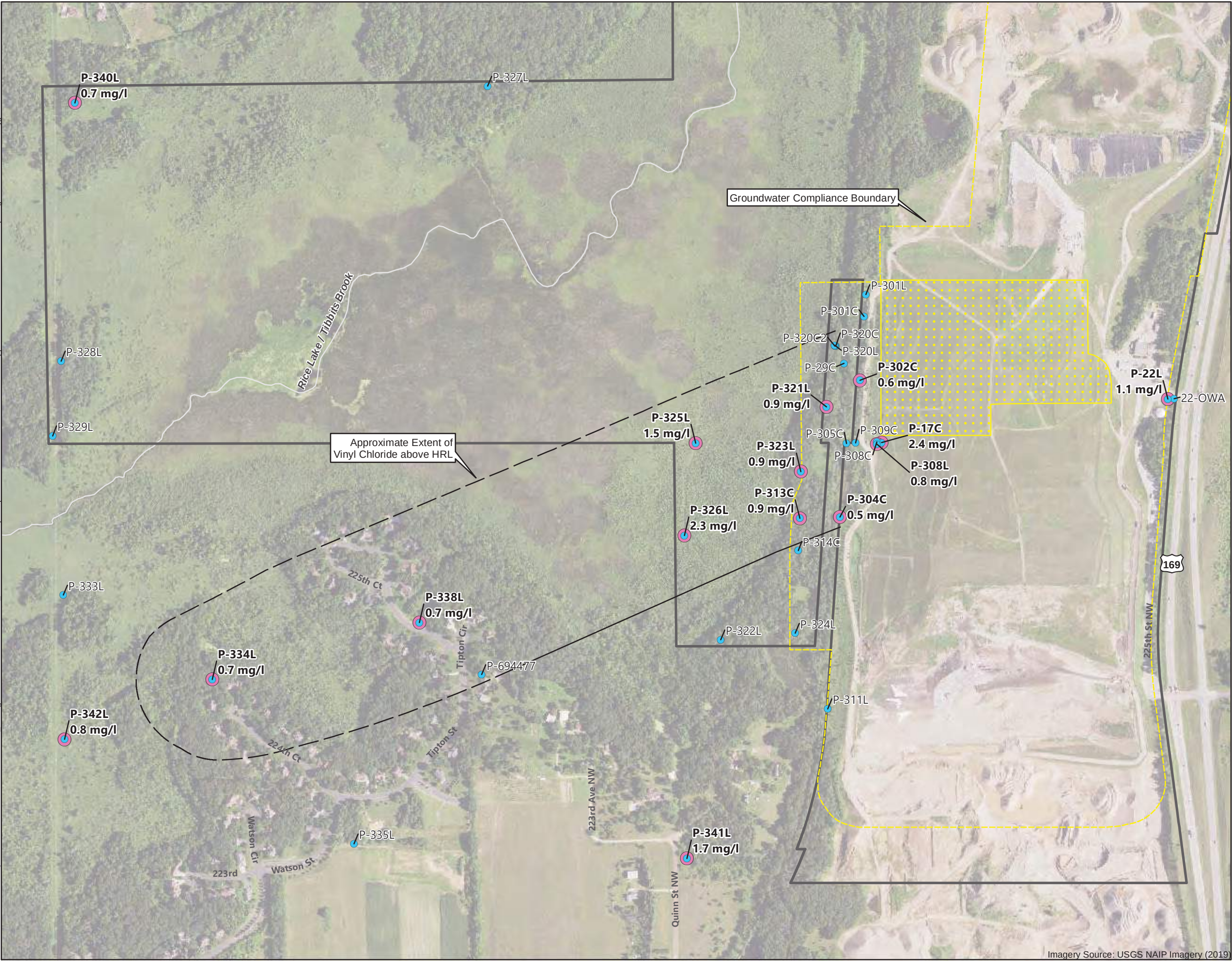
1b	Samples were diluted due to the preservation of the samples which causes instrument issues in headspace analysis.
B	The same analyte is found in the associated blank.
C3	The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.
C5	The reported concentration is an estimate. The continuing calibration standard associated with this data responded high. Data is likely to show a high bias concerning the result.
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
H	Recommended sample preservation, extraction or analysis holding time was exceeded.
J	The identification of the analyte is acceptable; the reported value is an estimate.
J3	The associated batch QC was outside the established quality control range for precision.
J4	The associated batch QC was outside the established quality control range for accuracy.
J6	The sample matrix interfered with the ability to make any accurate determination; spike value is low.
O1	The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.
Q	Sample was prepared and/or analyzed past holding time as defined in the method. Concentrations should be considered minimum values.
V	The sample concentration is too high to evaluate accurate spike recoveries.

MDH Human Health-Based Water Guidance Table

(1)	Value is representative of the lowest exposure duration published in the Minnesota Department of Health Human Health Advisory Table.
CR	Value represents the criteria for Chromium, hexavalent.
DCP	Value shown is 1,3-dichloropropene in the MDH criterion, however, the laboratory reports cis and trans isomers individually.
HBV20	Health Based Value 2020.
HBV22	Health Based Value 2022.
HRL09	Health Risk Limit 2009.
HRL13	Health Risk Limit 2013.
HRL15	Health Risk Limit 2015.
HRL18	Health Risk Limit 2018.
HRL23	Health Risk Limit 2023.
HRL93	Health Risk Limit 1993.
HRL94	Health Risk Limit 1994.
HRLMCL	Health Risk Limit; Maximum Contaminant Level.
ND	Not derived due to insufficient information.
RAA13	Risk Assessment Advice 2013.
RAA16	Risk Assessment Advice 2016.
RAA17	Risk Assessment Advice 2017.
XYL	Value shown is for the sum of the mixed o,m and p Xylene isomers.

Appendix E

Geochemical Parameter Maps



- Property Boundary
- Pre-Subtitle D Area
- Monitoring Well
- MNA Monitoring Well

Note:
- Displayed data from July-August 2023 monitoring event. Measured using field YSI probe.
- Data shown only at MNA network monitoring wells.

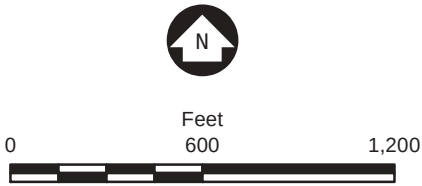
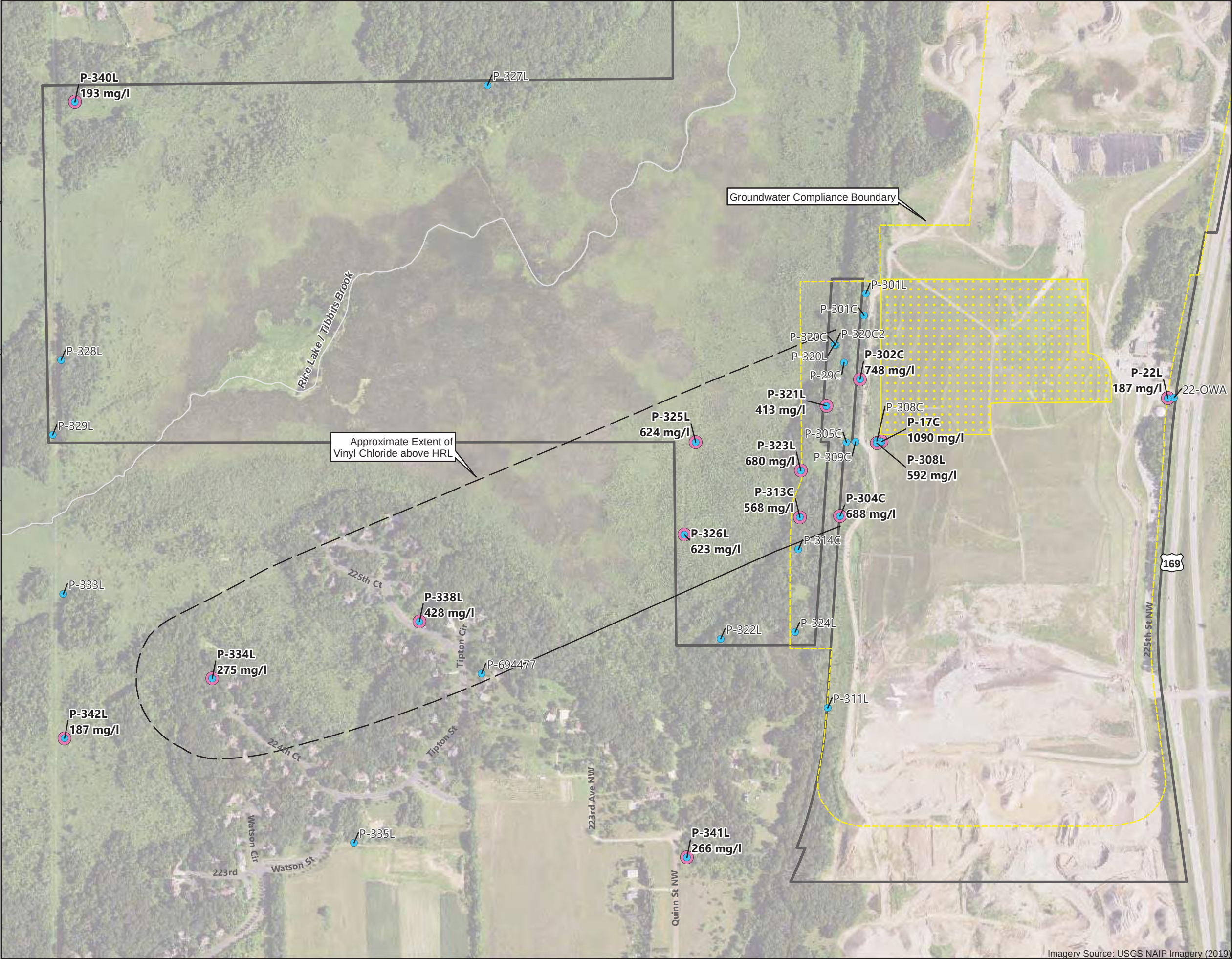


Figure E1
DISSOLVED OXYGEN
Elk River Landfill
Elk River, Minnesota



Bar Footer: ArcGIS 10.8.1, 2024-03-11 13:28 File: I:\Client\Waste Management\Elk River Landfill\Work Orders\23711005\Maps\Reports\2024 Initial Performance Evaluation\Appendix E - Geochemical Indicator Maps\Figure E2 - Alkalinity.mxd User: kac2



- Property Boundary
- Pre-Subtitle D Area
- Monitoring Well
- MNA Monitoring Well

Note:
- Displayed data from July-August 2023 monitoring event.

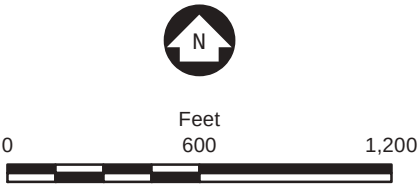
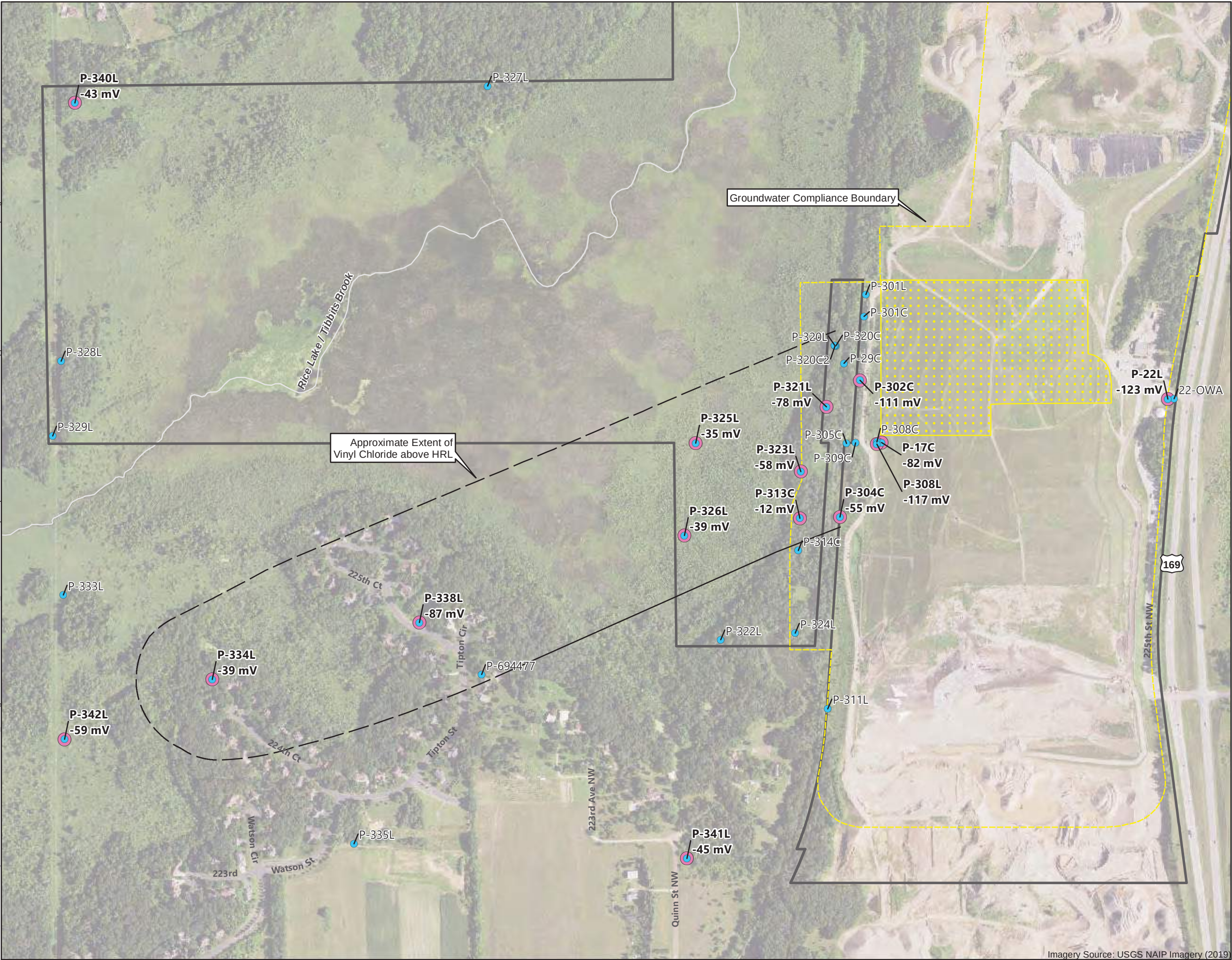


Figure E2
ALKALINITY
Elk River Landfill
Elk River, Minnesota





- Property Boundary
- Pre-Subtitle D Area
- Monitoring Well
- MNA Monitoring Well

Note:
- Displayed data from July-August 2023 monitoring event.
- Data shown only at MNA network monitoring wells.

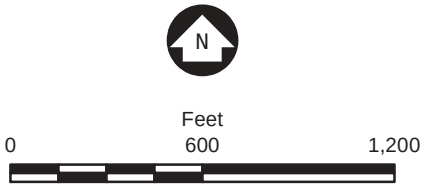
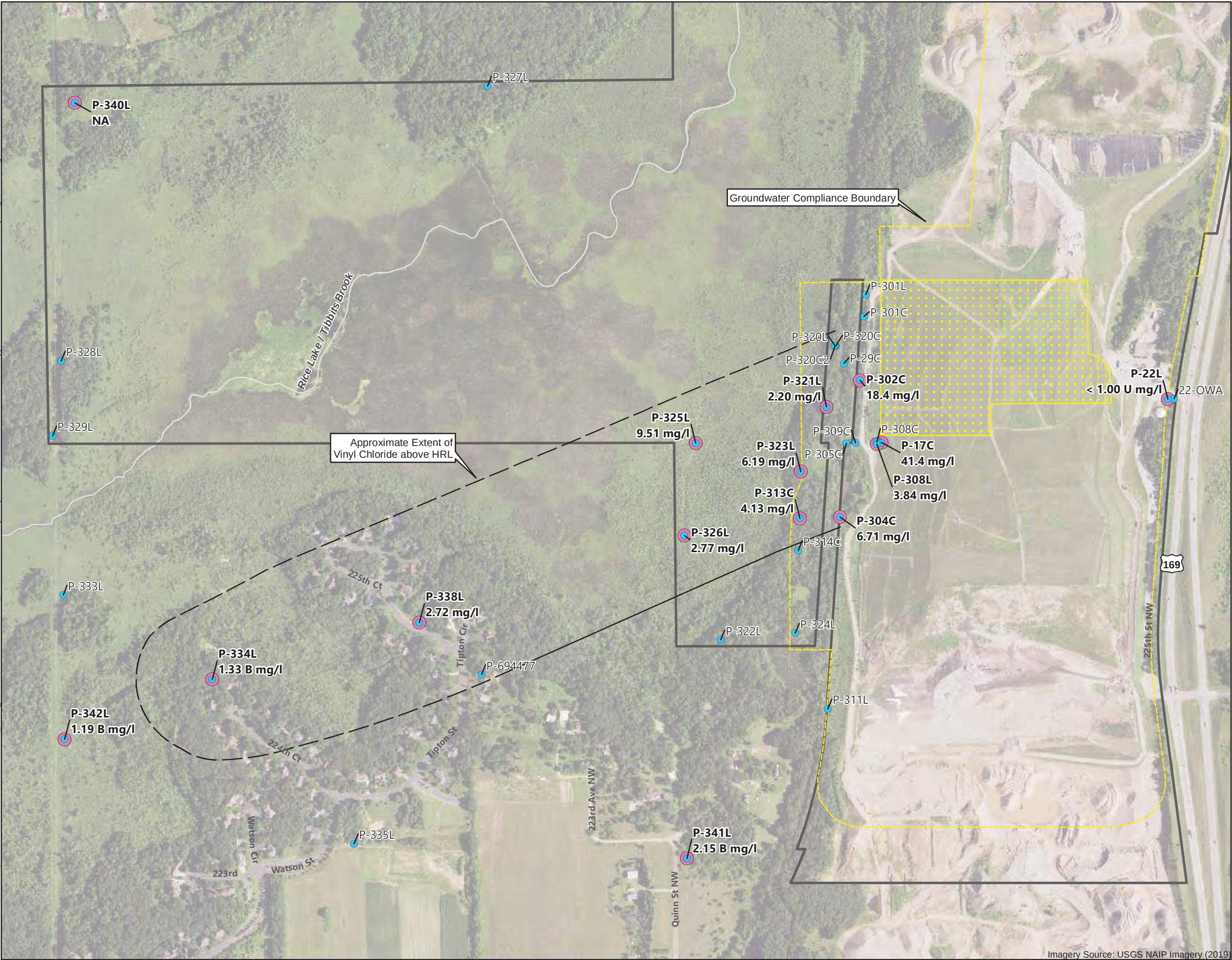


Figure E3
REDOX POTENTIAL
Elk River Landfill
Elk River, Minnesota





- Property Boundary
- Pre-Subtitle D Area
- Monitoring Well
- MNA Monitoring Well

Note:
- Displayed data from July-August 2023 monitoring event.

NA - Not Analyzed

U The analyte was analyzed for, but was not detected.

B The same analyte is found in the associated blank.

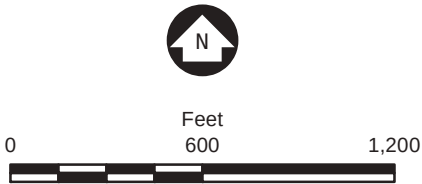
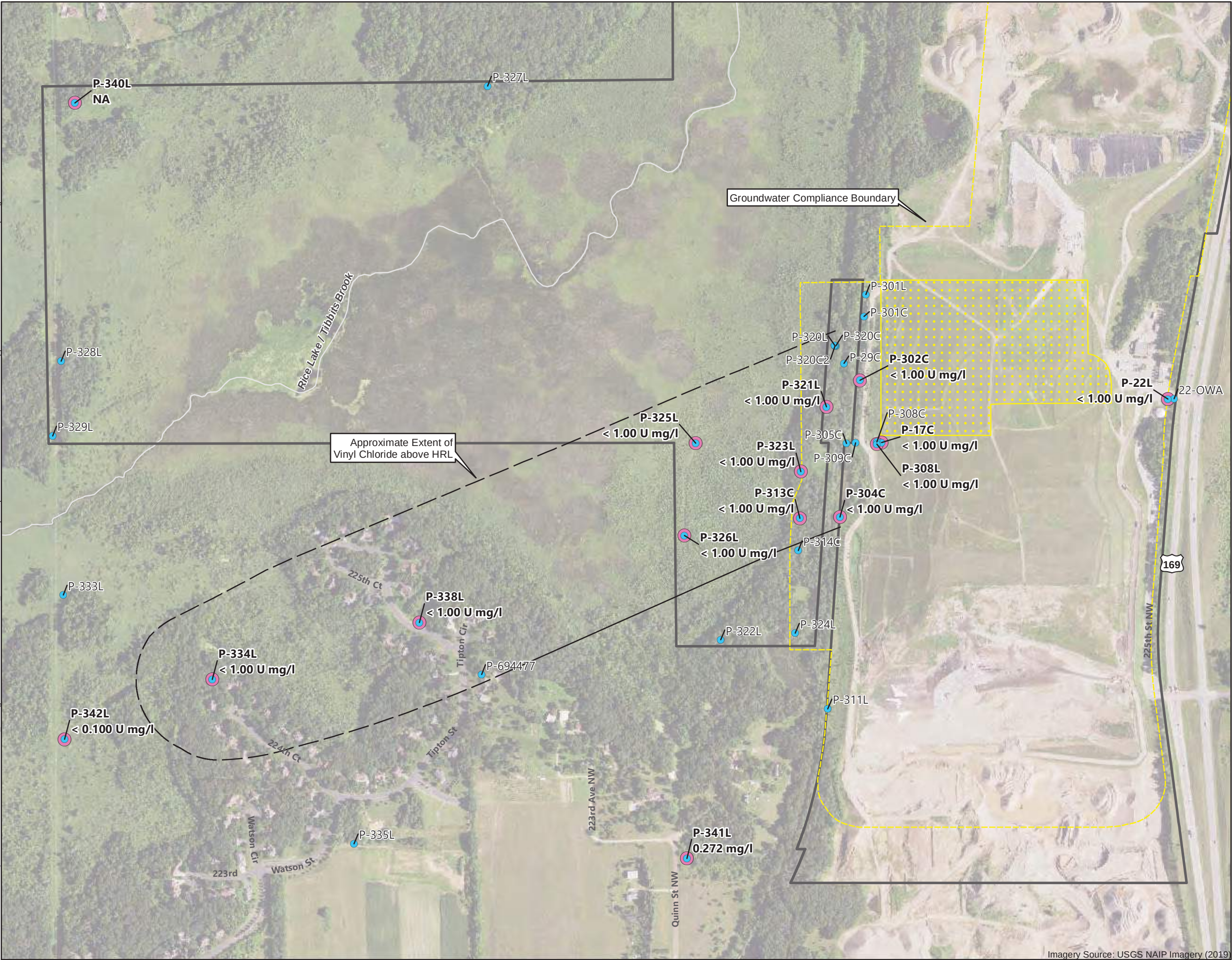


Figure E4
ORGANIC CARBON
Elk River Landfill
Elk River, Minnesota



Bar Footer: ArcGIS 10.8.1, 2024-03-11 13:28 File: I:\Client\Waste Management\Elk River Landfill\Work Orders\23711005\Maps\Reports\2024 Initial Performance Evaluation\Appendix E - Geochemical Indicator Maps\Figure E5 - Nitrate.mxd User: kac2



- Property Boundary
- Pre-Subtitle D Area
- Monitoring Well
- MNA Monitoring Well

Note:
- Displayed data from July-August 2023 monitoring event.
NA - Not Analyzed
U The analyte was analyzed for, but was not detected.

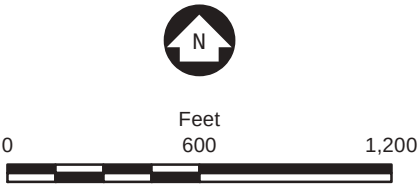
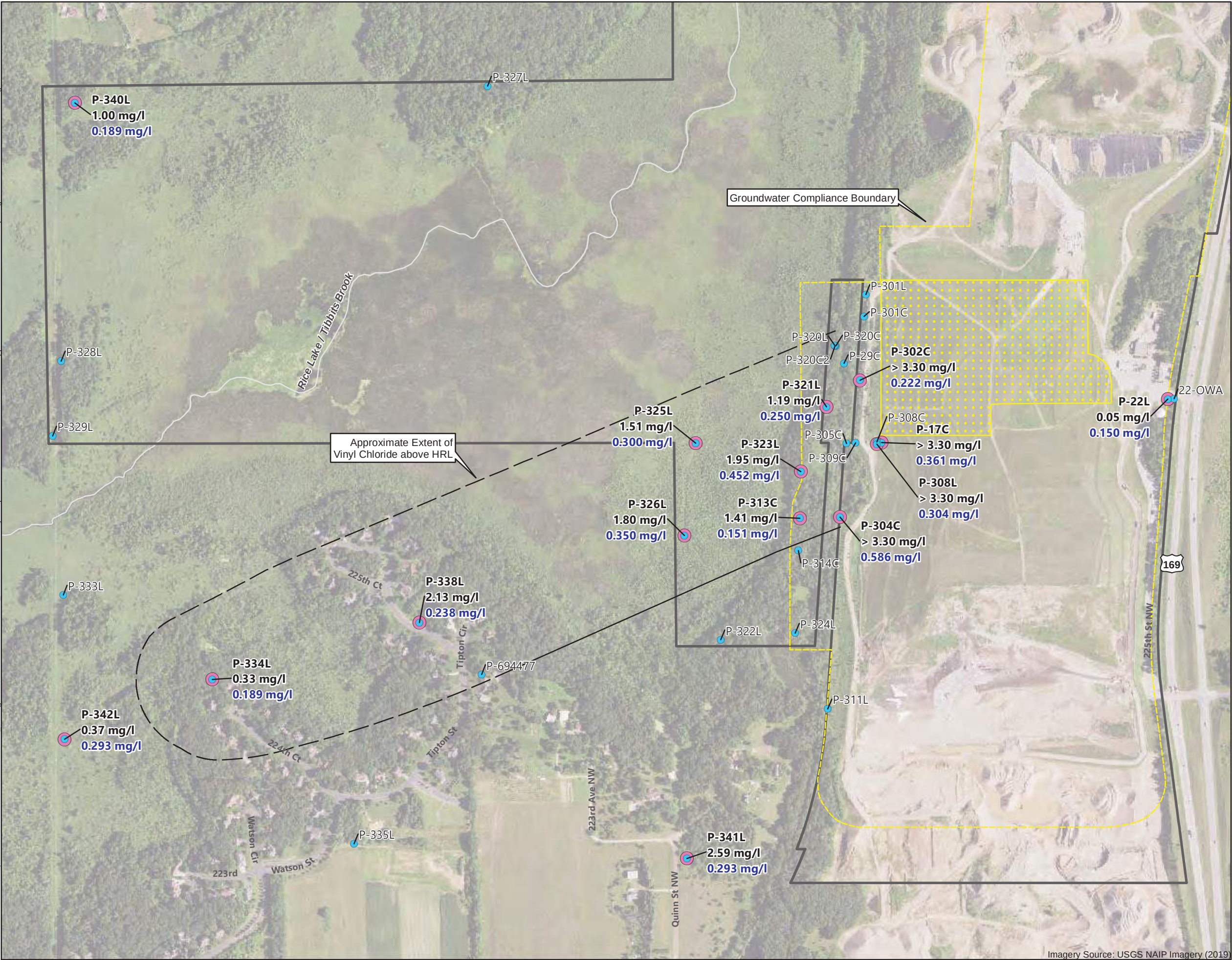


Figure E5
NITRATE
Elk River Landfill
Elk River, Minnesota





- Property Boundary
- Pre-Subtitle D Area
- Monitoring Well
- MNA Monitoring Well
- 6.5 mg/l Reduced Iron Concentration
- 200 mg/l Manganese Concentration

Note:
- Displayed data from July-August 2023 monitoring event.

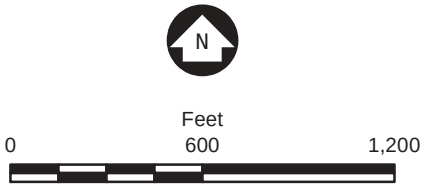
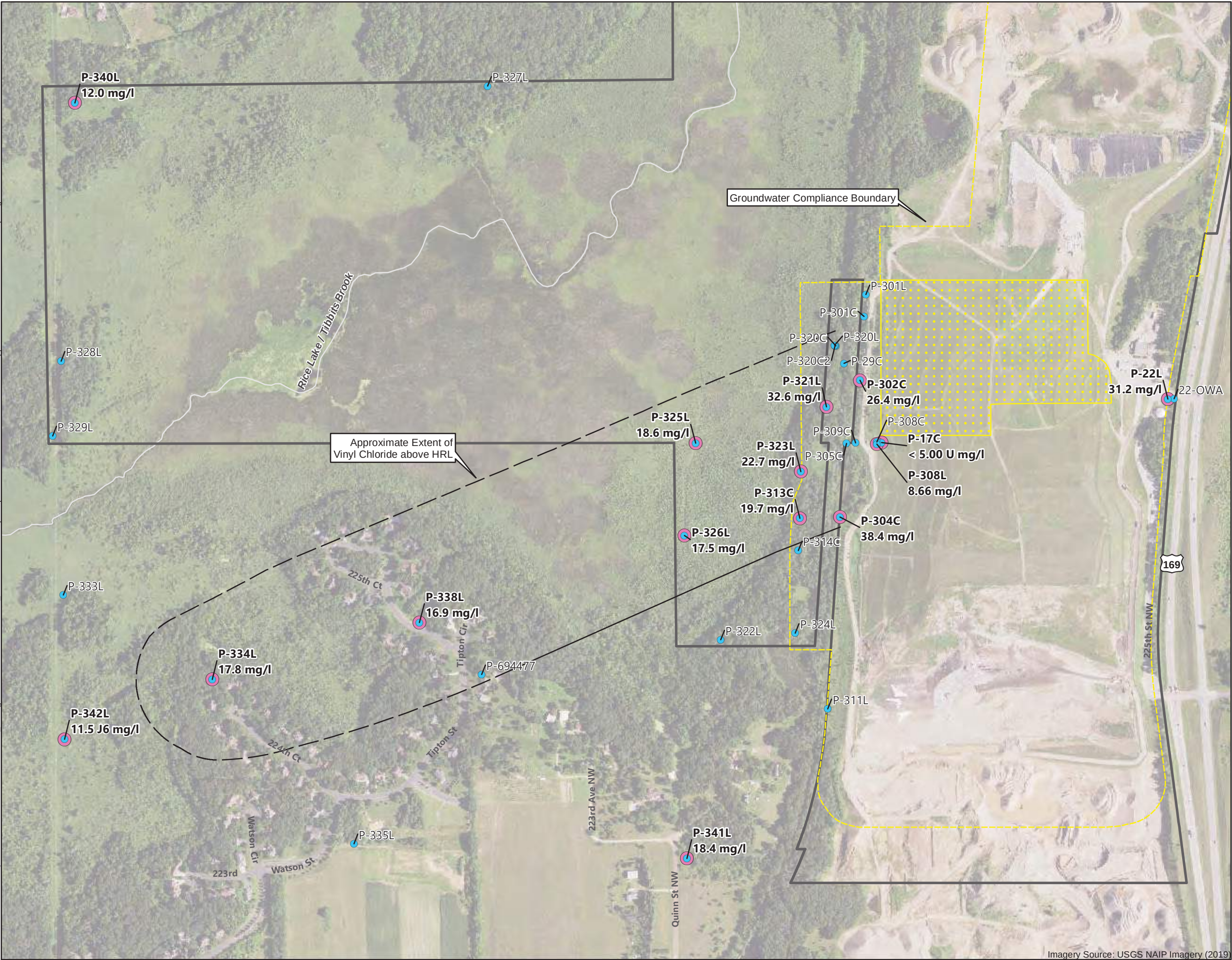


Figure E6
REDUCED IRON AND
MANGANESE
Elk River Landfill
Elk River, Minnesota



Bar Footer: ArcGIS 10.8.1, 2024-03-11 13:33 File: I:\Client\Waste Management\Elk River Landfill\Work Orders\23711005\Maps\Reports\2024 Initial Performance Evaluation\Appendix E - Geochemical Indicator Maps\Figure E7 - Sulfate.mxd User: kac2



- Property Boundary
- Pre-Subtitle D Area
- Monitoring Well
- MNA Monitoring Well

Note:
- Displayed data from July-August 2023 monitoring event.

U The analyte was analyzed for, but was not detected.

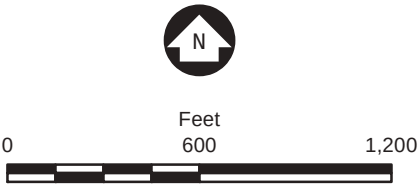
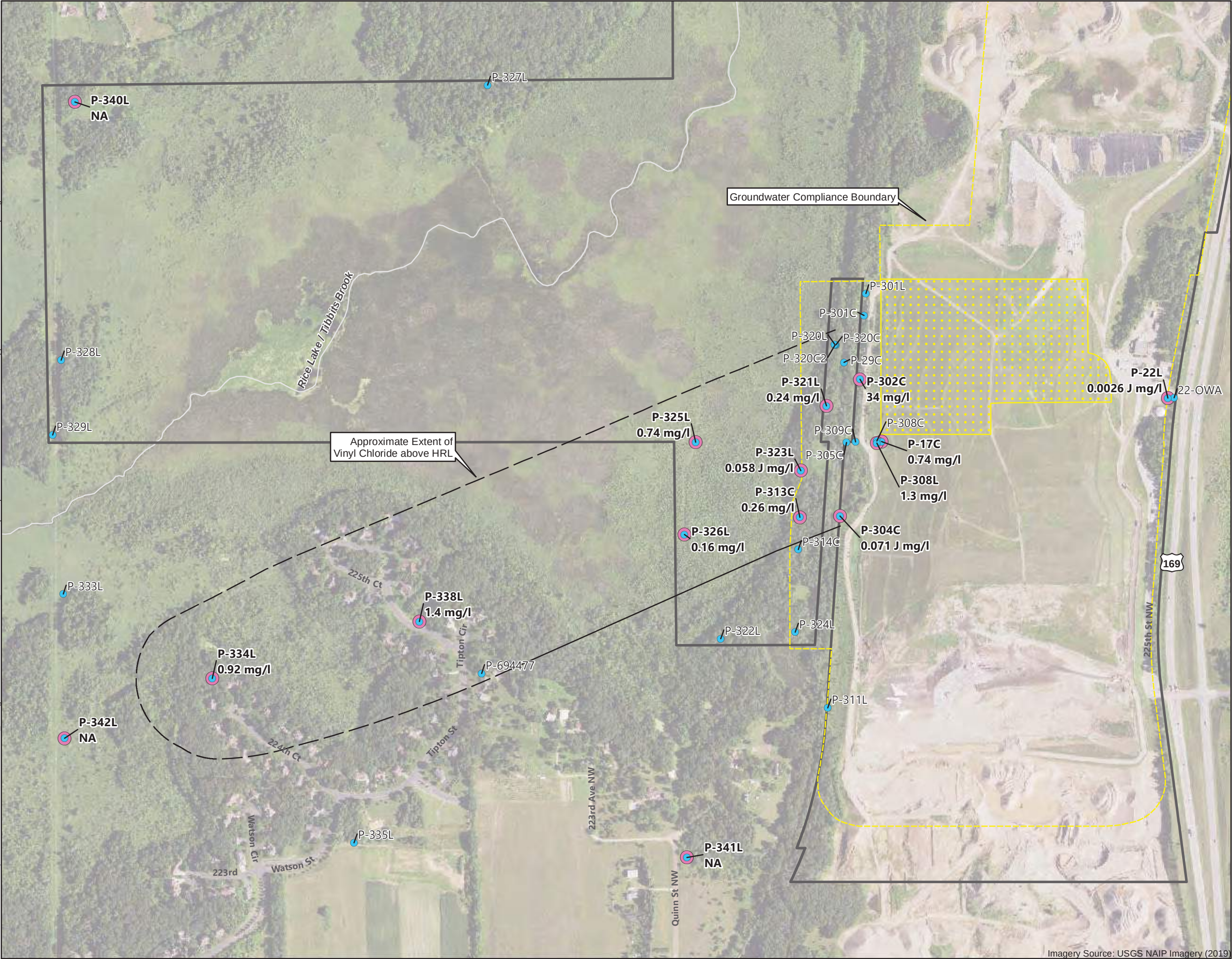


Figure E7
SULFATE
Elk River Landfill
Elk River, Minnesota





- Property Boundary
- Pre-Subtitle D Area
- Monitoring Well
- MNA Monitoring Well

Note:
- Displayed data from July-August 2023 monitoring event.
NA - Not Analyzed
J The identification of the analyte is acceptable; the reported value is an estimate.

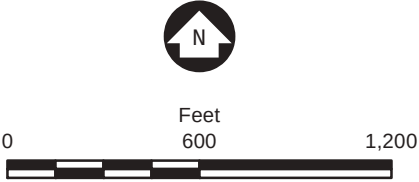
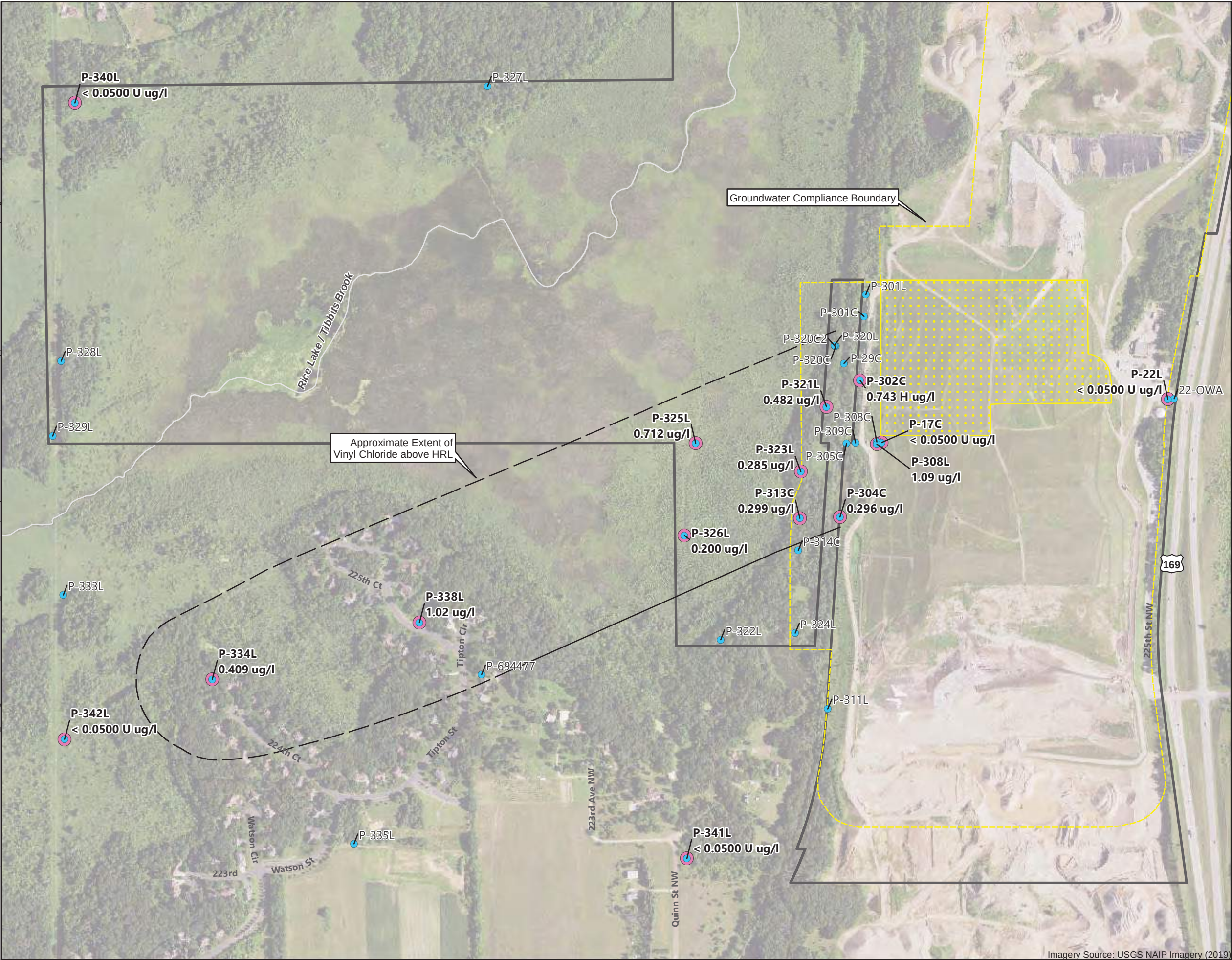


Figure E8
METHANE
Elk River Landfill
Elk River, Minnesota



Bar Footer: ArcGIS 10.8.1, 2024-03-11 13:34 File: I:\Client\Waste Management\Elk River Landfill\Work Orders\23711005\Maps\Reports\2024 Initial Performance Evaluation\Appendix E - Geochemical Indicator Maps\Figure E9 - Vinyl Chloride.mxd User: kac2



- Property Boundary
- Pre-Subtitle D Area
- Monitoring Well
- MNA Monitoring Well

Note:

- Displayed data from July-August 2023 monitoring event.
- Data shown only at MNA network monitoring wells.

U The analyte was analyzed for, but was not detected.

H Recommended sample preservation, extraction or analysis holding time was exceeded.

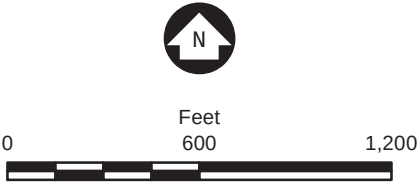


Figure E9

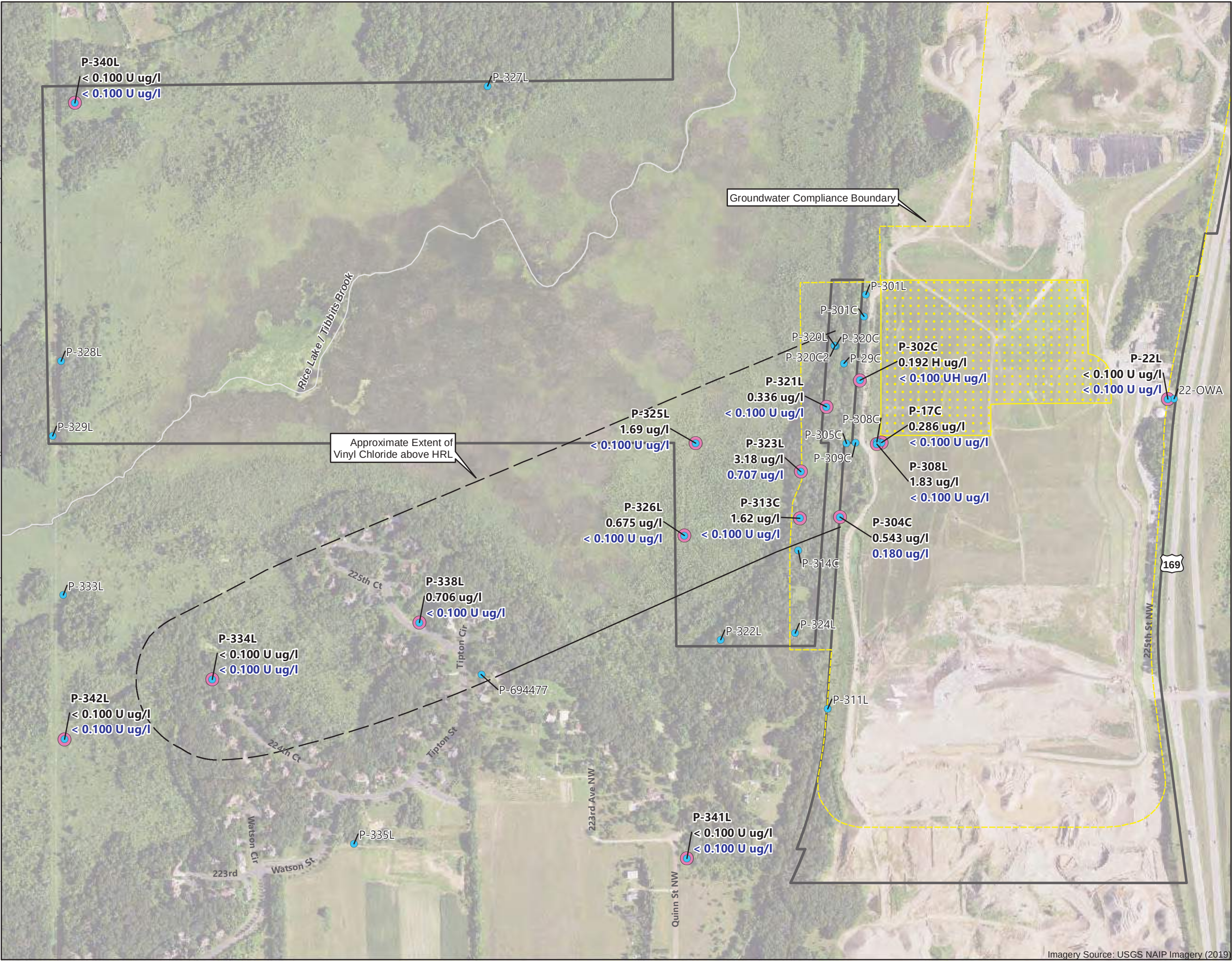
VINYL CHLORIDE

Elk River Landfill

Elk River, Minnesota



Barr Footer: ArcGIS 10.8.1, 2024-03-11 13:35 File: I:\Client\Waste Management\Elk River Landfill\Work Orders\2711005\Maps\Reports\2024 Initial Performance Evaluation\Appendix E - Geochemical Indicator Maps\Figure E10 - 1,2 Cis-Dichloroethylene and Trichloroethylene (TCE).mxd User: kac2



Property Boundary

Pre-Subtitle D Area

Monitoring Well

MNA Monitoring Well

6.5 ug/l

1,2-Dichloroethylene, cis Concentration

0.001 ug/l

Trichloroethylene (TCE) Concentration

Note:

- Displayed data from July-August 2023 monitoring event.
- Data shown only at MNA network monitoring wells.

U The analyte was analyzed for, but was not detected.

H Recommended sample preservation, extraction or analysis holding time was exceeded.

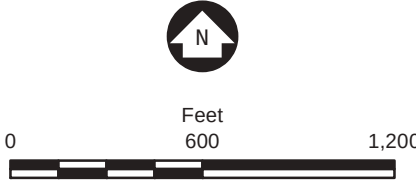


Figure E10

1,2 CIS-DICHLOROETHYLENE
AND TRICHLOROETHYLENE (TCE)
Elk River Landfill
Elk River, Minnesota



Appendix F

Magnetic Susceptibility Results

Table F1
Magnetic Susceptibility Results
Elk River Landfill

Sample ID	Geologic Unit	Top of Sample (feet)	Bottom of Sample (feet)	Magnetic Susceptibility	
				m ³ /kg	+ / - m ³ /kg
P-410L 97-97'	Till	97	97	2.3E-06	1.4E-07
P-410L 102-103'	Outwash	102	103	2.2E-06	3.4E-07
P-410L 129-130'	Outwash	129	130	1.0E-06	1.8E-07
P-410L 147-148'	Outwash	147	148	9.6E-07	1.0E-07
P-410L 167-168'	Outwash	167	168	8.7E-07	1.3E-07
P-342L 42-42'	Till	42	42	7.3E-07	2.0E-08
P-342L 50-51'	Outwash	50	51	1.3E-06	9.0E-08
P-342L 75-76'	Outwash	75	76	9.1E-07	7.0E-08
P-342L 97-98'	Outwash	97	98	1.8E-06	5.0E-08
Average				1.3E-06	1.2E-07

Note:

- Well P-410L installed approximately 1,400 feet north of well P-301L as part of a separate hydrogeologic evaluation

SITE LOGIC Report

Abiotic Potential

Contact: Anthony Neuens

Phone:

Address: Barr Engineering - Minneapolis, MN
4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435

Email: tneuens@barr.com

MI Identifier: 115UC

Report Date: 4-4-2023

Project Name: ERL-CA

Comments:

Overview

Although not always fully considered, abiotic degradation can be a substantial or even the primary process for chlorinated hydrocarbon destruction at sites undergoing or transitioning to monitored natural attenuation (MNA). A variety of iron-bearing minerals including iron sulfides (mackinawite and pyrite), iron oxides (magnetite), green rust, and iron-bearing clays are capable of complete or nearly complete degradation of PCE, TCE, and carbon tetrachloride (He et al. 2009). Some iron-bearing minerals also catalyze the degradation of chlorinated ethanes and the lesser chlorinated ethenes cis-dichloroethene (DCE) and vinyl chloride. While the quantities and types will vary, these reactive iron minerals are frequently identified in subsurface environments under iron reducing and sulfate reducing conditions.

Brown et al. (2007) recommend four avenues for evaluating the role of abiotic processes in contaminant attenuation. First, examining contaminant concentrations along the flow path - decreasing parent compound concentrations with no evidence of accumulation of chlorinated transformation products like cis-DCE and vinyl chloride suggest abiotic degradation. Performing compound specific isotope analysis (CSIA) or monitoring for products unique to abiotic reactions such as acetylene can also provide a strong line of evidence. Microcosm studies with native sediment and killed controls can also be performed. Finally, Brown et al. (2007) suggest performing mineralogical analyses on aquifer sediment to characterize reactive minerals such as magnetite or iron monosulfides

Magnetic Susceptibility - Magnetite

Magnetite (Fe_3O_4) is a mixed valence iron mineral shown to react with PCE, TCE, and carbon tetrachloride. Furthermore, Ferrey et al. (2004) conclusively linked the observed degradation of cis-DCE at a former ammunition plant to magnetite in the subsurface. No direct chemical test is available for quantification of magnetite. However, magnetite is the most abundant mineral in natural sediments that exhibits magnetic behavior. Therefore, magnetic susceptibility provides an inexpensive and valuable estimate of the quantity of magnetite in environmental samples.

X-ray Diffraction (XRD) - Mackinawite, Pyrite, Magnetite and Green Rust

XRD is one of the primary techniques used to identify unknown crystalline materials. Most minerals are crystalline and will scatter X-rays in a regular, characteristic manner dependent on their crystal structure.

- Mackinawite is the most reactive of the iron-bearing minerals and a crystalline form (tetragonal FeS) can be detected by XRD. Mackinawite will transform PCE and TCE primarily by elimination to acetylene. Carbon tetrachloride is transformed mainly to chloroform but carbon dioxide, formate, and carbon disulfide have also been detected. Finally, the more heavily chlorinated ethanes including hexachloroethane, pentachloroethane, and tetrachloroethanes react to form chlorinated ethenes which can be further degraded.
- Pyrite (FeS_2) catalyzes beta elimination transforming PCE, TCE, and cis-DCE to acetylene and ethene. Vinyl chloride is transformed to ethene and ethane. Pyrite is also capable of degradation of carbon tetrachloride potentially forming a number of products including chloroform, carbon dioxide, carbon disulfide, and formate depending on reaction conditions.
- While not quantitative like the magnetic susceptibility test, XRD can also detect magnetite when present at between 2% and 5% on a weight basis.
- Green rusts have been reported to transform a number of common chlorinated contaminants including cis-DCE, vinyl chloride, trichloroethanes, and tetrachloroethanes. While special sample care to prevent oxidation would be needed, XRD can be used to detect green rust.

Percent Clay

Clays have large surface areas, balanced by exchangeable cations, which can bind a large number of both organic and inorganic molecules impacting their availability and reactivity in the subsurface. While less well studied than the other iron-bearing minerals, various phyllosilicate clays have been shown to be capable of degradation of PCE, TCE, cis-DCE, vinyl chloride, and carbon tetrachloride

Sample Location	P-410L 97-97	P-410L 102-103	P-410L 129-130
Date Sampled	02/21/2023	02/21/2023	02/21/2023

Magnetic Susceptibility Analysis

Magnetic Susceptibility (m3/kg)	2.3E-6 ± 1.4E-7	2.2E-6 ± 3.4E-7	1.0E-6 ± 1.8E-7

Sample Location	P-410L 147-148	P-410L 167-168	P-342L 42-42
Date Sampled	02/28/2023	02/28/2023	03/03/2023

Magnetic Susceptibility Analysis

Magnetic Susceptibility (m3/kg)	9.6E-7 ± 1.0E-7	8.7E-7 ± 1.3E-7	7.3E-7 ± 2.0E-8

Sample Location	P-342L 50-51	P-342L 75-76	P-342L 97-98
Date Sampled	03/03/2023	03/03/2023	03/03/2023

Magnetic Susceptibility Analysis

Magnetic Susceptibility (m3/kg)	1.3E-6 ± 9.0E-8	9.1E-7 ± 7.0E-8	1.8E-6 ± 5.0E-8

* Analysis performed in triplicate and results reported as the mean followed by +/- standard deviation.

References

- Brown, R. A., J. T. Wilson and M. Ferrey (2007). "Monitored natural attenuation forum: The case for abiotic MNA." Remediation Journal **17**(2): 127-137.
- Ferrey, M. L., R. T. Wilkin, R. G. Ford and J. T. Wilson (2004). "Nonbiological Removal of cis-Dichloroethylene and 1,1-Dichloroethylene in Aquifer Sediment Containing Magnetite." Environmental Science & Technology **38**(6): 1746-1752.
- He, Y., C. Su, J. T. Wilson, R. T. Wilkin, C. Adair, T. Lee, P. Bradley and M. Ferrey (2009). Identification and characterization of methods for reactive minerals responsible for natural attenuation of chlorinated organic compounds in ground water, US EPA.
- Liu, Y., S. A. Majetich, R. D. Tilton, D. S. Sholl and G. V. Lowry (2005). "TCE Dechlorination Rates, Pathways, and Efficiency of Nanoscale Iron Particles with Different Properties." Environmental Science & Technology **39**(5): 1338-1345.
- Song, H. and E. R. Carraway (2005). "Reduction of Chlorinated Ethanes by Nanosized Zero-Valent Iron: Kinetics, Pathways, and Effects of Reaction Conditions." Environmental Science & Technology **39**(16): 6237-6245.

Abiotic Reactions of Chlorinated Compounds with Iron Bearing Minerals and Zero Valent Iron (ZVI). Summaries for iron bearing minerals are based on He et al. (2009) and references therein. He et al. available at <http://nepis.epa.gov/>. Summary of ZVI based on Liu et al. (2005) and Song et al. (2005).

Contaminant	Mineral	Degradation	Reported Degradation Intermediates and Products ¹
PCE	FeS	Yes	Acetylene, TCE, cis-DCE, 1,1-DCE, ethene
	Pyrite	Yes	TCE, acetylene, ethene
	Magnetite	Yes	Unknown ²
	³ GR(SO ₄)	Reports Differ	
	phyllosilicate clays	Yes	TCE, 1,1-DCE, vinyl chloride, 1,1,2-TCA, 1,1-DCA, chloroacetylene, acetylene, ethene, ethane
	ZVI	Yes	Ethene and ethane
TCE	FeS	Yes	Acetylene, cis-DCE, vinyl chloride, 1,1-DCE
	Pyrite	Yes	Acetylene, ethene, cis-DCE, (organic acids with DO present)
	Magnetite	Yes	Unknown ¹
	GR(SO ₄), GR(CO ₃)	No	Only observed degradation when Cu(II) added
	phyllosilicate clays	Yes	cDCE, vinyl chloride, acetylene, ethene, ethane
	ZVI	Yes	Ethane, ethene, acetylene with minor amounts of DCE, VC depending on conditions
cis-DCE	FeS	No	None detected
	Pyrite	Yes	Acetylene, ethene
	Magnetite	Yes	Unknown ²
	GR(SO ₄)	Yes	
	phyllosilicate clays	Yes	
	ZVI	Yes	Primarily acetylene and ethene but also much lesser amounts of ethane and VC and traces of methane, propane, propene, butane and butene
Vinyl chloride	FeS	Unknown	
	Pyrite	Yes	Ethene, ethane
	Magnetite	Yes	Unknown ²
	GR(SO ₄)	Yes	
	phyllosilicate clays	Yes	
	ZVI	Yes	Ethene, ethane, (no evidence of acetylene)

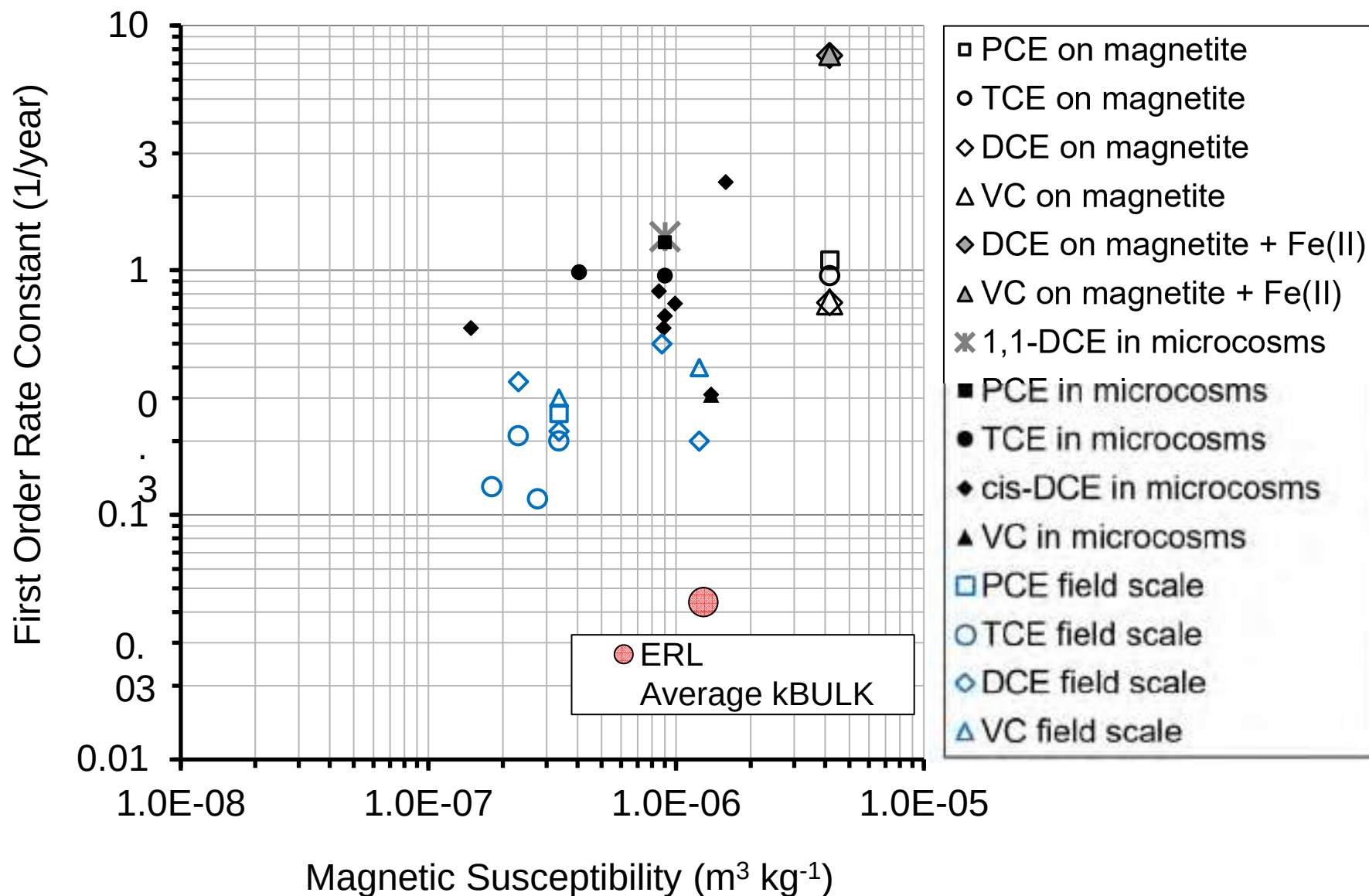
Contaminant	Mineral	Degradation	Reported Degradation Intermediates and Products ¹
1,1-DCA	FeS	Not Significant	None detected
1,1-DCA	GR(SO ₄)	Low conversion	Ethene and ethane (w/ Cu or Ag)
1,1-DCA	ZVI	Yes (low)	Ethane
1,2-DCA	FeS	Not Significant	None detected
1,2-DCA	FeS (Biogenic)	Yes	Not monitored
1,2-DCA	GR(SO ₄)	No	
1,2-DCA	ZVI	No	
1,1,1-TCA	FeS	Yes	1,1-DCA, ethene, 2-butyne
1,1,1-TCA	GR(SO ₄)	Yes	1,1-DCA, CA, ethene ethane
1,1,1-TCA	ZVI	Yes	1,1-DCA, ethane
1,1,2-TCA	FeS	Rate not significant	Small amounts of 1,1-DCE and vinyl chloride but rate not significant
1,1,2-TCA	GR(SO ₄)	Yes	Vinyl chloride, 1,1-DCE, ethene, ethane
1,1,2-TCA	ZVI	Yes	Ethane
1,1,1,2-TeCA	FeS	Yes	1,1-DCE
1,1,1,2-TeCA	GR(SO ₄)	Yes	1,1-DCE and minor (<1%) vinyl chloride, ethene, ethane
1,1,1,2-TeCA	phyllosilicate clays	Yes	1,1-DCE
1,1,1,2-TeCA	ZVI	Yes	TCE, 1,1-DCE
1,1,2,2-TeCA	FeS	Yes	TCE, cis-DCE, trans-DCE, acetylene
1,1,2,2-TeCA	GR(SO ₄)	Yes	TCE (major), cis-DCE, trans-DCE
1,1,2,2-TeCA	phyllosilicate clays	Yes	TCE
1,1,2,2-TeCA	ZVI	Yes	TCE, trans-DCE, cis-DCE
Carbon Tetrachloride	FeS	Yes	Chloroform, carbon disulfide, possibly methane, ethene, ethane
CT	Pyrite	Yes	Chloroform, CO ₂ , carbon disulfide, formate (highly dependent on conditions)
CT	Magnetite	Yes	Chloroform, carbon monoxide, methane, formate (highly dependent on conditions)
CT	GR(SO ₄)	Yes	Chloroform and hexachloroethane; Chloroform, DCM, methane, ethene
CT	phyllosilicate clays	Yes	Chloroform
CT	ZVI	Yes	Chloroform, dichloromethane, methane (depending on conditions)

Notes: GR(SO₄) sulfate green rust. GR(CO₃) carbonate green rust. ZVI zero valent iron

¹Compilation of reported degradation products. Mass recovery of products typically low -- additional undetected and unreported products are likely. Reported reaction products or proportions of reaction products were often a function of environmental conditions.

²No published studies that identify the transformation products of PCE, TCE, cis-DCE or vinyl chloride with magnetite. Ferrey et al (2004) analyzed for products of cis-DCE dechlorination including vinyl chloride, ethene, and ethane and did not find them. If Fe²⁺ sorbed to magnetite stabilizes carbene ions, the ultimate degradation product of cis-DCE on magnetite would be CO₂.

Figure F1 - Magnetic Susceptibility vs Rate Constant, Comparison to Other Sites



Appendix G

Trend Analysis

Table G1
Mann-Kendall Trend Analysis Summary

Location	total sample count	total count NDs	count used for trend ⁽¹⁾	NDs used in trend	Mean (ppb) ⁽²⁾	Std Deviation (ppb) ⁽²⁾	CV	MK Test Value (S) ⁽³⁾	p-value ⁽⁴⁾	Trend Statement	Note
P-17C	18	9								Not enough data above reporting limits to complete trend analysis	
P-22L	8	8								Not enough data above reporting limits to complete trend analysis	
P-29C	39	14	27	2	0.506	0.226	45%	-18	0.361	No statistical evidence according to the MK test of an upward or downward trend at 95% confidence level	Trend period 2015-2023
P-29D	39	39								Not enough data above reporting limits to complete trend analysis	
P-301C	40	24	25	9	0.119	0.178	150%	32	0.224	No statistical evidence according to the MK test of an upward or downward trend at 95% confidence level	Trend period 2016-2023
P-301L	39	34								Not enough data above reporting limits to complete trend analysis	
P-302C	39	12	27	0	0.469	0.228	49%	102	0.0176	Statistically significant upward trend at 95% confidence level	Trend period 2015-2023
P-303C	29	29								Not enough data above reporting limits to complete trend analysis	
P-304C	39	23	24	9	0.169	0.121	72%	-108	0.00314	Statistically significant downward trend at 95% confidence level	Trend period 2016-2023
P-305C	39	30								Not enough data above reporting limits to complete trend analysis	
P-308C	13	9								Not enough data above reporting limits to complete trend analysis	
P-308L	11	1	11	1	0.963	0.563	58%	-13	0.175	No statistical evidence according to the MK test of an upward or downward trend at 95% confidence level	Trend period 2019-2023
P-309C	13	4	9	0	0.362	0.0709	20%	-3	0.417	No statistical evidence according to the MK test of an upward or downward trend at 95% confidence level	Trend period 2015-2023
P-310C	29	29								Not enough data above reporting limits to complete trend analysis	
P-311C	29	29								Not enough data above reporting limits to complete trend analysis	
P-311D	39	39								Not enough data above reporting limits to complete trend analysis	
P-311L	34	34								Not enough data above reporting limits to complete trend analysis	
P-313C	39	13	27	5	0.364	0.234	64%	-206	0.000009	Statistically significant downward trend at 95% confidence level	Trend period 2015-2023
P-314C	26	7	26	7	0.326	0.277	85%	-148	0.00053	Statistically significant downward trend at 95% confidence level	Trend period 2015-2023
P-315L	9	9								Not enough data above reporting limits to complete trend analysis	
P-320C	39	18	26	5	0.218	0.139	64%	-35	0.226	No statistical evidence according to the MK test of an upward or downward trend at 95% confidence level	Trend period 2015-2023
P-320C2	38	16	25	3	0.14	0.107	76%	-21	0.329	No statistical evidence according to the MK test of an upward or downward trend at 95% confidence level	Trend period 2015-2023
P-320L	39	14	26	1	0.302	0.149	49%	-5	0.465	No statistical evidence according to the MK test of an upward or downward trend at 95% confidence level	Trend period 2015-2023
P-321L	39	3	36	1	1.108	0.63	57%	-331	0.0000032	Statistically significant downward trend at 95% confidence level	Trend period 2012-2023
P-322L	39	39								Not enough data above reporting limits to complete trend analysis	
P-323L	37	13	28	6	0.397	0.271	68%	-220	0.000007	Statistically significant downward trend at 95% confidence level	Trend period 2014-2023
P-324L	37	36								Not enough data above reporting limits to complete trend analysis	
P-325L	29	3	27	1	0.52	0.313	60%	37	0.226	No statistical evidence according to the MK test of an upward or downward trend at 95% confidence level	Trend period 2015-2023
P-326L	29	6	27	4	0.493	0.313	63%	-142	0.001610	Statistically significant downward trend at 95% confidence level	Trend period 2015-2023
P-327L	10	10								Not enough data above reporting limits to complete trend analysis	
P-328L	7	7								Not enough data above reporting limits to complete trend analysis	
P-329L	23	23								Not enough data above reporting limits to complete trend analysis	
P-333L	13	13								Not enough data above reporting limits to complete trend analysis	
P-334L	20	9	17	6	0.176	0.135	77%	76	0.00053	Statistically significant upward trend at 95% confidence level	Trend period 2019-2023
P-335L	18	18								Not enough data above reporting limits to complete trend analysis	
P-337L	7	7								Not enough data above reporting limits to complete trend analysis	
P-338L	8	5								Not enough data above reporting limits to complete trend analysis	
P-340L	6	6								Not enough data above reporting limits to complete trend analysis	
P-341L	2	2								Not enough data above reporting limits to complete trend analysis	
P-342L	2	2								Not enough data above reporting limits to complete trend analysis	
P694477	26	16	13	3	0.176	0.117	66%	29	0.0427	Statistically significant upward trend at 95% confidence level	Trend period 2019-2023

Table G1
Mann-Kendall Trend Analysis Summary

General Notes:

(1) For purposes of this trend analysis, all samples reported as non-detections were given the value of the reporting limit or detection limit unless otherwise noted. Mann-Kendall (MK) trend analyses were only considered if datasets had at least eight data points greater than or equal to the associated reporting or detection limit. To the extent possible, all data were used for trend analyses. Prior to completing the analyses, data were screened on a case-by-case basis to identify usable data within the time series and to remove ambiguities within the dataset (primarily as it relates to datasets with multiple detection limits). The following rules were used to screen data in a consistent manner:

- (a) Time series with samples that have multiple detection limits were replaced with the highest detection limit value. Detections below the highest detection limit were replaced with the detection limit value. As long as the number of detections remains above eight, a trend analysis was run.
- (b) To handle cases when analytical techniques improved over time and detection limits became lower, the period with the high detection limit(s) was excluded from the trend analysis, including both detections and non-detections. This removed ambiguity in the dataset caused by the prior non-detections.
- (c) Under most circumstances, non-detections were not selectively excluded within a data series. However, there are instances where this is an appropriate practice in order to maintain the maximum amount of information. For example, singular non-detections at relatively high limits were excluded if there were at least 5 usable data points before and after a non-detection in question. This avoided the situation where the majority of a dataset would have been replaced by the highest non-detection value (as with P-320L).

(2) Mean and standard deviations are reported for the data included in the trend analysis, not for the complete dataset. For data sets that included non-detects, mean and standard deviation were calculated using the Kaplan-Meier method.

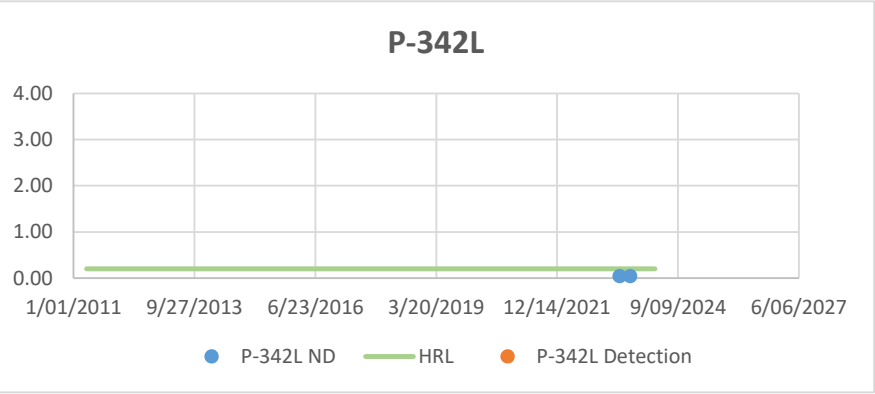
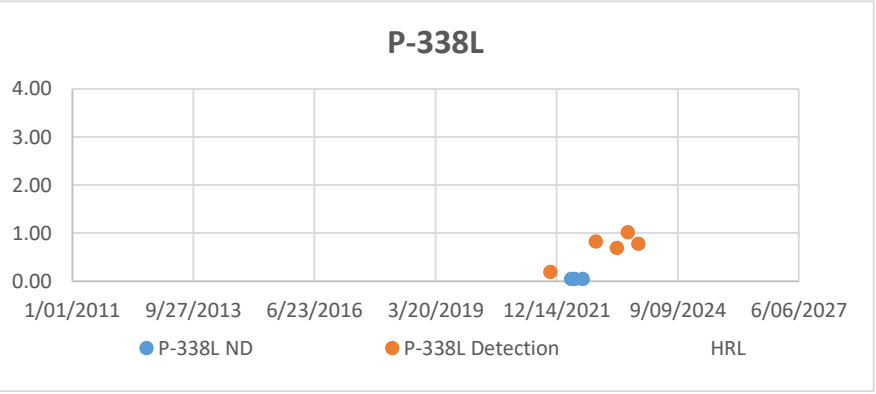
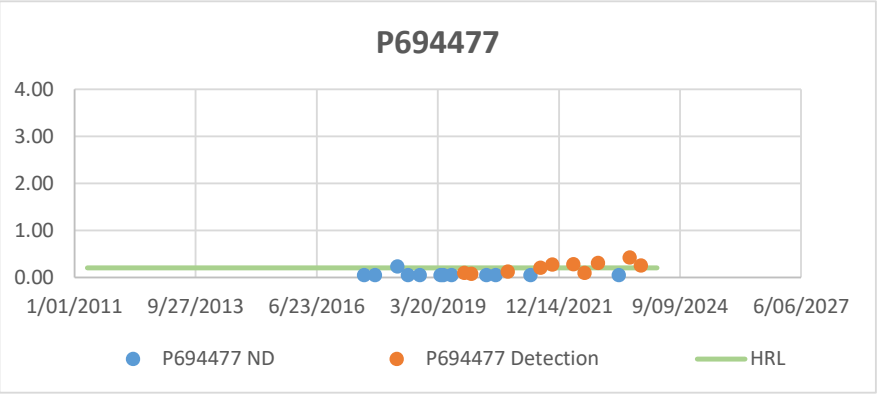
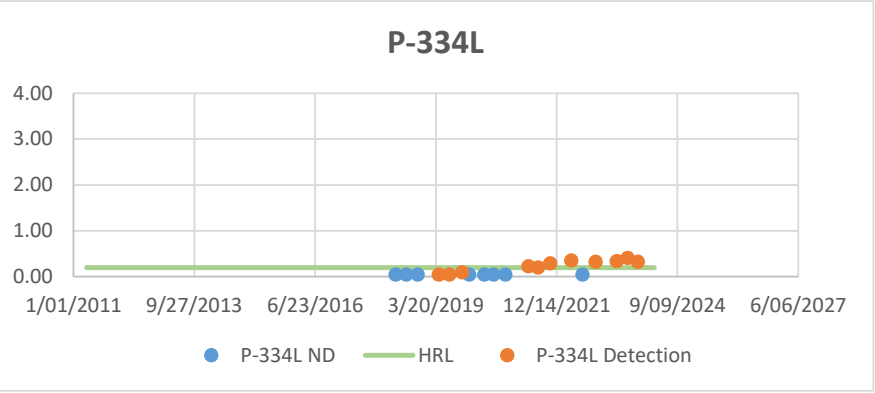
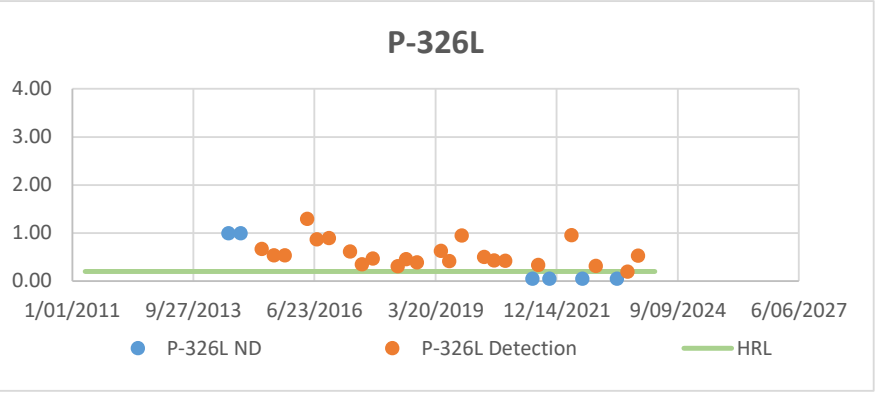
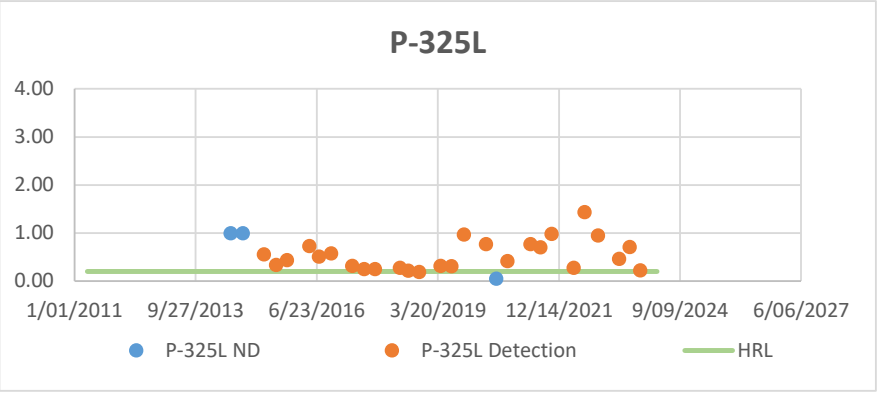
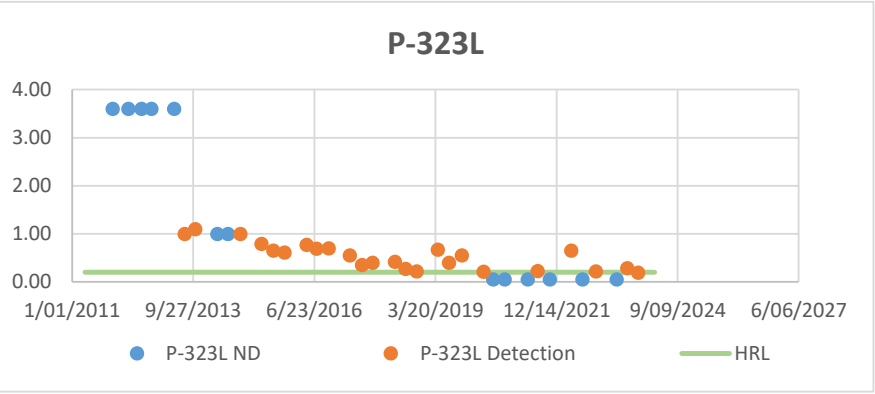
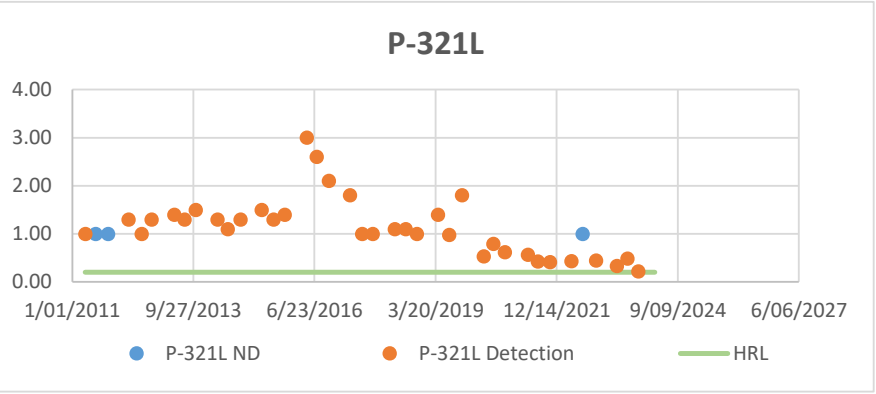
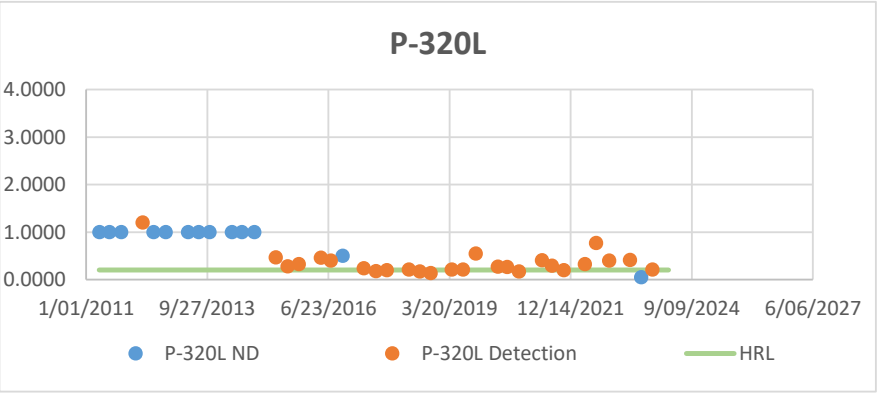
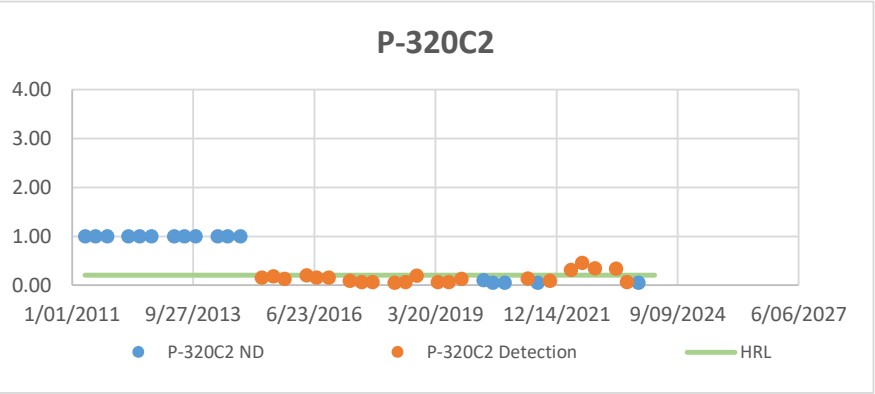
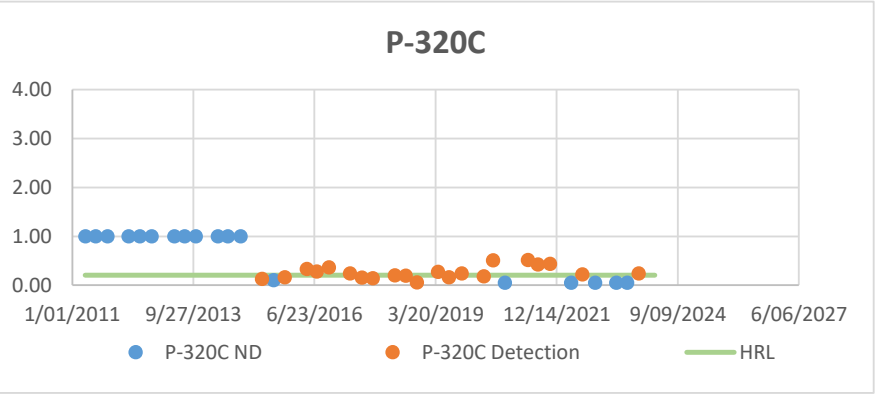
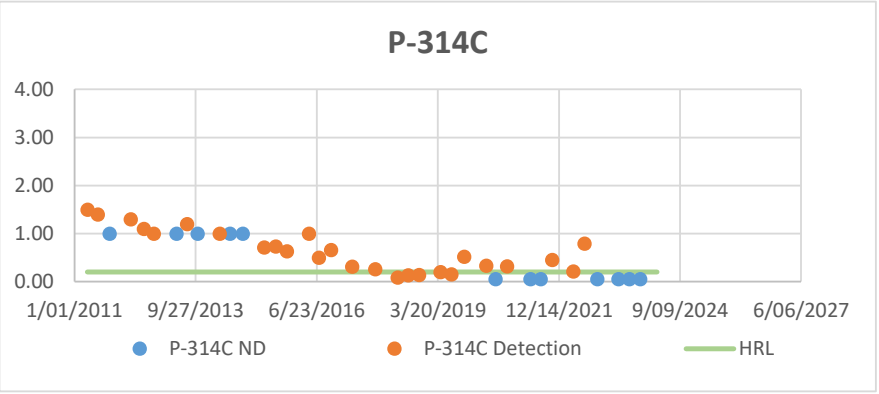
(3) The direction of the trend (upward or downward) is inferred based on the value of the Mann-Kendall (MK) test value, S. An S value that is greater than zero suggests an upward trend and an S value less than zero suggests a downward trend. Values that are close to zero suggest no net upward or downward trend. Statements concerning the statistical significance of the trend are inferred based on the associated p-value.

(4) Trends with p-values that are less than or equal to 0.05 are considered statistically significant trends at the 95% confidence level. Trends with P-values greater than 0.05 and less than or equal to 0.1 are considered possible trends, but are not statistically significant. Trends with p-values greater than 0.1 do not have enough evidence to indicate an upward or downward trend.

Figure G1
Vinyl Chloride Trends (2011-2023)

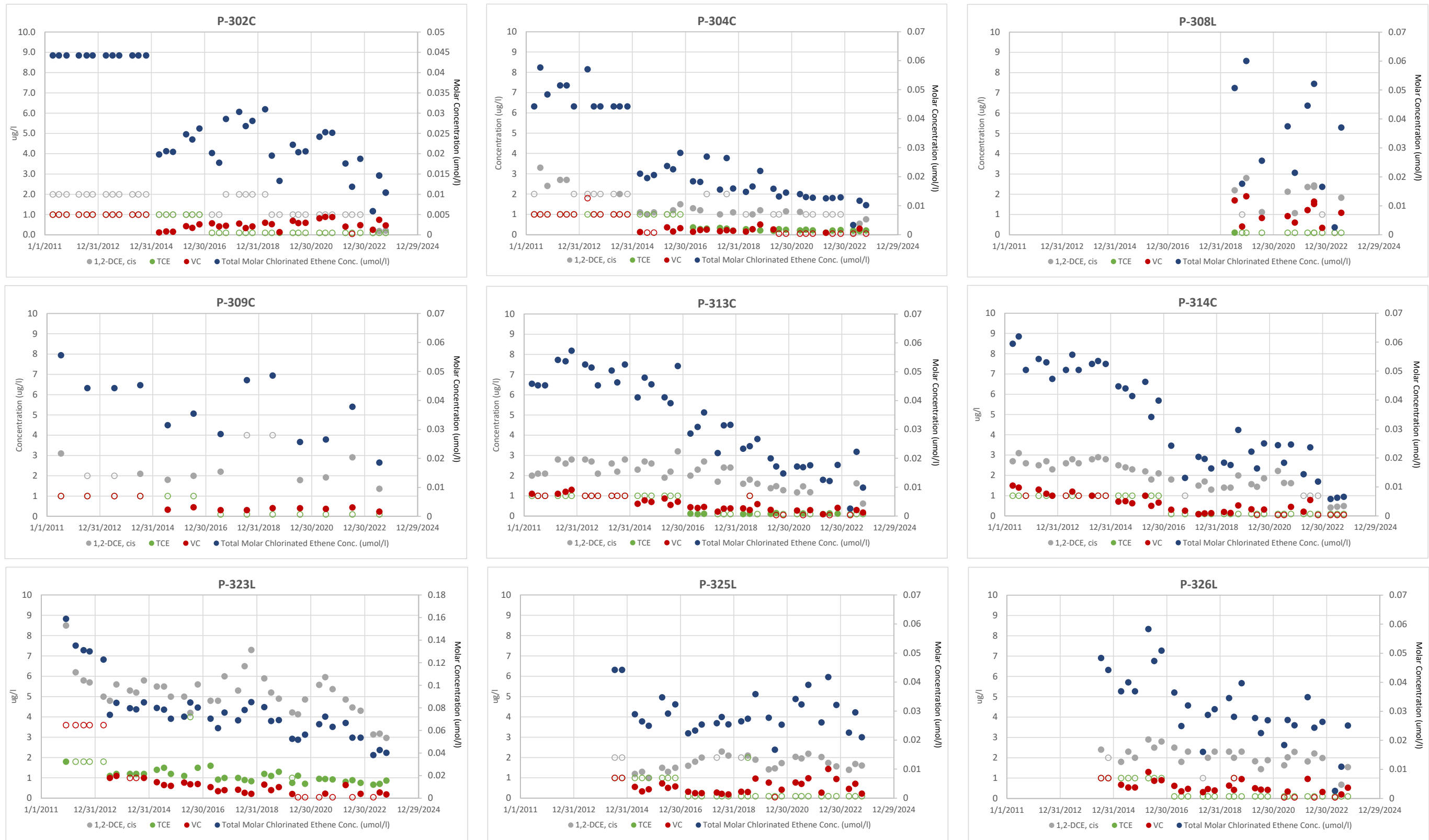


Figure G1
Vinyl Chloride Trends (2011-2023)



Note: Only locations where vinyl chloride has been detected in recent are displayed.
Trend lines shown for locations with 8 or more detections. Where trend line is shown, the displayed trends are based on detected concentrations only.

Figure G2
Vinyl Chloride, Potential Precursor Compound (TCE, DCE), and Total Molar Chlorinated Ethene Trends (2011-2023)



Notes: Only wells where TCE or cis-DCE have routinely been detected are displayed (PCE not detected).
Open symbol indicates sample was non-detect.

Appendix H

Attenuation Rate and Mass Estimates

Appendix H

Summary of Estimated Attenuation Rates and Related Projections

This appendix documents the inputs, assumptions, and methodology for developing A) estimated groundwater flow velocity, B) attenuation rates and resulting projections of vinyl chloride concentrations (and travel distance) downgradient of ERL, and C) vinyl chloride mass and input (flux) from the western edge of ERL into the groundwater system. Referenced equations and inputs are provided in Attachment H1.

A) Vinyl Chloride Transport Velocity and Approximated Arrival Times at Downgradient Monitoring Wells

The vinyl chloride transport velocity (V_{VC}) in groundwater in the lower outwash aquifer (where organics mass transport is predominantly occurring west of ERL) is estimated to be approximately 112 feet/year ([Equation 1](#)). The estimate is based on the observed extent of vinyl chloride downgradient of the facility at P-334L (assumed to be midway between P-334L and P-342L) and the beginning of landfill operations (estimated to be 1972).

Applying a retardation factor (R) of 1.052 for vinyl chloride ([Equation 2](#)), the groundwater flow velocity (V_{GW}) is calculated to be approximately 117 feet/year (ft/yr) ([Equation 3](#)). This calculated V_{GW} is approximately twice the calculated velocity from an aquifer test at P-308L performed in 2019 ([Equation 4](#)). This discrepancy is attributed to the heterogeneity of the lower outwash (e.g., coarse gravel was more abundant at wells P-325L and P-326L than at the wells along the west side of the landfill [Barr, 2015]).

Note that the vinyl chloride transport velocity would be higher if the release did not occur for years after landfill operations began. In the estimates provided in this Appendix, a +25% multiplier is applied to represent an alternative higher end estimate for vinyl chloride transport velocity ($V_{VC,HI} = 139$ ft/yr) and groundwater flow velocity ($V_{GW,HI} = 147$ ft/yr) to account for this uncertainty.

Using these velocity values, the estimated arrival times for the slug of elevated organics concentrations (observed at P-17C in 1992) to arrive at downgradient monitoring points was calculated (See Table H1). Based on this estimation, the slug of elevated organics concentrations has moved past P-325L / P-326L. The slug is estimated to be around well P-338L and is projected to reach well P-334L between 2024 and 2033.

B) Attenuation Rates

Location-specific (k_{POINT}) and bulk attenuation rates (k_{BULK}) and were calculated to further assess attenuation and develop projections based on existing data. Location-specific attenuation rates provide a gauge of the degree of attenuation is occurring at the evaluated location. For example, a value of 0.07/year represents a concentration half-life of approximately 10 years. Bulk attenuation rates provide an overall assessment of attenuation across the entire length of a plume (with some limitations as described below).

Location-Specific Attenuation Rates (k_{POINT})

Location-specific vinyl chloride attenuation rates are useful in assessing trends and projecting time until concentrations reach a certain level (i.e. Intervention Limits) at well locations¹. This evaluation was only applied to vinyl chloride in the central and southern portions of the plume (where decreasing vinyl chloride trends are occurring near the Compliance Boundary and Property Boundary) and not the

¹ Location-specific attenuation rates should not be used to make projections across an entire plume (Newell & Rifai et. al, 2002).

Appendix H

Summary of Estimated Attenuation Rates and Related Projections

northern third of the plume (i.e., north of well P-321L) due to the mix of stable and increasing concentration trends (Appendix G). Attenuation rates were also not calculated for downgradient locations due to too few detections (P-342L), insufficient data (P-338L), no statistically significant trend (P-325L) or increasing trends (P-334L and P-694477).

Vinyl chloride concentration data from 2011 to 2023 was reviewed to calculate k_{POINT} values (Newell & Rifai et. al, 2002) for six wells located near (P-313C, P-314C, P-321L, P-323L) and beyond (P-325L, P-326L) the Compliance Boundary (see [Equation 6](#)).

Calculated k_{POINT} values ranged from 0.125 (P-321L) to 0.254 (P-314C) (Table H2). The k_{POINT} values indicate the following. Using first order kinetics and k_{POINT} values, projections for when each of these wells may approach Intervention Limits (ILs) were calculated. These projections range from approximately 1 (i.e., 2025 at P-314C and P-323L) to 12 years (i.e., 2036 at P-321L) and are shown in Table H2².

Bulk Attenuation Rates (k_{BULK})

Bulk attenuation rates represent an overall measure (or value) that quantifies the rate of attenuation over a defined length of a groundwater plume at one point in time. Bulk attenuation rates and can be used to project the distance a plume will expand while being subjected to attenuation processes (Newell & Rifai et. al, 2002).

Bulk attenuation rates (k_{BULK}) were estimated using trend line analysis methods outlined in MPCA guidance (MPCA, 2006). A primary assumption in applying this method is that the plume (i.e., vinyl chloride and other organics) have achieved steady state (i.e., is stable / not expanding). The steady state assumption is valid at ERL (based on current data), given the long operational history of the facility and non-detect concentrations at distal well P-342L; however this assumption is subject to change based on results of the proposed investigation referenced in Section 6.0 of the report and continued monitoring of organics in groundwater downgradient of the ERL.

Two approaches were applied to develop a range of potential bulk attenuation rates along the plume centerline (P-308L, P-323L, P-326L, P-334L, P-338L, and P-342L) using the trend line analysis method. July 2019, July 2021, and July-August 2023 datasets were applied with the objective of including wells P-308L (installed in 2019), P-338L (installed in 2021) and P-342L (installed in 2023).

- 1) July 2019, July 2021, and July-August 2023 datasets (vinyl chloride only).
- 2) July 2019, July 2021 and July-August 2023 datasets (total molar concentration of vinyl chloride and precursor compounds PCE, TCE, DCE).

Using these two approaches ([Equation 5](#)), the resulting estimated bulk attenuation rates are:

Method	Bulk Att. Rate at $V_{\text{GW}} = 115 \text{ ft/yr}$			Bulk Att. Rate at $V_{\text{GW}} = 137 \text{ ft/yr}$		
	$K_{\text{BULK},2019}$ (/yr)	$K_{\text{BULK},2021}$ (/yr)	$K_{\text{BULK},2023}$ (/yr)	$K_{\text{BULK},2019, \text{HI}}$ (/yr)	$K_{\text{BULK},2021, \text{HI}}$ (/yr)	$K_{\text{BULK},2023, \text{HI}}$ (/yr)
1. Vinyl chloride*	0.082	0.023	0.035	0.103	0.029	0.044
2. Molar total chlorinated ethenes**	0.047	0.035	0.047	0.059	0.044	0.059
Overall average	0.045			0.056		

² Note that the location-specific attenuation rates may be biased low as they do not account for conversion of precursor compounds (PCE, TCE, and DCE) to vinyl chloride.

Appendix H

Summary of Estimated Attenuation Rates and Related Projections

Notes: * - This approach likely represents a low estimate of attenuation rates as conversion from precursor compounds (PCE, TCE, DCE) to vinyl chloride are not considered.
** - This approach includes precursor compounds to capture transformation to vinyl chloride and may represent a high estimate of vinyl chloride attenuation rates as precursor compounds are present at several locations and generally attenuate more rapidly than vinyl chloride.

The estimated vinyl chloride travel velocities and k_{BULK} are applied to evaluate the following scenarios. See Table H3 for details.

- A) Scenario A: What is the estimated highest vinyl concentration at the Compliance Boundary that would naturally attenuate below the IL or detection limit (0.05 micrograms per liter [$\mu\text{g/l}$]) before reaching nearest residential water supply user in the direct downgradient flowpath of the mapped vinyl chloride extent if the groundwater flow path is complete³.
- Range: 0.23 to 11 $\mu\text{g/l}$
 - Average: 1.0 $\mu\text{g/l}$

This scenario suggests that, on average, vinyl chloride concentrations at or below 1.0 $\mu\text{g/l}$ at the Compliance Boundary will attenuate before reaching the nearest residential well downgradient of P-342L.

- B) Scenario B: What is the estimated highest vinyl chloride concentration at monitoring well P-342L that would naturally attenuate below the IL or detection limit (0.05 $\mu\text{g/l}$) before reaching nearest residential water supply user in the direct downgradient flow path of the mapped vinyl chloride extent if the groundwater flow path is complete³.
- Range: 0.08 to 0.32 $\mu\text{g/l}$
 - Average: 0.14 $\mu\text{g/l}$

This scenario suggests that, on average, vinyl chloride concentrations at or below 0.14 $\mu\text{g/l}$ in groundwater at well P-342L will attenuate before reaching the nearest downgradient residential well.

- C) Scenario C: How far is vinyl chloride projected to travel downgradient of the Compliance Boundary considering peak 2023 concentrations reported near Compliance Boundary (0.48 $\mu\text{g/l}$ at P-321L) if the groundwater flow path is complete³?
- Range: 3,200 to 11,300 feet
 - Average: 5,900 feet

This scenario suggests that, based on average bulk attenuation rates, the vinyl chloride detected in groundwater at well P-321L will travel a distance of 5,900 feet before decreasing below the IL or detection limit (0.05 $\mu\text{g/l}$). For context the nearest residential water supply user in the direct downgradient flow path of the mapped vinyl chloride extent is approximately 7,700 feet downgradient of the Compliance Boundary.

Bulk attenuation rates were cross-referenced against observed vinyl chloride concentration data where wells with sufficient historical data exists. The highest bulk attenuation rate calculated (0.082/yr) was found to be in good agreement with measured concentration data in wells beneath RL/TB along the southern extent of the vinyl chloride plume downgradient of the compliance boundary. For example, the

³ The groundwater flow path may not be complete based on the observed lower outwash thickness and 2023 monitoring results from well P-342L.

Appendix H

Summary of Estimated Attenuation Rates and Related Projections

estimated groundwater travel time between P-313C and P-326L is approximately 6 years assuming a vinyl chloride transport velocity of approximately 112 feet/year. The average concentration at P-313C in 2012 was 0.43 µg/l. Seven years later, the average 2023 concentration at P-326L was 0.26 µg/l. Using first order kinetics and the calculated attenuation rate of 0.082/yr, the anticipated concentration at P-326L in 2023 would also be 0.26 µg/l; therefore, the highest calculated bulk attenuation rate appears to be in line with vinyl chloride concentrations observed over time in this example.

Along the northern portion of the plume downgradient of the compliance boundary, bulk attenuation rates underestimate the observed decrease in vinyl chloride. For example, the estimated groundwater travel time between P-321L and P-325L is approximately 8 years assuming a vinyl chloride transport velocity of approximately 112 feet/year. The average concentration at P-321L in 2012 was 1.4 µg/l. Seven years later, the average 2023 concentration at P-325L was 0.47 µg/l. Using first order kinetics and the highest calculated attenuation rate of 0.082/yr, the anticipated concentration at P-326L in 2023 would be 0.73 µg/l; therefore, the highest calculated bulk average attenuation rate appears to underestimate the observed vinyl chloride concentration decrease in this example.

C) Mass Estimates of Vinyl Chloride

The change in vinyl chloride mass flux in groundwater flowing from western edge of the landfill was estimated using a mass flux approach that applies principles of Darcy's Law for the purpose of comparing current and past conditions. The Approximate Extent of Vinyl Chloride Above Intervention Limits shown on Cross Section A-A' (Figure 8 of the 2021 Groundwater Corrective Action Work Plan; Barr, 2021) represents the evaluated cross-sectional area through which groundwater is flowing. The mass flux through this cross sectional area was evaluated using groundwater quality and hydraulic head datasets from 2010, 2019, and 2023. Data inputs, assumptions, and calculated values are included in Table H4.

Using this method, the mass flux of vinyl chloride flowing from the western edge of ERL is estimated to be 0.017 lb/yr in 2023. The 2023 mass flux rate is 82% lower than the estimated mass flux rates from 2010 (0.098 lb/yr) and 70% lower than 2019 (0.057 lb/yr). Similar to the k_{POINT} attenuation values, the zones showing the greatest decrease in mass flux over that time period were in the central and southern areas while the northern area remained similar over that time period.

Summary

The projections described above suggest the following:

- The slug of elevated organics in groundwater previously observed in 1992-1994 at well P-17C is estimated to currently be located near well P-338L and is projected to reach well P-334L between 2024 and 2033.
- Vinyl chloride concentrations are projected to meet ILs along the Compliance Boundary and Property boundary along the southern two-thirds (P-313C, P-314C, P-321, P-323L, P-326) within the next 12 years. The timing of vinyl chloride to meet ILs along the Compliance Boundary / Property boundary in the northern one-third of the plume has not been predicted due to mixed trends in this area (e.g. P-320C and P-325L).
- Assuming the plume is stable and groundwater flow paths are complete³, the 2023 vinyl chloride concentrations observed along the Compliance Boundary are anticipated to attenuate under

Appendix H

Summary of Estimated Attenuation Rates and Related Projections

natural conditions before reaching the nearest residential well downgradient of well P-342L (using average k_{BULK} value).

- Mass flux calculations show the estimated mass of vinyl chloride migrating downgradient of the ERL has declined by 82 % since 2010. This decline is expected to result in lower downgradient vinyl chloride concentrations and reduce the plume extents in the future.
- Vinyl chloride has not been detected to date at P-342L; however, concentrations at or below 0.14 µg/l in groundwater at well P-342L are projected to attenuate before reaching the nearest downgradient residential well (using average k_{BULK} value) if the groundwater flow path is complete³.

Consideration on Estimate Rates and Projections Presented Above

The attenuation rates and the resulting projections are estimates that are based on existing data (at this time) and that are subject to method limitations and stated assumptions described above (i.e., not definitive values). Further monitoring at current reporting limits and at recently installed wells (i.e., in the last decade) is needed to improve confidence in and refine these estimates as appropriate. Furthermore, downgradient effects of the previously referenced slug of organics observed from 1992-1994 at monitoring well P-17C may be influencing groundwater conditions in the monitoring network which may result in over estimation of attenuation rates.

References

- Barr Engineering Co., 2021. Groundwater Corrective Action Work Plan, Elk River Landfill, March 2021.
- Barr, 2015. Supplemental Site-Wide Hydrogeologic Evaluation Report, Elk River Landfill, June, 2015.
- MPCA, 2006. Guidelines, Natural Attenuation of Chlorinated Solvents in Groundwater. Minnesota Pollution Control Agency, Site Remediation Section, Revised June 2006.
- Newell & Rifai et. al, 2002. Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies. United States Environmental Protection Agency Groundwater Issue. EPA/540/S-02/500. November 2002.

Attachments

Attachment H1 – Equations and Inputs

Table H1 – Organics Plug Travel Projections

Table H2 – Projecting Time to Achieve ILs at Wells

Table H3 – Bulk Attenuation Projections

Table H4 – Mass Flux of Vinyl Chloride Downgradient of ERL

Attachments

Attachment H1
Equations and Inputs
Elk River Landfill

Equation 1) Vinyl Chloride Velocity Estimate $\rightarrow V_{VC}=x/t_{LF}$

<u>Variable</u>	<u>Value</u>	<u>Units</u>	<u>Source/Comment</u>
x	5800	ft	Estimated distance vinyl chloride has traveled from source (assumed center of Pre-Subtitle D Area)
t_{LF}	52	years	Years from beginning of landfill operations (est. 1972) to detection of vinyl chloride at P-334L in 2019.
V_{VC}	112	ft/yr	Vinyl chloride velocity $V_{VC,HI}$ 139 ft/yr +25% higher end estimate

Equation 2) Retardation Factor $\rightarrow R=1+r_b k_d/n$

<u>Variable</u>	<u>Value</u>	<u>Units</u>	<u>Source/Comment</u>
r_s	2.65	kg/L	Quartz solids density
r_b	1.9875	kg/L	Bulk Density $\rightarrow r_b=r_s(1-n)$
f_{oc}	0.00035		Fractional organic carbon - https://www.itrcweb.org/DNAPL-ISC_tools-selection/Content/Appendix%20I.%20Foc%20Tables.htm
k_{oc}	18.6	L/kg	MPCA Risk-Based Guidance for Soil Leaching Pathway, Working Draft Guidelines (1998)
k_d	0.00651	L/kg	Soil Distribution Coefficient $\rightarrow k_d=f_{oc}k_{oc}$
n	0.25		2015 Hydro Report (Barr)
R	1.052		Retardation Factor - Vinyl chloride 5.2% retarded

Equation 3) Groundwater Velocity $\rightarrow V_{GW}=V_{VC}R$

<u>Variable</u>	<u>Value</u>	<u>Units</u>	<u>Source/Comment</u>
V_{GW}	117	ft/yr	Velocity of Groundwater at Base of Lower Outwash Unit $V_{GW,HI}$ 147 +25% higher end estimate

Equation 4) ALTERATE Groundwater Velocity $\rightarrow V_{GW}=Ki/n$

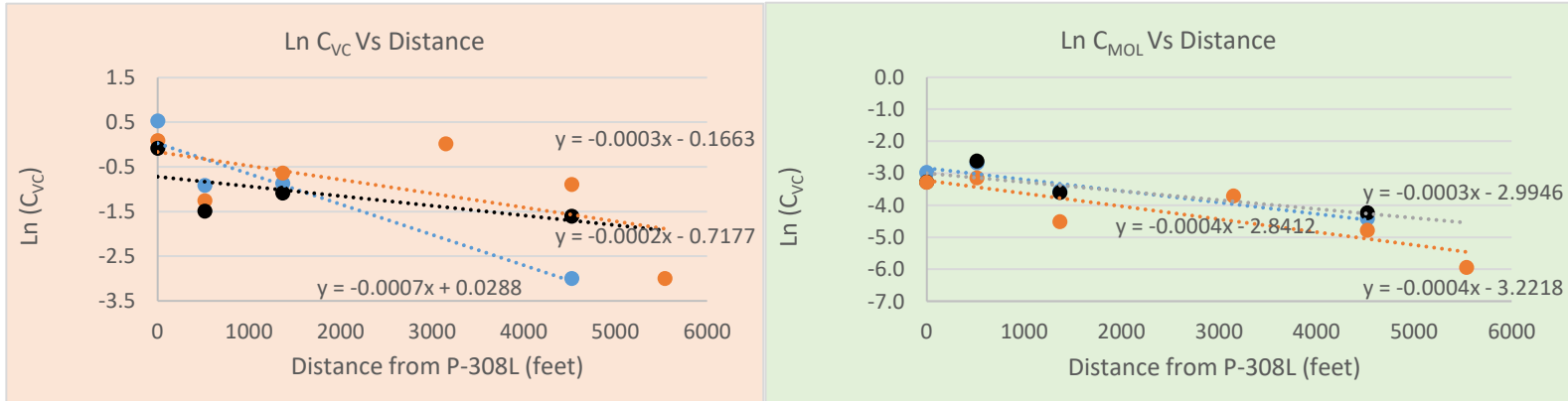
<u>Variable</u>	<u>Value</u>	<u>Units</u>	<u>Source/Comment</u>
K	41.99	ft/day	P-308L Step Test (2019) ALTERNATE IS 5.67 ft/d (0.002 cm/s from 2015 Hydro Report)
n	0.25		2015 Hydro Report
$x_{P323L-P334L}$	3990	ft	Distance from P-323L to P-334L
i	0.00097	ft/ft	Avg water Levels 2018-2019 (P-323L, P-334L), Distance between the locations (3990 ft)
V_{GW}	59.7	ft/yr	Not utilized for attenuation rate calculations as it does not align with vinyl chloride presence at well P-334L

Attachment H1
Equations and Inputs
Elk River Landfill

Equation 5) Overall Bulk Attenuation Rate (Solve for k_{BULK}) $\rightarrow -k/V_{GW}$ =Regression Slope (see MPCA, 2006 - Appendix A for methodology)

	Distance (ft)	July 2019		July 2021		July-Aug 2023		Molar July 2019		Molar July 2021		Molar July-Aug 2023		total chlorine
		C_{VC} (ug/l)	$\ln C_{VC}$	C_{VC} (ug/l)	$\ln C_{VC}$	C_{VC} (ug/l)	$\ln C_{VC}$	C_{MOL} (umol/l)	$\ln C_{MOL}$	C_{MOL} (umol/l)	$\ln C_{MOL}$	C_{MOL} (umol/l)	$\ln C_{MOL}$	
P-308L	0	1.7	0.53	0.92	-0.08	1.09	0.09	0.051	-2.981	0.037	-3.284	0.0371	-3.294	
P-323L	516	0.4	-0.92	0.23	-1.49	0.29	-1.26	0.068	-2.682	0.072	-2.627	0.0427	-3.154	
P-326L	1365	0.42	-0.87	0.34	-1.08	0.53	-0.64	0.028	-3.563	0.027	-3.612	0.0109	-4.519	
P-338L	3147	not yet installed		not yet installed		1.02	0.02	not yet installed		not yet installed		0.0244	-3.713	
P-334L	4521	0.05	-3.00	0.20	-1.60	0.41	-0.89	0.012	-4.423	0.014	-4.247	0.0083	-4.791	
P-342L	5539	not yet installed		not yet installed		0.05	-3.00	not yet installed		not yet installed		0.0026	-5.952	
Reg. Slope		-0.0007	Plot Slope	-0.0002	Plot Slope	-0.0003	Plot Slope	-0.0004	Plot Slope	-0.0003	Plot Slope	-0.0004	Plot Slope	AVG.
k_{BULK}		0.082	/yr	0.023	/yr	0.035	/yr	0.047	/yr	0.035	/yr	0.047	/yr	0.045 /yr
$k_{BULK,HI-VELO}$		0.103	/yr	0.029	/yr	0.044	/yr	0.059	/yr	0.044	/yr	0.059	/yr	0.056 /yr

Note: Red values are non-detect and displayed at reporting limit.



Bulk attenuation rates indicate attenuation is occurring over the length of the plume, but there is high variability in rates based on calculation methods.

C_{VC} = vinyl chloride concentration

Attachment H1
Equations and Inputs
Elk River Landfill

Equation 6) Location-specific Attenuation Rates (k_{POINT})(see Newell & Rifai et al., 2002 for calculation methods)

Note: **Red** values are non-detect and displayed at reporting limit.

P-313C	VC (ug/l)	ln VC	Yrs	P-314C	VC (ug/l)	ln VC	Yrs	P-321L	VC (ug/l)	ln VC	Yrs
4/19/2011	1.1	0.095	0.0	4/19/2011	1.5	0.405	0.0	4/19/2011	1.0	0.000	0.0
7/11/2011	1.0	0.000	0.2	7/11/2011	1.4	0.336	0.2	7/12/2011	1.0	0.000	0.2
10/17/2011	1.0	0.000	0.5	10/17/2011	1.0	0.000	0.5	10/24/2011	1.0	0.000	0.5
4/10/2012	1.1	0.095	1.0	4/10/2012	1.3	0.262	1.0	4/10/2012	1.3	0.262	1.0
7/26/2012	1.2	0.182	1.3	7/26/2012	1.1	0.095	1.3	7/26/2012	1.0	0.000	1.3
10/16/2012	1.3	0.262	1.5	10/16/2012	1.0	0.000	1.5	10/17/2012	1.3	0.262	1.5
4/22/2013	1.0	0.000	2.0	4/22/2013	1.0	0.000	2.0	4/22/2013	1.4	0.336	2.0
7/18/2013	1.0	0.000	2.2	7/18/2013	1.2	0.182	2.2	7/17/2013	1.3	0.262	2.2
10/14/2013	1.0	0.000	2.5	10/14/2013	1.0	0.000	2.5	10/15/2013	1.5	0.405	2.5
4/22/2014	1.0	0.000	3.0	4/15/2014	1.0	0.000	3.0	4/15/2014	1.3	0.262	3.0
7/9/2014	1.0	0.000	3.2	7/9/2014	1.0	0.000	3.2	7/9/2014	1.1	0.095	3.2
10/22/2014	1.0	0.000	3.5	10/22/2014	1.0	0.000	3.5	10/22/2014	1.3	0.262	3.5
4/15/2015	0.61	-0.494	4.0	4/15/2015	0.71	-0.342	4.0	4/14/2015	1.5	0.405	4.0
7/21/2015	0.78	-0.248	4.3	7/21/2015	0.73	-0.315	4.3	7/21/2015	1.3	0.262	4.3
10/22/2015	0.7	-0.357	4.5	10/22/2015	0.63	-0.462	4.5	10/21/2015	1.4	0.336	4.5
4/20/2016	0.87	-0.139	5.0	4/20/2016	1.0	0.000	5.0	4/19/2016	3.0	1.099	5.0
7/12/2016	0.55	-0.598	5.2	7/12/2016	0.5	-0.693	5.2	7/11/2016	2.6	0.956	5.2
10/20/2016	0.71	-0.342	5.5	10/20/2016	0.66	-0.416	5.5	10/19/2016	2.1	0.742	5.5
4/12/2017	0.44	-0.821	6.0	4/12/2017	0.31	-1.171	6.0	4/11/2017	1.8	0.588	6.0
7/20/2017	0.4	-0.916	6.3	10/19/2017	0.26	-1.347	6.5	7/21/2017	1.0	0.000	6.3
10/17/2017	0.45	-0.799	6.5	4/23/2018	0.088	-2.430	7.0	10/17/2017	1.0	0.000	6.5
4/23/2018	0.22	-1.514	7.0	7/17/2018	0.13	-2.040	7.2	4/17/2018	1.1	0.095	7.0
7/16/2018	0.37	-0.994	7.2	10/16/2018	0.14	-1.966	7.5	7/16/2018	1.1	0.095	7.2
10/15/2018	0.38	-0.968	7.5	4/10/2019	0.2	-1.609	8.0	10/15/2018	1.0	0.000	7.5
4/9/2019	0.38	-0.968	8.0	7/9/2019	0.15	-1.897	8.2	4/8/2019	1.4	0.336	8.0
7/9/2019	0.3	-1.204	8.2	10/23/2019	0.52	-0.654	8.5	7/10/2019	0.98	-0.020	8.2
10/22/2019	0.59	-0.528	8.5	4/22/2020	0.329	-1.112	9.0	10/23/2019	1.8	0.588	8.5
4/23/2020	0.31	-1.184	9.0	7/8/2020	0.05	-2.996	9.2	4/21/2020	0.53	-0.637	9.0
7/8/2020	0.05	-2.996	9.2	10/13/2020	0.32	-1.139	9.5	7/8/2020	0.79	-0.234	9.2
10/13/2020	0.05	-2.996	9.5	4/22/2021	0.05	-2.996	10.0	10/12/2020	0.62	-0.481	9.5
4/21/2021	0.27	-1.306	10.0	7/15/2021	0.05	-2.996	10.2	4/21/2021	0.57	-0.571	10.0
7/13/2021	0.05	-2.996	10.2	10/19/2021	0.451	-0.796	10.5	7/12/2021	0.42	-0.860	10.2
10/19/2021	0.29	-1.231	10.5	4/11/2022	0.21	-1.561	11.0	10/19/2021	0.42	-0.879	10.5
4/14/2022	0.09	-2.386	11.0	7/12/2022	0.789	-0.237	11.2	4/14/2022	0.43	-0.835	11.0
7/14/2022	0.05	-2.996	11.2	10/27/2022	0.05	-2.996	11.5	7/15/2022	0.05	-2.996	11.2
11/2/2022	0.41	-0.904	11.5	4/18/2023	0.05	-2.996	12.0	11/3/2022	0.45	-0.807	11.6
4/24/2023	0.05	-2.996	12.0	7/18/2023	0.05	-2.996	12.3	4/24/2023	0.33	-1.097	12.0
7/20/2023	0.30	-1.207	12.3	10/17/2023	0.05	-2.996	12.5	7/20/2023	0.48	-0.730	12.3
10/17/2023	0.17	-1.760	12.5					10/18/2023	0.22	-1.519	12.5
k_{P313C} 0.2172				k_{P314C} 0.2536				k_{P321L} 0.1245			

NOTE: k_{POINT} =slope of plotted LN VC vs Time Plot using this methodology

**Attachment H1
Equations and Inputs
Elk River Landfill**

Equation 6) continued

<u>P-323L</u>	<u>VC (ug/l)</u>	<u>ln VC</u>	<u>Yrs</u>		<u>P-326L</u>	<u>VC (ug/l)</u>	<u>ln VC</u>	<u>Yrs</u>
12/1/2011	3.6				7/14/2014	1.0		
4/10/2012	3.6				10/21/2014	1.0		
7/26/2012	3.6				4/14/2015	0.67	-0.400	0
10/16/2012	3.6				7/22/2015	0.54	-0.616	0.3
4/22/2013	3.6				10/22/2015	0.54	-0.616	0.5
7/17/2013	1.0	0.000	0		4/22/2016	1.3	0.262	1.0
10/14/2013	1.1	0.095	0.2		7/11/2016	0.87	-0.139	1.2
4/15/2014	1.0	0.000	0.7		10/19/2016	0.9	-0.105	1.5
7/10/2014	1.0	0.000	1.0		4/13/2017	0.62	-0.478	2.0
10/22/2014	1.0	0.000	1.3		7/18/2017	0.35	-1.050	2.3
4/14/2015	0.79	-0.236	1.7		10/16/2017	0.47	-0.755	2.5
7/21/2015	0.65	-0.431	2.0		5/10/2018	0.31	-1.171	3.1
10/21/2015	0.61	-0.494	2.3		7/17/2018	0.46	-0.777	3.3
4/19/2016	0.77	-0.261	2.8		10/17/2018	0.39	-0.942	3.5
7/11/2016	0.69	-0.371	3.0		5/2/2019	0.63	-0.462	4.1
10/20/2016	0.7	-0.357	3.3		7/9/2019	0.42	-0.868	4.2
4/11/2017	0.55	-0.598	3.7		10/22/2019	0.95	-0.051	4.5
7/21/2017	0.35	-1.050	4.0		4/23/2020	0.50	-0.687	5.0
10/17/2017	0.4	-0.916	4.3		7/13/2020	0.43	-0.842	5.3
4/19/2018	0.42	-0.868	4.8		10/14/2020	0.42	-0.863	5.5
7/16/2018	0.27	-1.309	5.0		5/27/2021	0.05	-2.996	6.1
10/15/2018	0.22	-1.514	5.2		7/13/2021	0.34	-1.085	6.3
4/8/2019	0.67	-0.400	5.7		10/15/2021	0.05	-2.996	6.5
7/10/2019	0.4	-0.916	6.0		4/13/2022	0.96	-0.043	7.0
10/23/2019	0.55	-0.598	6.3		7/14/2022	0.05	-2.996	7.3
4/21/2020	0.21	-1.565	6.8		11/2/2022	0.32	-1.149	7.6
7/8/2020	0.05	-2.996	7.0		4/24/2023	0.05	-2.996	8.0
10/12/2020	0.05	-2.996	7.2		7/20/2023	0.20	-1.609	8.3
4/21/2021	0.05	-2.996	7.8		10/17/2023	0.53	-0.637	8.5
7/12/2021	0.23	-1.492	8.0					
10/19/2021	0.05	-2.996	8.3					
4/14/2022	0.65	-0.431	8.7					
7/15/2022	0.05	-2.996	9.0					
11/3/2022	0.22	-1.523	9.3					
4/24/2023	0.05	-2.996	9.8					
7/20/2023	0.29	-1.255	10.0					
10/18/2023	0.19	-1.666	10.3					
k_{P323L} 0.2505					k_{P326L} 0.1985			

NOTE: k_{POINT}=slope of plotted LN VC vs Time Plot using this methodology

**Attachment H1
Equations and Inputs
Elk River Landfill**

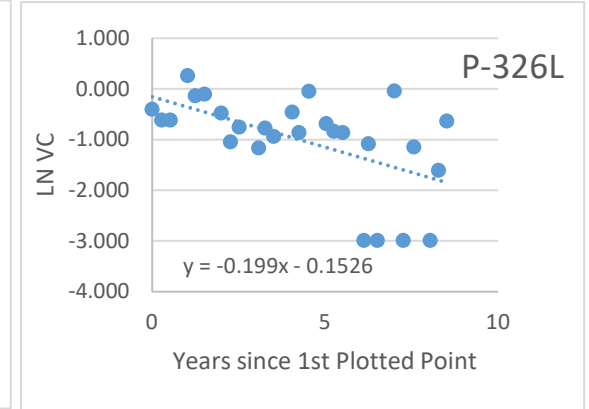
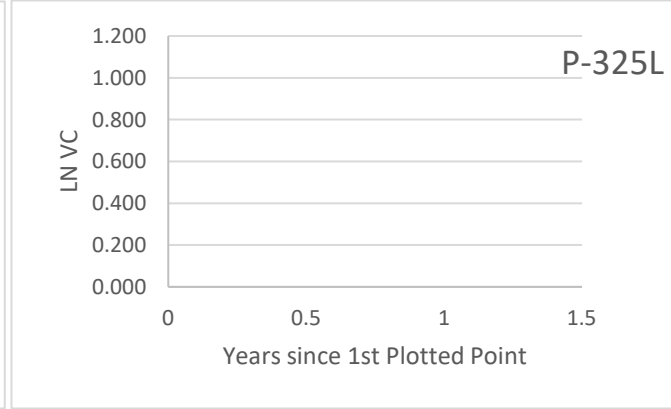
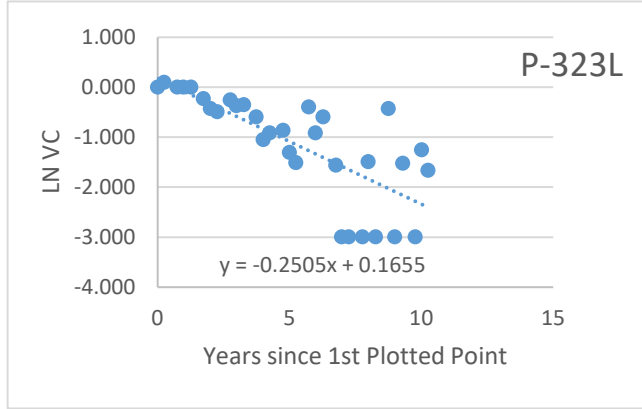
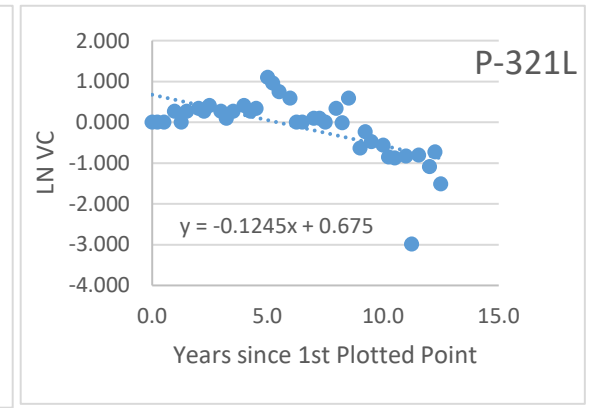
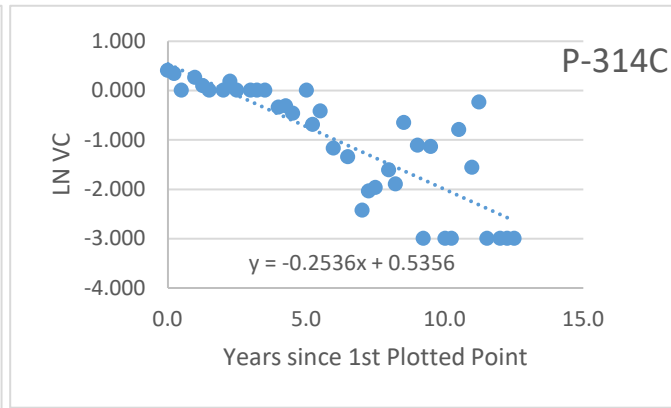
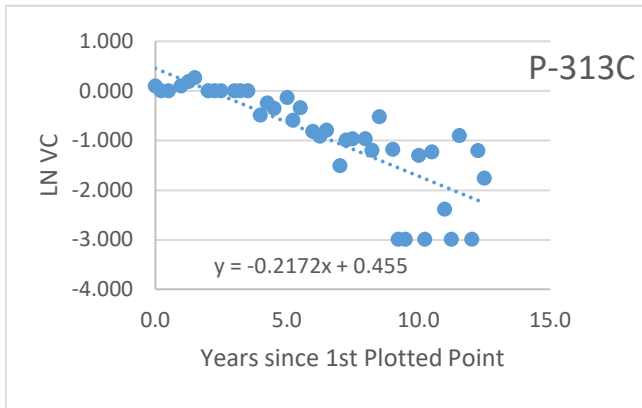


Table H1
Organics Plug Travel Projections

Projections/Estimated timing of when the 1992 organics slug arrived/will arrive downgradient of ERL (if not attenuated before arriving)

Location	Distance from P-17C/P-308L (feet)	Estimated Arrival Year (using V_{VC})	Estimated Arrival Year (using $V_{VC,HI}$)	Observed Maximum Vinyl Chloride Concentration to Date (ug/l)	Observed Maximum Vinyl Chloride Concentration Occurrence (Date)	Notes
P-325L	1158	<u>2002</u>	<u>2000</u>	0.97	7/14/2022	P-325L was installed in 2014.
P-326L	1365	<u>2004</u>	<u>2002</u>	1.3	4/22/2016	P-326L was installed in 2014.
P-338L	3147	<u>2020</u>	<u>2015</u>	1.0	7/24/2023	P-338L was installed in 2021.
P-334L	4521	<u>2033</u>	<u>2024</u>	0.41	7/24/2023	P-334L was installed in 2018.
P-342L	5539	<u>2042</u>	<u>2032</u>	<0.05	none detected	P-342L was installed in 2023

Inputs

V_{VC}	112 ft/yr	Vinyl Chloride Travel Velocity (estimated)
$V_{VC,HI}$	139 ft/yr	Vinyl Chloride Travel Velocity (high estimate)
Year	1992 Starting Year of Organics Concentration Spike at P-17C (1992-1994)	

Table H2
Projecting Time to Achieve ILs at Wells

Well	k _{POINT}	C ₀	C ₀ Date	C _{IL}	Projected Year C _{IL} Achieved
P-313C	0.217	1.1	4/19/2011	0.05	2026
P-314C	0.254	1.5	4/19/2011	0.05	2025
P-321L	0.125	1	4/19/2011	0.05	2036
P-323L	0.251	1.0	7/17/2013	0.05	2025
P-326L	0.199	0.67	4/14/2015	0.05	2029

Notes: -Projected Year C_{IL} Achieved is based on application of first order kinetics using the calculated overall attenuation rate and dataset shown in Equation 6.
 -Locations nearest to the Compliance Boundary and Property Boundary are shown.

Equation / Variables

$$C_{IL} = C_0 e^{-kt}$$

t = time (years)

k_{POINT} = Calculated overall attenuation rate at well (/year)

x = distance

C_{IL} = Vinyl chloride intervention limit (0.05 ug/l)

C₀ = Vinyl chloride concentration at date listed. Listed date based on first detections at well since 2011 (or installation date)

Table H3
Bulk Attenuation Projections

Scenario	Description	Guiding Equation	Overall Attenuation Rate		Vinyl Chloride Travel Distance, Velocity, and Time					Vinyl Chloride Concentration	
			Variable	Overall Attenuation Rate (/yr)	Start Point	End Point	Distance (feet)	V _{GW} (ft / year)	Travel Time (years)	C _{IL} (ug/l)	C _{CB} (ug/l)
A	Calculate the estimated maximum vinyl chloride concentration at the Compliance Boundary that would naturally attenuate below ILs before reaching nearest residential water supply user downgradient of mapped extent assuming the flow path is complete ¹ ?	$C_{CB} = \frac{C_{IL}}{e^{-k \frac{x}{V_{GW}}}}$	k _{2019, VC}	0.082	Compliance Boundary	Nearest Directly Downgardient Residential Water Supply User	7724	117	66	0.05	11
			k _{2021, VC}	0.023							0.23
			k _{2023, VC}	0.035							0.51
			k _{2019, MOL}	0.047							1
			k _{2021, MOL}	0.035							0.51
			k _{2023, MOL}	0.047							1.1
			k _{AVG}	0.045							<u>1.0</u>
B	Calculate the estimated maximum vinyl chloride concentration at P-342L that would naturally attenuate below ILs before reaching nearest residential water supply user downgradient of mapped extent (C. Thompson) assuming the flow path is complete ¹ ?	$C_{P-342L} = \frac{C_{IL}}{e^{-k \frac{x}{V_{GW}}}}$	k _{2019, VC}	0.082	P-342L	Nearest Directly Downgardient Residential Water Supply User	2638	117	24	0.05	0.32
			k _{2021, VC}	0.023							0.08
			k _{2023, VC}	0.035							0.11
			k _{2019, MOL}	0.047							0.14
			k _{2021, MOL}	0.035							0.11
			k _{2023, MOL}	0.047							0.14
			k _{AVG}	0.045							<u>0.14</u>
C	How far is vinyl chloride projected to travel downgradient of the Compliance Boundary before attenuating below ILs considering the peak 2023 concentrations reported near Compliance Boundary (0.48 ug/l at P-321L) assuming the flow path is complete ¹ ?	$x = \left(\frac{\ln \frac{C_{IL}}{C_{CB}}}{-k} \right) V_{GW}$	k _{2019, VC}	0.082	Compliance Boundary	NA	3231	117	NA	0.05	0.48
			k _{2021, VC}	0.023			11309				
			k _{2023, VC}	0.035			7539				
			k _{2019, MOL}	0.047			5654				
			k _{2021, MOL}	0.035			7539				
			k _{2023, MOL}	0.047			5654				
			k _{AVG}	0.045			<u>5900</u>				

Assumptions/Notes:

- Bulk k_{VC} values may be conservatively biased low due to observed presence of parent compounds to vinyl chloride upgradient of P-334L.
- The extent of vinyl chloride is stable and no longer expanding.
- First order kinetics applied, i.e. C_x=C₀e^{-kt}
- The higher end groundwater velocities (+25%) do not yield different results than what is shown above. A change in groundwater velocities yields a proportional change in attenuation rates. This results in no change to results in bolded text above.
- NA = Not applicable or not analyzed
- Inputs in Standard Text, **Results in Bolded Text**

Value calculated using average attenuation rate, or estimated groundwater velocity, is underlined.

¹ The groundwater flow path may not be complete based on the observed lower outwash thickness and 2023 monitoring results from well P-342L.

Variables

- C_{CB} = Vinyl chloride concentration at Compliance Boundary.
- t = time
- k = overall attenuation rate
- x = distance
- C_{IL} = Vinyl chloride intevention limit (0.05 ug/l)
- V_{VC} = Vinyl chloride velocity
- C_{P334L} = Vinyl chloride concentration at P-334L
- k_{MOL} = Bulk attenuation rate of chlorinated ethenes (PCE, TCE, 1,2-DCE, and VC)
- k_{VC} = Bulk attenuation rate of vinyl chloride

Table H4
Mass Flux of Vinyl Chloride Downgradient of ERL (April 2010 / 2019 / 2023)

Mass Flux of Vinyl Chloride Downgradient of ERL - April 2010											
Box ID	Wells Included in "Box"	"Box" Depth (feet)	"Box" Width (feet)	"Box" Area (sq feet)	K (ft/day)	GW Elev u/g (ft MSL)	GW Elev d/g (ft MSL)	i (ft/ft)	VC Conc (µg/L)	VC Flux (g/day)	VC Flux (lb/yr)
A - south	P-314C	27	500	13500	41.99	952	951	0.0011	2.00	0.04	0.03
B	P-313C	27	250	6750	41.99	952	951	0.0011	1.40	0.01	0.01
C	P-323L	25	400	10000	41.99	952	951	0.0011	1.00	0.01	0.01
D	P-321L	50	400	20000	41.99	952	951	0.0011	1.20	0.03	0.03
E	4 Wells	55	400	22000	41.99	952	951	0.0011	0.85	0.03	0.02
F - north	2 Wells	55	500	27500	41.99	952	951	0.0011	0.03	0.001	0.001
									Total	<u>0.12</u>	<u>0.098</u>
Distance u/g to d/g contour (feet)						875					

Mass Flux of Vinyl Chloride Downgradient of ERL - 2019											
Box ID	Wells Included in "Box"	"Box" Depth (feet)	"Box" Width (feet)	"Box" Area (sq feet)	K (ft/day)	GW Elev u/g (ft MSL)	GW Elev d/g (ft MSL)	i (ft/ft)	VC Conc (µg/L)	VC Flux (g/day)	VC Flux (lb/yr)
A - south	P-314C	27	500	13500	41.99	952	951	0.0011	0.29	0.01	0.004
B	P-313C	27	250	6750	41.99	952	951	0.0011	0.42	0.004	0.003
C	P-323L	25	400	10000	41.99	952	951	0.0011	0.54	0.01	0.01
D	P-321L	50	400	20000	41.99	952	951	0.0011	1.4	0.04	0.03
E	4 Wells	55	400	22000	41.99	952	951	0.0011	0.29	0.01	0.01
F - north	2 Wells	55	500	27500	41.99	952	951	0.0011	0.20	0.01	0.01
									Total	<u>0.07</u>	<u>0.057</u>
Distance u/g to d/g contour (feet)						875					

Decrease in VC flux in 2019 compared to April 2010:											42%

Mass Flux of Vinyl Chloride Downgradient of ERL - 2023											
Box ID	Wells Included in "Box"	"Box" Depth (feet)	"Box" Width (feet)	"Box" Area (sq feet)	K (ft/day)	GW Elev u/g (ft MSL)	GW Elev d/g (ft MSL)	i (ft/ft)	VC Conc (µg/L)	VC Flux (g/day)	VC Flux (lb/yr)
A - south	P-314C	27	500	13500	41.99	949	948	0.0011	0.05	0.001	0.001
B	P-313C	27	250	6750	41.99	949	948	0.0011	0.17	0.002	0.001
C	P-323L	25	400	10000	41.99	949	948	0.0011	0.17	0.002	0.002
D	P-321L	50	400	20000	41.99	949	948	0.0011	0.35	0.009	0.007
E	4 Wells	55	400	22000	41.99	949	948	0.0011	0.17	0.005	0.004
F - north	2 Wells	55	500	27500	41.99	949	948	0.0011	0.07	0.003	0.002
									Total	<u>0.02</u>	<u>0.017</u>
Distance u/g to d/g contour (feet)						900					

Decrease in VC flux in 2023 compared to April 2010:											82%

Table H4
Mass Flux of Vinyl Chloride Downgradient of ERL (April 2010 / 2019 / 2023)

Notes:

- Mass flux estimated using transect/box model method by application of Darcy's Law.
- Estimated "Box Width" based on Approximate Extent of Vinyl Chloride above IL and Maximum Estimated Northern Extent of VC above ILs on Figure 2 of this GWCA Initial Performance Evaluation. Estimated "Box Depth" based on Figure 4 of the Work Plan (Barr, 2021)
- Hydraulic conductivity (K) data based on P-308L step test (2019)
- Wells P-29C, P-320C, P-320C2, and P-321L included in Box E. Wells P-301C and P-301L included in Box F.
- 2019 groundwater elevations/horizontal gradient (i) are based on 952 ft MSL (u/g) and 951 ft MSL (d/g) contours on Figure 3 of CAER. For consistency, the 2010 groundwater elevations/horizontal gradient (i) were kept consistent with 2019. The current downgradient well network was not yet established.
- 2023 groundwater elevations/horizontal gradient (i) are based on 949 ft MSL (u/g) and 948 ft MSL (d/g) contours on Figure 6 of this GWCA Initial Performance Evaluation.
- 2010 Average Vinyl Chloride concentrations are from the April 2010 monitoring event from wells located in each "box". For locations with no data or where non-detect values were reported due to higher reporting limits, data from the nearest date where a detection was reported is applied. These data points are *italicized*.
- 2019 and 2023 Average Vinyl Chloride concentrations are average values from wells located in each "box".

EXHIBIT 7

Air, Water, Land, Climate / Water / [Water quality initiatives](#)

Protecting wild rice waters

SECTION MENU ▼

Contact

Wastewater.Permitting.MPCA@state.mn.us

Wild rice is an important part of the biological community in many Minnesota lakes, streams, and wetlands. Wild rice is also a cultural resource to many, particularly members of the Dakota and Ojibwe Tribal Nations in Minnesota, and it is an important

economic resource to those who harvest and market it. Minnesota recognizes wild rice as its official state grain.



Wild rice is found primarily in low-sulfate waters. Sulfate is a naturally occurring chemical and can also be found in discharges from mining operations, wastewater treatment plants, and industrial facilities.

The MPCA is currently working to fully implement a water quality standard to protect wild rice from excess sulfate. The standard, 10 mg/L sulfate, which was adopted in 1973, applies to [“waters used for production of wild rice.”](#) The agency is also working with permittees, researchers, Tribal partners, other levels of government, as well as the public to investigate ways to protect wild rice.

History

The MPCA has sponsored studies on how sulfate affects wild rice. Research projects in 2012-2013, including a field survey, laboratory experiments, and mesocosm (outdoor growth tank) experiments, helped to inform a 2017 proposal to amend the existing sulfate water quality standard. This rulemaking attempt was ultimately unsuccessful. Consequently, the 1973 sulfate water quality standard remains in effect. MPCA is committed to implementing this standard.

Implementation

The 10 mg/L sulfate water quality standard is designed to protect wild rice and applies in specific waters called “waters used for production of wild rice” ([Minn. R. 7050.0224](#)).

Where the standard applies. The MPCA has developed a list of approximately 2,400 waters used for production of wild rice. This list was developed from multiple sources of information — biological monitoring data, survey databases, and various inventories — to determine where the wild rice beneficial use has been, or could be, attained.



Wild rice producing waters

This online search tool will assist in identifying waters used for production of wild rice, as well as in identifying facilities that require a permit review because they are located in a watershed upstream or partially upstream of such waters.

[Open tool](#)

NPDES/SDS permitting

The MPCA is continuing to work with permittees, the public, and state, local, federal partners, and tribal nations to develop ways to protect this important Minnesota resource through implementation of the long-standing 10 mg/L sulfate standard via monitoring, assessment, and permitting.

- The MPCA held an [informational meeting](#) (May 24, 2023) for representatives of NPDES/SDS permitted facilities, to discuss where the standard applies and how the standard would be considered in NPDES/SDS permits.
- In a [follow-up meeting](#) (June 28, 2023) we discussed options if a facility can't meet a permit limit and the framework for developing site-specific sulfate standards to protect waters used for production of wild rice.
- In the [final meeting in the series](#) (Sept. 27, 2023), MPCA staff responded to NPDES/SDS permit-related questions received during the feedback periods, and leaders from the University of Minnesota Duluth Natural Resources Research Institute provided information about their sulfate treatment technology research.
- [Minnesota Wild Rice Sulfate Water Quality Standard NPDES/SDS wastewater permit implementation \(wq-wwprm1-42\)](#)
- [Procedures for implementing the Class 4A Wild Rice Sulfate Standards in NPDES wastewater permits in Minnesota \(wq-wwprm2-109\)](#)

Impaired waters

In the [2024 Impaired Waters List](#), MPCA identified a total of 43 waterbodies (56 assessment units) as impaired due to measured sulfate levels in excess of 10 mg/L.

Site-specific standards

- [Framework for developing and evaluating site-specific sulfate standards for the protection of wild rice \(wq-s6-66a\)](#) (December 2023)

More information

- Johnson, N. W., Pastor, J., & Swain, E. B. (2019). Cumulative sulfate loads shift porewater to sulfidic conditions in freshwater wetland sediment. *Environmental Toxicology and Chemistry*, 38(6), 1231-1244. <https://doi.org/10.1002/etc.4410>.
- LaFond-Hudson, S., Johnson, N. W., Pastor, J., & Dewey, B. (2018). Iron sulfide formation on root surfaces controlled by the life cycle of wild rice (*Zizania palustris*). *Biogeochemistry*, 141(1), 95-106. <https://doi.org/10.1007/s10533-018-0491-5>.
- LaFond-Hudson, S., Johnson, N. W., Pastor, J., & Dewey, B. (2022). Sulfur geochemistry destabilizes population oscillations of wild rice (*Zizania palustris*). *Journal of Geophysical Research: Biogeosciences*, 127(8), e2022JG006809. <https://doi.org/10.1029/2022JG006809>.
- Moyle, J. B. (1944). Wild rice in Minnesota. *Journal of Wildlife Management*, 8(3), 177-184. <https://doi.org/10.2307/3795695>.
- Myrbo, A., Swain, E. B., Engstrom, D. R., Coleman Wasik, J., Brenner, J., Dykhuizen Shore, M., Peters, E. B., & Blaha, G. (2017). Sulfide generated by sulfate reduction is a primary controller of the occurrence of wild rice (*Zizania palustris*) in shallow aquatic ecosystems. *Journal of Geophysical Research: Biogeosciences*, 122(11), 2736-2753. <https://doi.org/10.1002/2017JG003787>.
- Pastor, J., Dewey, B., Johnson, N. W., Swain, E. B., Monson, P., Peters, E. B., & Myrbo, A. (2017). Effects of sulfate and sulfide on the life cycle of *Zizania palustris* in hydroponic and mesocosm experiments. *Ecological Applications*, 27(1), 321-336. <https://doi.org/10.1002/eap.1452>.



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EXHIBIT 8

Information

Wild rice is an important part of the ecosystem in many Minnesota lakes and streams. Wild rice is also a cultural resource to many, particularly members of Minnesota's Dakota and Ojibwe tribal communities, and is an important economic resource to those who harvest and market it.

The MPCA has preliminarily determined that a list of approximately 2400 waters can reasonably be considered as constituting "waters used for production of wild rice". This list was developed based on reviewing multiple sources of information - including various inventories, biological monitoring, and survey databases – to determine where the wild rice beneficial use has been or could be attained.

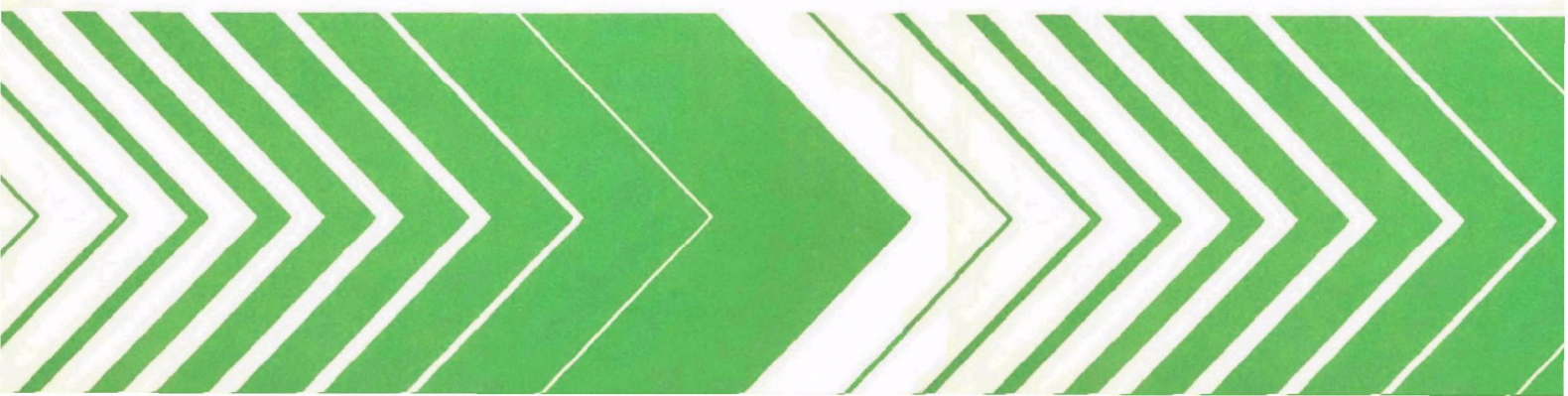
This list includes many waters that are wholly or partially within tribal boundaries and therefore have shared state and tribal jurisdiction. Appearance on this list does not supersede any applicable tribal water quality standards or regulations on wild rice harvest. The waters are included to show where MPCA will be reviewing water program activities to ensure the 10 mg/L sulfate standard is met.

EXHIBIT 9

Research and Development



Chemical and Physical Effects of Municipal Landfills on Underlying Soils and Groundwater



RESEARCH REPORTING SERIES

Research reports of the Office of Research and Development, U.S. Environmental Protection Agency, have been grouped into nine series. These nine broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and a maximum interface in related fields. The nine series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies
6. Scientific and Technical Assessment Reports (STAR)
7. Interagency Energy-Environment Research and Development
8. "Special" Reports
9. Miscellaneous Reports

This report has been assigned to the ENVIRONMENTAL PROTECTION TECHNOLOGY series. This series describes research performed to develop and demonstrate instrumentation, equipment, and methodology to repair or prevent environmental degradation from point and non-point sources of pollution. This work provides the new or improved technology required for the control and treatment of pollution sources to meet environmental quality standards.

EPA-600/2-78-096
May 1978

CHEMICAL AND PHYSICAL EFFECTS OF MUNICIPAL LANDFILLS
ON UNDERLYING SOILS AND GROUNDWATER

by

Environmental Effects Laboratory
U.S. Army Engineer Waterways Experiment Station
Vicksburg, Mississippi 39180

Interagency Agreement No. EPA-IAG-D4-0569

Project Officer

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FOREWORD

The Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimony to the deterioration of our natural environment. The complexity of that environment and the interplay between its components require a concentrated and integrated attack on the problem.

Research and development is that necessary first step in problem solution and it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems for the prevention, treatment, and management of wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, for the preservation and treatment of public drinking water supplies, and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research; a most vital communications link between the researcher and the user community.

This report presents results from the field investigation of three municipal solid waste landfill sites to determine their effects on surrounding soils and groundwater. It provides basic data on the potential pollution from land disposal of municipal solid waste and will add to the knowledge required to determine the environmental consequences of the land as a rector of waste materials.

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ABSTRACT

Three municipal landfill sites in the eastern and central United States were studied to determine the effects of the disposal facilities on surrounding soils and groundwater. Borings were made up the groundwater gradient, down the groundwater gradient and through the landfill. Soil and groundwater samples from the test borings were examined. Groundwater samples were analyzed chemically. Soil samples were tested physically and distilled water extracts and nitric acid digests of the soils were analyzed chemically.

Groundwater samples from under and downgradient from the landfill showed elevated levels of sulfate in every case. At some sites increased levels of nitrate, total organic carbon and cyanide could be related to the presence of the landfill.

No changes in physical characteristics could be related to the presence of the landfill at any site. No evidence was found in this study to indicate that sub-landfill soils seal themselves.

Distilled water extracts prepared from soil samples showed consistently low levels for all soluble constituents. Generally, there was more sulfate, chloride, organic carbon, nitrate and higher levels of trace metals in extracts of soils from under the landfill than from soils collected at similar depths outside the landfill.

Nitric acid digests of soil samples showed great variability in chemical composition. At two of the three sites; iron, manganese, boron, beryllium and zinc were found in higher concentrations in nitric acid digests immediately under the landfill.

The results of this investigation indicate that chemical characteristics; but, not physical characteristics were altered in sub-landfill soils. Removal of pollutants from leachate through the action of soil was observed for only a very limited number of pollutants.

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SECTION 1

INTRODUCTION

Disposal on land is the oldest method of municipal solid waste disposal and is still the most widely used system. Over 90% of all municipal wastes are currently disposed of on land in open dumps or sanitary landfills. The sanitary landfill with systematic deposition, compaction and burial of refuse emerged in the 1930's as the safest, least objectionable system of land-based disposal. Some 1,400 cities are currently using landfills to dispose of some 318 thousand metric tons per day of solid wastes. The expenditure of money on solid waste disposal is surpassed only by that spent on schools and roads in most municipal budgets(1).

The disposition of solid wastes in landfills carries the inherent potential for degrading the quality of groundwater in the area of the landfill. There are numerous examples of municipal landfills producing groundwater pollution. Garland and Mosher(2) have cited several examples where the pollution from landfills could be detected; including one case where effects could be observed at a distance of 3 kilometers due to high selenium values in groundwater samples. Exler(3) reported that a landfill in Germany had a groundwater pollution plume that was also detectable for a distance of 3 kilometers down the flow gradient from the fill. The polluted groundwater in this case showed high levels of chloride and dissolved organic material.

The pollution of groundwater by landfills has in some cases caused severe degradation of drinking water supplies to the extent that such water is no longer potable. Incidences of pollution of this sort cause grave economic hardship on local governments that must attempt to relieve the pollution problem or provide a new water supply.

Some landfills are designed to contain all contaminants, but many allow the slow downward leakage of water that has come in contact with the buried refuse. This latter design anticipates the removal of undesirable materials in this leachate either by filtration through or adsorption onto the earth materials between the bottom of the landfill and the water table. This purification process is referred to as attenuation. The attenuated leachate that does reach the water table is then diluted by the much larger quantity of groundwater into which it flows. Groundwater pollution occurs when this filtration, adsorption and dilution process does not operate successfully.

Although some prediction of attenuation properties can be made from soil characteristics, such as clay content, particle size distribution, cation exchange capacity, etc., there is no conclusive method for verifying that attenuation is not effective until groundwater pollution is observed. The

soil beneath a landfill should show an increase in contaminants if attenuation is occurring. Therefore, the examination of earth materials beneath sanitary landfills should be a useful technique for gauging the extent of pollutant attenuation.

The objectives of the present investigation are to examine three landfills that are situated in widely different geological circumstances in order to:

- a) discover if changes have occurred in the chemical characteristics of local groundwater because of landfill operation,
- b) determine the influence of the landfilled refuse on the chemical characteristics and physical properties of the geologic materials directly below the landfill,
- c) determine if chemical constituents that are present in the soil below the landfill can be released into contacting water,
- d) establish if a relationship exists between the depth below the refuse and the chemical and physical properties of the earth materials, and
- e) discover if any physical or chemical characteristics of the material beneath a landfill can be used to predict the extent of contaminant attenuation.

To meet these objectives, an idealized concept or model (Figure 1) for leachate movement and attenuation was developed to provide a rationale for the sampling program. In this model the rainwater falling on the landfill saturates the refuse and then percolates through the soil directly below. A variable portion of the filterable and exchangeable material in the leachate is deposited in the soil below the landfill. This attenuated leachate continues downward into the water table. Groundwater flowing under the landfill dilutes the leachate and carries the pollutants in a plume down the groundwater gradient. Based on this idealized model, borings were located in such a way as to produce:

- a) groundwater from wells beneath the landfill and from wells located both up and down the groundwater flow gradient in the area of the landfill,
- b) samples of soil from beneath the landfill and from comparable depths outside the landfill,
- c) soil samples collected at different levels down the boreholes both outside and beneath the landfill, and
- d) samples collected near the top of the saturated zone (water table) around and inside the landfill.

Physical testing of soil samples collected below the landfill and at comparable depths outside the landfill was undertaken to evaluate changes related to the buried refuse. The physical characterization included percent

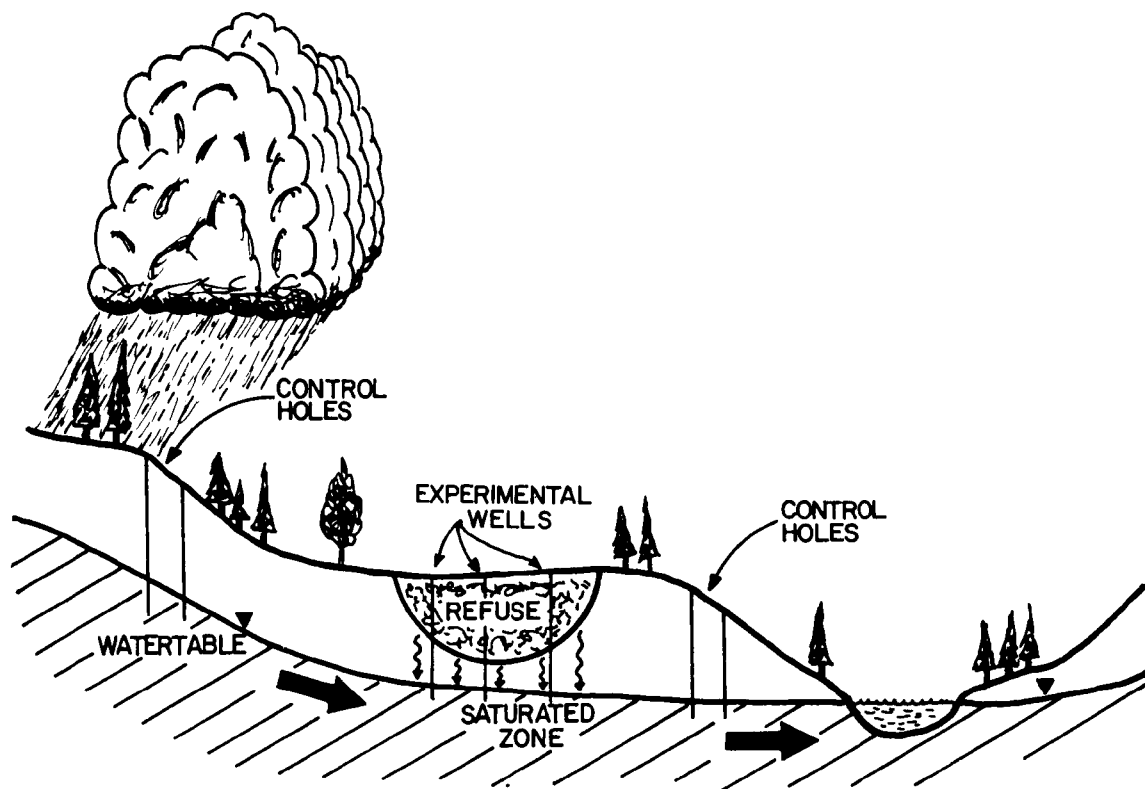


Figure 1. Sketch of typical landfill showing sampling plan. The updip control holes show background levels. The experimental wells and downdip control holes show contaminant movement from the landfill. Bold arrows indicate direction of groundwater movement.

moisture, dry density, grain size distribution, permeability and soil classification. Randomization was used to test for significant differences in physical properties. Vertical variability in selected bore holes was also evaluated. The small sample sizes did not allow the use of statistical tests.

The samples of groundwater collected in this study were used to indicate loss of contaminants from the landfill or the soil beneath the landfill into the local groundwater. If contaminants are moving to the water table, their concentrations should be higher beneath and down dip from the landfill. A list of analyses run is given in Table 1. A one-way analysis of variance technique was employed to assess the significance of changes in water quality.

Soil samples from beneath the landfill and from comparable depths outside the landfill were treated in two ways: One aliquot of soil was extracted with distilled water to remove all ions that could be dislodged by water alone. A list of analyses run is given in Table 1. The distilled water extract gives a rate of release of material from the soil into the surrounding water. The water extract is assumed to represent the maximum concentration available in water contacting the soil, not the maximum, total amount capable of being leached from the soil. The distilled water leach then indicates the mobility of various ions being held in the soil. The most effective attenuation is occurring when the soil beneath the landfill shows an ability to accumulate a contaminant and to release the contaminant at a very slow rate. A randomization technique was used to test the significance of differences observed in the composition of the distilled water extracts of soil samples collected directly beneath the landfill and samples collected at comparable depth outside the landfill. The significant results of the randomization test point out those elements at each site whose mobility in aqueous solution is effected by material from the landfill. A second aliquot of fresh soil was digested with hot, 8N nitric acid to bring all ions not bound into silicate lattices into solution. A list of analyses run is also given in Table 1. This digest represents the total of all materials that could potentially be leached from the soil under the most severe conditions. Since it is assumed that there is no lateral movement of leachate above the water table, differences in composition between digests of these samples can be interpreted as the loss or gain of material in the soil due to the presence of the landfill.

A randomization technique was used to test for significant differences in composition between acid digests of soil samples collected directly below the landfill and samples collected at comparable depths (and above the water table) outside the landfill. The significant results from the randomization tests point out those elements at each site that are being added to the soil or removed from the soil by the movement of leachate from the landfill.

If the soil beneath the landfill is being altered by leachate from the landfill, any change should be most pronounced directly beneath the refuse and the magnitude of this change should decrease with depth. Samples of soil were taken at intervals down the boreholes to determine if any correlation between the concentration of materials in the soil and depth (or sample elevation) could be observed. Correlation with sample elevation was only attempted with those elements that had shown a significant contrast in concentrations available under and away from the landfill at each site. A

TABLE 1. CHEMICAL CONSTITUENTS ANALYTICALLY DETERMINED IN GROUNDWATER FILTRATES, DISTILLED WATER EXTRACTS, AND NITRIC ACID DIGESTS

Constituent	Groundwater filtrate	Water extract of soil samples	Nitric acid digests of soil samples
SO ₄	X	X	--
SO ₃	X	X	--
Cl	X	X	--
NO ₃ -N	X	X	--
NO ₂ -N	X	X	--
CN	X	X	--
TOC	X	X	--
Ca	X	X	--
Fe	X	X	X
Mg	X	X	--
Mn	X	X	X
Na	X	X	--
As	X	X	X
B	X	X	X
Be	X	X	X
Cd	X	X	X
Cr	X	X	X
Cu	X	X	X
Hg	X	X	X
Ni	X	X	X
Pb	X	X	X
Se	X	X	X
Zn	X	X	X

-- = Not determined.

Spearman rank correlation technique was employed. The correlation technique made it possible to see if consistent relationships could be observed between sample elevation and sample composition in borings made inside and outside the landfill.

Samples of soil collected near the top of the saturated zone both outside and inside the landfill were examined to see if any effects of lateral movement of leachate could be observed. Distilled water leaches and nitric acid digests of these soil samples were analyzed. Plots of analyses were prepared to assess any changes in constituents that could be related to the presence of the landfill. No attempt was made to evaluate these analyses statistically because of the small sample sizes involved.

SECTION 2

CONCLUSIONS

At all three municipal landfill sites, changes in the chemical composition of the groundwater could be related to the position of the borings with respect to the landfill. Water quality below and down the groundwater flow gradients from the landfills showed increased sulfate levels in every case. At several sites increased nitrate, total organic carbon, and cyanide levels could be related to the presence of the landfill.

No changes in physical parameters measured in soil samples in this study could be related to the effect of the landfill. No consistent alterations in dry density, water content, permeability, or percent fines could be related to the position of soil samples with respect to the landfill. Physical characteristics of sub-landfill soil samples as measured by standard engineering techniques were not significantly different from samples collected at comparable depth outside the landfill. No consistent vertical changes in soil physical characteristics in borings through the landfill could be detected. The percolation of leachate did not alter the permeability of the soil beneath the refuse. No evidence was found in this study to substantiate the idea that sub-landfill soils seal themselves.

Distilled water extracts prepared from soil samples showed all soluble constituents were present in very small quantities. Many variations observed were not consistent from one site to another. In general, there was more leachable sulfate, chloride, organic carbon, nitrate and more available trace metals in soil from under the landfills than in soils from similar depths outside the landfill. Calcium, iron and zinc were the only metals that showed decreased availability under any of the landfills. The lack of water-extractable iron under the landfill at the one actively operating site was probably due to its precipitation as an insoluble compound such as sulfide. In another series of distilled water extracts, many constituents showed decreasing availability with increasing sample depth in borings below the landfill, suggesting their source was the refuse in the landfill. Calcium and zinc were exceptions to this trend and showed increasing levels in distilled water extracts with increasing depth. This trend may be due to removal by leaching by organic acids from the refuse (especially in the case of calcium) or the formation of insoluble compounds under the landfill.

Analyses of distilled water extracts of soil samples taken from near the water table shows that the maximum concentration of many constituents as measured in the water extract can be displaced down the groundwater gradient from the landfill. Displacement of the concentration maxima was noted with nitrate, organic carbon, calcium, iron, magnesium, manganese, sodium and boron.

Nitric acid digests of soil show great variability in chemical composition. At two sites iron, manganese, boron, beryllium and zinc were found in higher concentrations in nitric acid digests from immediately under the landfill than at comparable depths outside the landfill. This suggests that these metals are being added to the soil under the landfill (i.e. attenuated). Only arsenic showed a decreased level under the landfills suggesting it was being mobilized or leached from the sub-landfill soil.

Analyses of nitric acid digests from soil samples collected at increasing depth below the landfill indicate that iron, manganese, arsenic, boron, beryllium, lead, selenium and zinc (at site B) are accumulating in soil immediately beneath the landfill. Only two metals, nickel and zinc (at site C), showed an increasing abundance with increasing depth indicating these metals are leaching out of the upper layers of sub-landfill soil.

Analyses of nitric acid digests of soil samples taken from near the water table also show that the maximum concentration of some of the landfill constituents can be displaced down the groundwater gradient from the landfill. This trend was noted for the maximum concentrations of arsenic, manganese, copper and lead.

The results of this investigation indicate that chemical characteristics, but not physical characteristics, were altered in soil under the landfill, and chemical changes in the sub-landfill soil can be related to the capacity of the soil to filter, absorb or precipitate the contaminants from the refuse. Instances were noted where the leachate added material to the soil and also mobilized normal soil constituents to effect changes in soil composition.

SECTION 3

RECOMMENDATIONS

The interaction between leachate from municipal refuse and soil is complex varying with the character of the soil and the composition of the leachate. The chemical character of the soil is itself changed as material is added or leached out. The landfill leachate varies with the nature of the refuse disposed and the type of decomposition occurring. The results of this survey indicate that significant chemical changes occur in the soil that can be related to the attenuation process.

Future investigations should include characterization of the landfill leachate before and after contact with the soil as well as analysis of acid digests of the soil. Any future study of sub-landfill soils should include soil variables such as mineralogy, cation exchange capacity, and slurry pH. Any continued work on leachate-soil interaction could include following soil changes through several annual cycles until stabilization of the refuse occurs. Further physical testing should be undertaken on a very fine scale, carefully including the soil-refuse interface.

Field investigations of this nature while involving many variables, represent the best approach to the understanding of how attenuation processes operate and their effect on groundwater quality. Continued work of this type may allow us to predict and overcome the hazard to groundwater resources involved in landfill disposal.

18.
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SECTION 4

METHODS AND MATERIALS

SITE SELECTION

Three municipal landfills were selected from widely different geographic areas in the Eastern United States. All sites were selected from areas where rainfall and infiltration rates were sufficient to produce an abundance of leachate. A summary of the important engineering and geologic characteristics of each of the sites selected for this survey is given in Table 2. The sites are designated only by letter.

Two principal factors effecting the character of the contaminants leaving a landfill are the nature of waste buried, and the age of material in the site. Other factors that impinge on the problem of the character of leachate from a landfill are oxidation-reduction conditions in the landfill, temperature in the landfill, and dilution of the leachate by local groundwater flow. The exact type and amount of waste material deposited in each site is difficult to determine, especially if the landfill has been completed and closed. Only in the case of site A is there a reasonably complete listing of wastes available from the local Department of Public Works (Table 3). Note that several types of industrial wastes have gone into this site including wastes from local rubber manufacturing, meat packing and paper mill operations. The information regarding the nature of waste placed at site B is not available. The waste is thought to be largely municipal (household and commercial) with only minor industrial input since there are no large manufacturing operations in the area served by the landfill. No waste survey is available for site C; but, engineering reports associated with the project state that the site received 900 tons per day of commercial and household refuse and 200 tons per day of incinerator ash. This site also received a great deal of sewage sludge and has been top-dressed with this material.

Sanitary landfill leachate typically changes in composition as the material in the landfill degrades (4,5) therefore the age of the landfill is an important consideration. Site A had been officially closed for fifteen years when the samples for this study were collected. However, there was some evidence of recent, unauthorized use of the site as an open dump for household refuse. The refuse was originally placed in trenches and was not compacted. Differential settling produced a series of shallow gullies where the trenches had been dug. The municipality later filled in the depressions with sewage sludge. At site B, the landfill was completed in 1972, and then regraded to produce a recreation area. The regrading included exposing and reburying part

TABLE 2. SUMMARY OF THE CHARACTERISTICS OF THE THREE SITES SELECTED FOR STUDY

Characteristic	Site A	Site B	Site C
Geographic area within the U.S.	North Central	South Central	East Central
General geologic setting	Glacial outwash (valley train deposits)	Wind-blown silt and clay (loess)	Deeply weathered residual soil (metamorphic terrane)
Mean annual rainfall	74 cm	124 cm	104 cm
Mean annual air temperature	8°C	19°C	13°C
Nature of waste	Municipal and industrial	Municipal and industrial(?)	Municipal and industrial(?)
Liner used below refuse	None	None	None
Thickness of refuse observed	4.82-6.52 m (avg. 5.40 m)	1.92-4.88 m (avg. 3.08 m)	14.02-24.70 m (avg. 19.45 m)
Thickness of unsaturated zone	18.23-20.24 m (avg. 19.33 m)	0.91-3.51 m (avg. 2.47 m)	0.91-10.88 m (avg. 4.79 m)
Nature of material in unsaturated zone	Sand	Clayey silt	Silty sand
Average hydraulic conductivity below refuse	1×10^{-1} cm/sec	7.3×10^{-7} cm/sec	2.9×10^{-5} cm/sec
Average thickness of covering material	1.65 m	0.09 m	0.82 m
Character of covering material	Sand and gravel	Clay	Clay
Dates of operation of site	1947 - 1961	1959 - 1972	1964 - present
Type of operation	Trench and fill	Surface fill	Surface fill

TABLE 3. CHARACTER OF WASTE DEPOSITED IN LANDFILL AT SITE A AS LISTED
BY THE MUNICIPALITY

Mixed demolition refuse

Sand
Dirt
Gravel
Rock
Broken pavement
Construction materials

Household refuse

Domestic garbage and kitchen wastes
Domestic incinerator residue
Cans and glass bottles
Furniture and carpets
Major appliances

Yard refuse

Logs
Grass and garden clippings
Brush
Chipped limbs and leaves

Commercial refuse

Used tires
Mixed commercial trash
Kitchen wastes
Commercial incinerator residue
Scrap metal
Wood crates

Industrial wastes

Rubber manufacturing wastes
Rubber scrap
Liquid and wet chemical waste
Paper mill sludge
Oil, tar and asphalt
Meat packing waste
Paunch
Manure
Sewage grit
Sewage sludge

of the refuse and compacting the landfill prior to partial paving with asphalt. The regrading took place only a year before this investigation. Site C was still receiving wastes; but, the portion where two of the borings (1 and 2) were placed had been closed from one to three years at the time of sampling.

All of the sites selected had been in place long enough to have possibly effected the groundwater and soil beneath and around the landfill (see Table 2). All of the sites contain domestic and commercial wastes; but only site A has received a major amount of industrial waste. These landfills were chosen because they have many factors in common with other landfills in the Eastern United States. All contain mixed residential and commercial refuse buried using prevailing landfilling methods.

SAMPLING PROCEDURES

A general sampling plan for all sites was generated using the theoretical model as described above (Figure 1) and then modified to fit the requirements at the individual sites. The general sampling scheme called for six or more holes to be bored at each landfill: a minimum of two holes to be bored through the buried refuse and five to six holes to be bored outside the landfill. This sampling pattern allowed comparison between typical, uneffected groundwater and soil, and groundwater and soil which was in contact with leachate draining from the buried refuse.

All sampling was done with a truck-mounted, rotary drill using 16.8 cm OD hollow-stem auger. The auger with a central plug in place was drilled in to the desired depth. The central plug was removed and a Hvorslev fixed-piston sampler (Figure 2) or a split spoon sampler (Figure 3) was pressed into the sediment or soil directly below the end of the auger using the hydraulic cylinders on the drill rig. In this way an undisturbed soil or sediment sample was obtained. The split spoon sampler was only used in cases where objects were encountered in the subsurface that could not be penetrated by the thin-walled tube (Shelby tube) on the Hvorslev sampler.

The vertical distribution of soil/sediment samples collected down the hole was arranged in a way to maximize the probability of collecting samples at two critical points in the boring: the refuse-soil interface, and the top of the saturated zone. Since the strongest effects of leachate on the subfill material should occur directly below the refuse, a sample was always taken at the depth predicted by the landfill design as being the combined thickness of the refuse and cover. Sampling then continued at closely spaced intervals down the hole. The top of the water-saturated zone was predicted from water table measurements that had been recorded for other wells in the area. A series of closely spaced samples was taken in this interval. The holes were allowed to remain open for two to three days with the auger flights in place. These auger flights served as a temporary well casing to prevent seepage from the surface from entering the well. Groundwater samples were obtained from the temporary wells by lowering a bailer into the top of the hollow stem auger. After a groundwater sample was obtained the auger was removed and the holes were backfilled with cement and/or bentonite to a point well above the water table. The filling was then completed with well cuttings. This

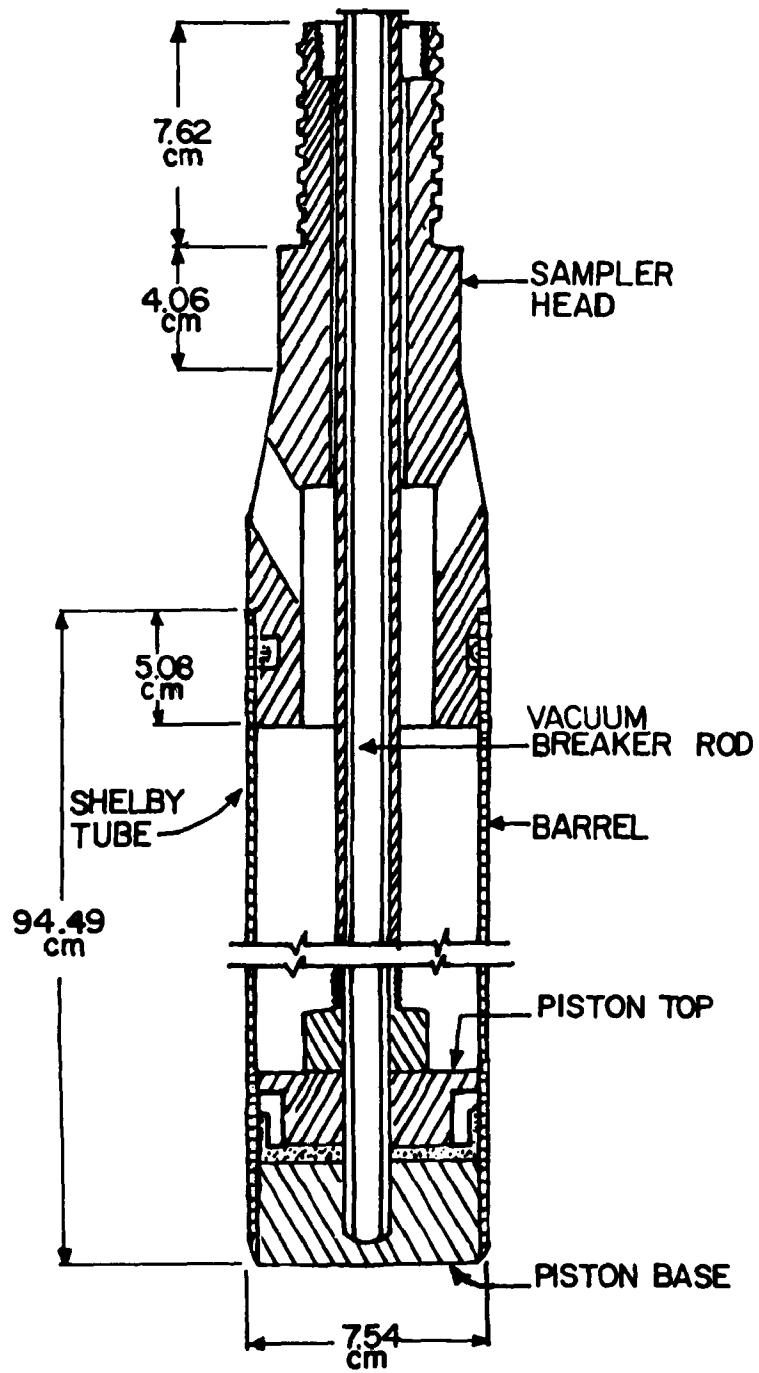
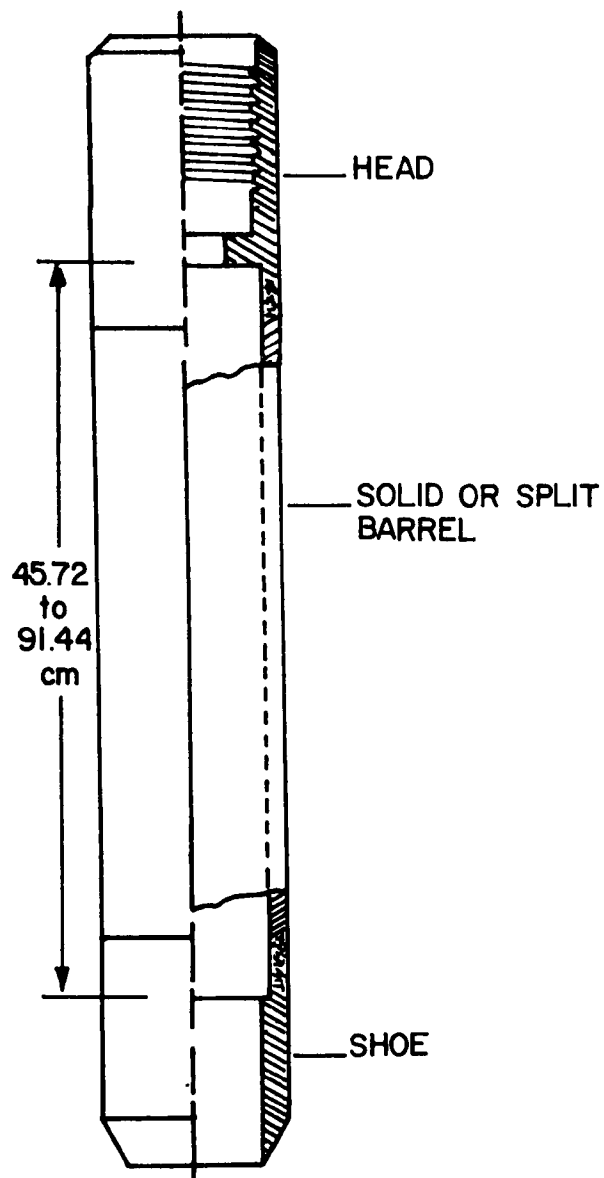


Figure 2. Sketch of Hvorslev Sampler



QD. 5.08cm, 6.35cm, 7.62cm, or 8.89cm
I.D. 3.81cm, 5.08cm, 6.35cm, or 7.62cm

Figure 3. Sketch of split spoon sampler.

was done to assure that a well would not provide a conduit for flow of polluted water to the water table.

The locations of all borings at each landfill site are given in Figures 4-6. Arrows in these figures indicate the most probable direction of groundwater flow deduced from water level maps (Figures A-1, B-1, C-1 in appendices) and chemical data. The descriptive well logs are presented in the appendices (Tables A-1--A-8, B-1--B-8, C-1--C-9). Tables A-9, B-9, and C-10 list all soil/sediment samples examined from each boring giving their elevation and other relevant data.

SAMPLE HANDLING AND PREPARATION TECHNIQUES

Two different types of soil samples were collected in the boring program: samples for physical testing and samples for chemical analysis. Groundwater samples were also taken from each well for chemical analysis. The set of samples obtained for physical testing was used to determine soil class under the unified soil classification system (6), dry density, grain-size distribution, water content and permeability. These physical parameters were determined using standard engineering test procedures. This sample set was collected without disturbing the soil more than necessary. All physical testing samples were carefully packaged and sealed in coring tubes to retain the original moisture content and sample texture during transportation.

Depth to groundwater was measured with a chalked, steel tape at each boring. All of the groundwater samples were collected from the borings by bailing the water from the center of the hollow stem auger using a bailer made from small diameter tubing. The groundwater was transferred to polyethylene bottles which were labelled and packed in an insulated chest filled with crushed ice. The samples were stored under refrigeration and kept tightly capped until they were prepared for chemical analysis. The preparation consisted of centrifuging each sample at 2200 rpm for 30 minutes. The resulting supernatant was membrane-filtered through a 0.45 μ m filter and split into five subsamples which were preserved as shown in Table 4.

Samples of soil for chemical analysis were collected simultaneously with the samples for physical testing; but, no attempt was made to maintain the soil in an undisturbed condition. Each sample was removed from the sampler, placed in a wide-mouthed polyethylene bottle, labelled, and packed in an ice-filled chest. These soil samples were refrigerated during all subsequent transportation and/or storage. Two extracts were made from each soil sample: one with distilled water and one with 8N nitric acid. The material that could be easily leached out with distilled water was considered transient and would readily be leached from the soil by dissolution in rainwater. The nitric acid leach would contain the transient materials and also all of the material that could be solubilized by a strong, oxidizing acid. Those elements present as carbonates or sulfides, or adsorbed to clay minerals, to iron oxide or to insoluble organic materials would be freed (7,8). Elements in non-clay silicate lattices would be leached only to a minor degree (9).

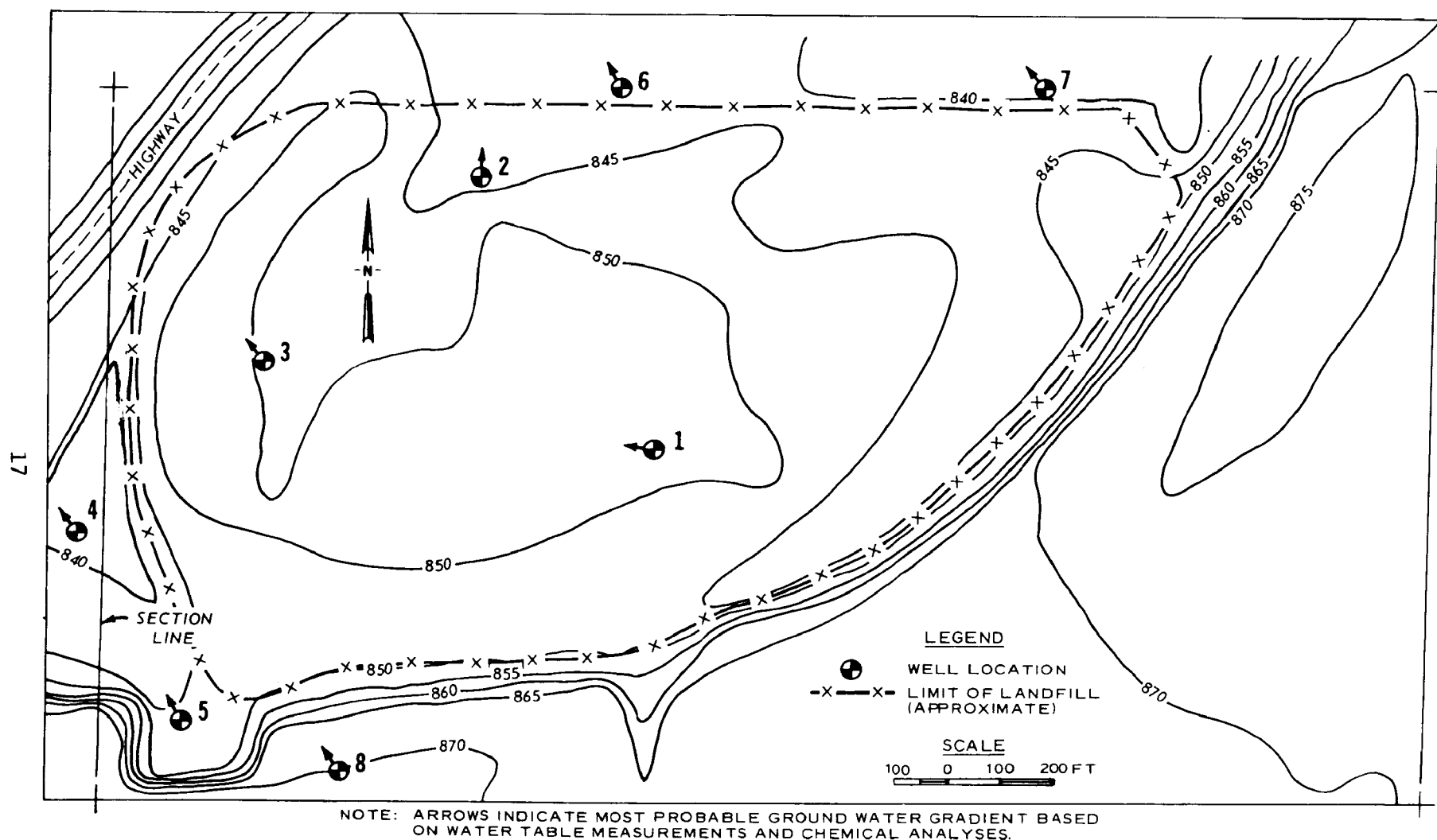


Figure 4. Topographic map of site A (contour lines are in feet above mean sea level). 0.305 m = 1 ft.

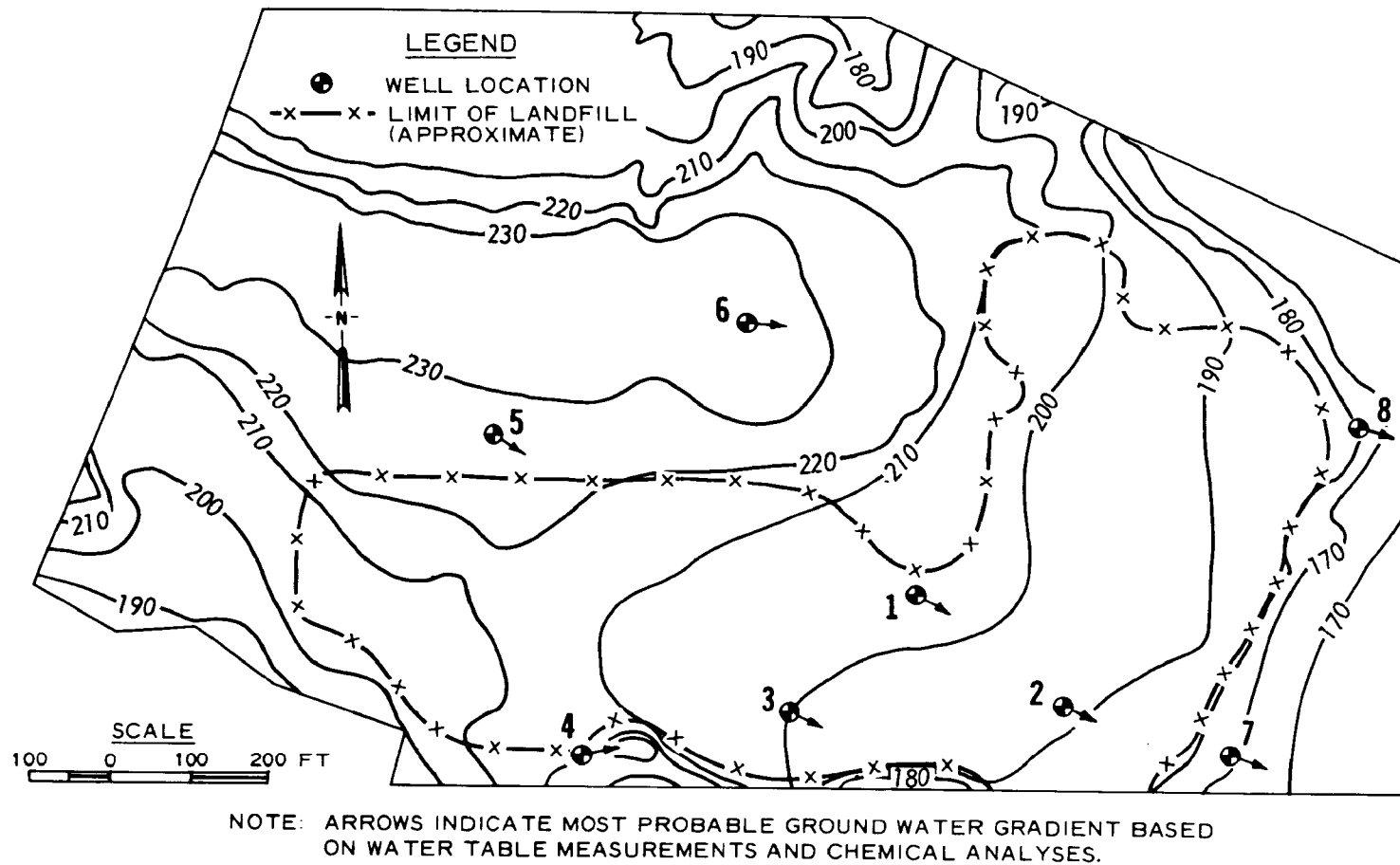
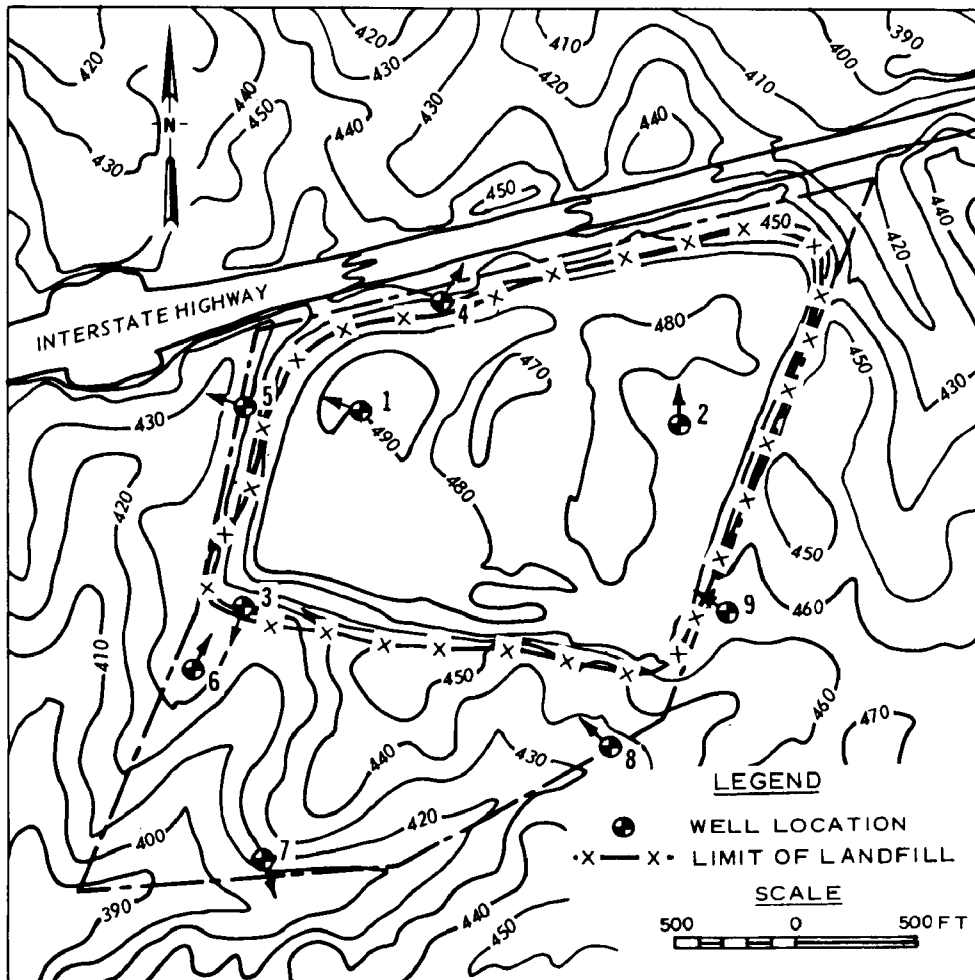


Figure 5. Topographic map of site B (contour lines are in feet above mean sea level). 0.305 m = 1 ft.



NOTE: ARROWS INDICATE MOST PROBABLE GROUND WATER GRADIENT BASED ON WATER TABLE MEASUREMENTS AND CHEMICAL ANALYSES.

Figure 6. Topographic map of site C (contour lines are in feet above mean sea level). 0.305 m = 1 ft.

TABLE 4. METHODS OF PRESERVATION OF WATER EXTRACTS AND FILTERED GROUNDWATER SUBSAMPLES FOR CHEMICAL ANALYSIS

Chemical species to be determined	Method of preservation
SO ₄ , SO ₃ , Cl, NO ₃ , NO ₂	Refrigeration to 4°C
CN	Sample brought to pH 11 with NaOH
Total organic carbon	Refrigeration to 4°C
Ca, Fe, Mg, Mn, Na, As, B, Be, Cd, Cr, Cu, Ni, Pb, Se, Zn	Samples acidified with HCl to pH 1
Hg	KMnO ₄ added and samples acidified with HNO ₃ to pH 1

For distilled water extracts, the contents of each sample bottle was mixed to assure a homogeneous sample. A 200-gram subsample of moist soil was weighed out into a 1000-ml polycarbonate centrifuge bottle and six hundred ml of distilled-deionized water was added to each. The centrifuge bottles were shaken on a rotary shaker for one hour, and then centrifuged at 2200 rpm for 30 minutes. The supernatant was filtered through a 0.45 nm membrane filter. The filtrate was split into five subsamples for chemical analysis. The subsamples were preserved as outlined in Table 4.

A second subsample consisting of 50 grams of moist soil was taken from each sample bottle for nitric acid digestion. In each digestion the soil was weighed into a 250-ml fluorocarbon beaker and 60 ml of 8N reagent grade nitric acid was added. The soil-acid suspension was heated to 95°C for 45 minutes and stirred every fifteen minutes. After cooling to room temperature, the suspension was filtered through a 0.45 nm membrane filter. The digested soil was washed in the filter three times with 20-ml portions of 8N nitric acid. The filtrate was quantitatively transferred to a 250-ml volumetric flask and brought up to volume with 8N nitric acid and then stored in a polyethylene bottle. No preservation procedure was necessary.

A third subsample was taken from each sample bottle to determine the moisture content of the soil. These moisture contents were used to correct subsequent chemical analyses so that soil acid digests could be expressed in milligrams per kilogram dry weight of soil.

PHYSICAL TESTING METHODS

The physical tests run on these samples included water content, sample dry density, permeability, and grain-size analysis. Data gathered from these tests and visual examination of the samples were used to classify the materials into standard soil engineering categories. All testing was done using standard soil engineering methods (10).

To determine water content, a sample taken from a sealed coring tube was weighed into a tared sample dish, dried at 110°C and weighed periodically until a constant weight was obtained.

Sample dry density (or dry unit weight) is the weight of oven-dried soil per unit volume of soil. This measurement can be made in two different ways: by trimming the soil sample into a precisely measured regular shape and drying and weighing the trimmed sample; or, by sealing the surface of a soil specimen with wax and measuring its volume by water displacement, then removing the sealing material and drying and weighing the specimen. The water displacement procedure was used with samples containing gravel or other coarse material that prevented the sample from being trimmed accurately.

Grain-size analysis was performed by sieving the dried, disaggregated soil through a standard sieve series. Standard hydrometer density measurements were run on a suspension prepared from the fraction passing the 200-mesh sieve.

Permeability measurements were made using a constant-head test system with coarse-grained soils, and a falling-head test system with fine sands or clays. In all cases standard procedures and equipment were employed (10).

The major characteristics (especially grain-size analyses and characteristics of the fine fraction) of the samples were used to classify the soils. The classification system is summarized in Table 5. These classification categories and symbols are used to summarize soil characteristics in the logs presented in Tables A-1--A-8, B-1--B-8, and C-1--C-9.

CHEMICAL ANALYTICAL METHODS

The techniques used in analyzing the filtered groundwater samples, distilled water extracts and nitric acid digests are summarized in Table 6. In all cases, the samples were run within the recommended time limits for the storage of samples (11).

The analyses of groundwater samples is given in milligrams per liter of filtered sample. The water extracts are also presented in milligrams per liter of filtered extractant. The water extract represents an equilibrium or near equilibrium solution with respect to the solid phases and the adsorbed phases in the soil; therefore, the analytical data are presented on a solution basis rather than a dry weight basis. The nitric acid digests are a determination of the total acid digestible fraction; therefore, the results are presented as milligrams extracted per kilogram dry weight of soil.

TABLE 5. DESCRIPTIONS OF USCS SOIL GROUPS (6)

Group symbol	Typical group description
GW	Well-graded (poorly-sorted) gravels, gravel-sand mixtures, little or no fines
GP	Poorly-graded (well-sorted) gravels, or gravel-sand mixtures, little or no fines
GM	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures
SW	Well-graded (poorly-sorted) sands, gravelly sands, little or no fines
SP	Poorly graded (well-sorted) sands, gravelly sands, little or no fines
SM	Silty sands, sand-silt mixtures
SC	Clayey sands, sand-clay mixtures
ML	Inorganic silts, very fine sands, clayey silts, low plasticity
CL	Inorganic clays, low to medium plasticity, lean clays
OL	Organic silts and organic silty clays of low plasticity
MH	Inorganic silts, micaceous or diatomaceous fine, sandy or silty soils, elastic silts
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity, organic silts
Pt	Peat and other highly organic soils

TABLE 6. TECHNIQUES USED IN THE ANALYSIS OF DISTILLED WATER EXTRACTS,
NITRIC ACID DIGESTS AND GROUNDWATER FILTRATES

Chemical species	Procedures and/or instrumentation*	Lowest reporting* concentration in (ppm)
SO ₄	Standard Turbidimetric Method ⁺ in combination with a Varian Model 635 Spectrophotometer	8
SO ₃	Standard Potassium Iodide-Iodate Titration method ⁺	1
Cl	Standard Mercuric Nitrate Titration method ⁺	5
NO ₃ -N	Technicon II Auto Analyzer, Industrial Method no. 100-70W ⁺	0.01
NO ₂ -N	Same as above	0.01
CN	Technicon II Auto-Analyzer, Industrial Method no. 315-74W ⁺	0.01
TOC	Determined with Envirotech Model No. DC 50 TOC Analyzer	1
Ca	Determined with a Spectrametrics Argon Plasma Emmission Spectrophotometer Model II	0.03
Fe	Same as above	0.05
Mg	Same as above	0.03
Mn	Same as above	0.03
Na	Same as above	0.03
As	Determined with a Gaseous Hydride System, Perkin-Elmer Atomic Absorption Unit	0.001
B	Determined with a Spectrametrics Argon Plasma Emission Spectrophotometer Model II	0.02

(continued)

TABLE 6 (continued)

Chemical species	Procedures and/or instrumentation*	Lowest reporting concentration in (ppm)
Be	Same as above	0.02
Cd	Same as above	0.03
Cr	Same as above	0.03
Cu	Same as above	0.02
Hg	Determined with a Nisseisangyo Zeeman Shift Atomic Absorption Spectrophotometer	0.0002
Ni	Determined with a Spectrametrics Argon Plasma Emission Spectrophotometer Model II	0.03
Pb	Same as above	0.1
Se	Determined with a Perkin-Elmer Heated Graphite Atomizer Atomic Absorption Unit	0.002
Zn	Determined with a Spectrametrics Argon Plasma Emissions Spectrophotometer Model II	0.03

* Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

+ Standard Methods for the Examination of Water and Wastewater, American Public Health Association, New York, 13th Edition, 1971.

+ Technicon Industrial Systems, Tarrytown, New York.

SECTION 5

RESULTS AND DISCUSSION

PHYSICAL TESTING

The soil parameters measured in the physical testing program are those most likely to be effected by the infiltration of leachate from overlying refuse. The literature indicates that the leachate suspension is filtered by the uppermost layer of soil below the refuse (4). Filtration of the leachate should cause the soil to show:

- a) an increase in density due to the addition of fine material in intergranular spaces,
- b) a decrease in permeability due to accumulation of fine-grained particles that obstruct the natural pore connections in the soil,
- c) an increase in the percentage of fine silt- and clay-sized material (less than 200-mesh grain size) due to accumulated leachate residue, and
- d) a change in water content due to the accumulation of water retaining organic material.

A complete tabulation of data obtained from the physical testing program is given in Tables 7, 8 and 9. A summary contrasting the physical characteristics found in the samples from directly below the landfill and at comparable elevations outside the landfill is given in Table 10. None of the sites show significant differences in dry density between soil beneath and outside the landfill. Likewise, the variation in water content shows no pattern that can be related to the position of the sample with respect to the landfill. The data available on permeability or hydraulic conductivity do show a significant difference between inside (sub-refuse) and outside samples for site B. Unfortunately, it is very difficult to obtain reliable, reproducible permeability measurements from this extremely fine-grained, loess-based soil. Laboratory experiments with reconstituted samples indicated that the permeability is very dependent on the state of compaction of the material. Slight disturbances of the samples could account for a great deal of the variation observed or the differences might have been produced by the grading and compaction when the completed fill was developed as a recreation area. There is no significant difference in the weight percentage of material finer than 200-mesh for samples under and outside the landfills at any of the three sites. If the residue from leachate is being trapped, it constitutes a very small portion of the cored sample.

TABLE 7. PHYSICAL TESTING DATA FOR SAMPLES FROM SITE A

Boring no.	Sample no.	Depth (m)	Dry density (g/cc)	Water content (%)	Permeability or hydraulic cond. (cm/sec)	Classification
1	P1	7.20 - 7.70	1.60	4.1	1.1×10^{-1}	Sand (SP), brown
1	P4	10.94 - 11.64	1.62	3.1	1.1×10^{-1}	Sand (SP) with trace gravel, brown
1	P6	22.65 - 22.84	1.59	3.9	1.4×10^{-1}	Sand (SP) with trace gravel, brown
2	P1	6.25 - 6.68	1.61	3.6	0.58×10^{-1}	Sand (SP) with trace gravel, brown
2	P2	6.92 - 7.44	1.72	3.3	--	Gravelly sand (SP), brown
2	P3	8.81 - 9.42	1.64	2.9	1.1×10^{-1}	Sand (SP) with gravel, brown
2	P4	13.87 - 14.39	1.50	6.7	0.47×10^{-1}	Sand (SP), brown
2	P5	19.51 - 19.87	1.55	3.8	0.76×10^{-1}	Sand (SP) with gravel, brown
2	P6	24.39 - 24.94	1.56	3.8	--	Sand (SP) with trace gravel, brown
3	P1	7.86 - 8.32	1.63	5.2	0.82×10^{-1}	Sand (SP) with gravel, brown
3	P3	10.82 - 11.25	1.61	2.5	1.1×10^{-1}	Sand (SP) with trace gravel, brown
3	P5	22.25 - 22.53	1.76	2.4	1.3×10^{-1}	Gravelly sand (SP), brown
4	P1	3.20 - 3.90	1.59	7.5	2.0×10^{-1}	Sand (SP), brown
4	P3	6.25 - 6.62	1.59	4.0	--	Sand (SP), brown
5	P1	4.57 - 5.29	1.65	2.8	--	Sand (SP) with gravel, brown
5	P3	7.62 - 8.20	1.67	2.9	--	Sand (SP) with gravel, brown
5	P5	18.44 - 18.83	1.74	2.7	--	Sand (SP) with gravel, brown
6	P1	4.72 - 5.33	1.57	2.8	--	Sand (SP) with gravel, brown
6	P3	7.77 - 8.42	1.71	3.2	--	Sand (SP) with gravel, brown
6	P5	19.00 - 19.48	1.69	2.9	--	Sand (SP) with gravel, brown
7	P1	4.42 - 4.76	1.62	3.3	--	Sand (SP) with trace gravel, brown
7	P3	7.77 - 8.26	1.78	3.1	--	Gravelly sand (SP), brown
7	P4	13.26 - 13.75	1.75	2.9	--	Sand (SP) with gravel, brown
8	P1	14.32 - 15.03	1.64	4.5	--	Sand (SP) with trace gravel, brown
8	P3	17.38 - 17.96	1.66	3.4	--	Sand (SP) with gravel, brown
8	P5	28.65 - 28.99	1.70	4.2	--	Sand (SP) with gravel, brown

Note: -- indicates no data available.

TABLE 9. PHYSICAL TESTING DATA FOR SAMPLES FROM SITE B

Boring no.	Sample no.	Depth (m)	Density (g/cc)	Water content (%)	Permeability or hydraulic cond. (cm/sec)	Classification
1	P1	6.25 - 6.37	--	26.7	--	Silt (ML) gray
1	P2	8.41 - 8.87	1.48	33.3	7.72×10^{-8}	Silty clay (CL) gray
2	P2	3.66 - 4.15	1.57	24.7	8.41×10^{-7}	Silt (ML) grayish brown
2	P3	5.79 - 6.52	1.56	28.8	6.22×10^{-7}	Silt (ML) grayish brown
6	P1	6.10 - 6.77	1.40	20.1	7.72×10^{-5}	Silt (ML) brownish tan
6	P3	9.15 - 9.85	1.57	30.3	3.24×10^{-6}	Silt (ML) grayish brown
7	P3	4.57 - 5.27	1.53	28.9	7.84×10^{-6}	Silt (ML) brownish gray
8	P1	6.10 - 6.68	--	32.5	--	Silt (ML) olive gray

Note: -- indicates no data available.

TABLE 9. PHYSICAL TESTING DATA FOR SAMPLES FROM SITE C

Boring no.	Sample no.	Depth (m)	Dry density (g/cc)	Water content (%)	Permeability or hydraulic cond. (cm/sec)	Classification
1	P1	25.91 - 26.36	1.53	18.5	6.6×10^{-5}	Sandy silt (ML), brown
1	P3	28.96 - 29.40	1.71	17.3	7.8×10^{-5}	Silty sand (SM), brown
2	P1	18.29 - 18.96	1.65	19.4	6.6×10^{-5}	Silty sand (SM), brown
2	P3	22.26 - 22.59	1.66	18.9	2.8×10^{-4}	Sandy silt (ML), brown
3	P1	19.97 - 20.46	1.69	21.1	1.2×10^{-6}	Clayey, sandy silt (ML), brown
3	P3	22.47 - 22.92	1.69	18.1	2.9×10^{-5}	Sandy silt (ML), brown
4	P1	1.70 - 2.03	1.52	28.9	3.0×10^{-7}	Clayey, sandy silt (ML), brown
4	P4	8.49 - 8.76	1.64	21.2	5.7×10^{-6}	Sandy silt (ML), brown
6	P2	0.91 - 1.46	1.63	16.4	5.9×10^{-5}	Clayey, sandy silt (ML), tan
6	P4	4.57 - 5.11	1.78	14.9	1.9×10^{-5}	Sandy silt (ML), brown
7	P2	0.91 - 1.58	1.52	20.3	4.3×10^{-5}	Sandy silt (ML), reddish brown
9	P4	7.32 - 7.88	1.69	19.2	1.7×10^{-5}	Silty sand (SM), brown

TABLE 10. COMPARISON OF THE PHYSICAL PROPERTIES OF THE UPPERMOST
SAMPLES COLLECTED WITHIN AND OUTSIDE THE LANDFILLS

Sample	Location (inside/outside)	Dry density (gm/cc)	Water content (%)	Permeability (cm/sec)	Weight % finer than 200 mesh
A 1P1	inside	1.60	4.1	1.1×10^{-1}	<2%
A 2P1	inside	1.61	3.6	0.58×10^{-1}	<2%
A 3P1	inside	1.63	5.2	0.82×10^{-1}	<2%
A 4P1	outside	1.59	7.5	--	<2%
A 5P1	outside	1.65	2.8	--	<2%
A 8P1	outside	1.64	4.5	--	<2%
A 6P1	outside	1.57	2.8	--	<2%
A 7P1	outside	1.62	3.3	--	<2%
B 1P2	inside	1.48	33.3	7.72×10^{-8}	99%
B 2P2	inside	1.57	24.7	8.41×10^{-7}	99%
B 6P1	outside	1.40	20.1	7.72×10^{-5}	99%
B 7P3	outside	1.53	28.4	7.84×10^{-6}	96%
C 1P1	inside	1.53	18.5	6.6×10^{-5}	64%
C 2P1	inside	1.65	19.4	6.6×10^{-5}	44%
C 3P1	outside	1.69	21.1	1.2×10^{-6}	66%
C 4P1	outside	1.52	28.9	3.0×10^{-7}	82%
C 6P2	outside	1.63	16.4	5.9×10^{-5}	52%
C 7P2	outside	1.52	20.3	4.3×10^{-5}	58%

In each boring under the landfill a series of samples were taken at increasing depth. Again, no consistent pattern could be observed relating the physical characteristics to the depth (or elevation).

None of the physical tests with the possible exception of permeability measurements at site B showed any consistent differences between samples taken directly under the landfill and those taken outside the landfill. No consistent pattern could be found in samples taken at differing depths in the same borings under the landfills. Any differences which do occur apparently are confined to a narrow range immediately at the interface between the refuse and the soil. Detection of these would probably require examination of a core through this interface region in very fine detail. None of the usual engineering tests demonstrated any effects which could be attributed to attenuation.

CHEMICAL ANALYSES OF GROUNDWATER

The goal of the groundwater investigation is to determine if changes in chemical parameters observed in different borings at each site could be related to the position of the boring with regard to the landfill and the direction of groundwater movement. A survey of the literature suggests that of the chemical parameters measured those most likely to indicate contamination from leachate in the groundwater are sulfate, chloride, total organic carbon, calcium, iron, magnesium, manganese and sodium (2,3). The minor and trace elements appearing in the groundwater around a landfill vary widely depending on the concentrations present in the waste at a particular landfill.

The tabulation of groundwater analyses obtained from wells at sites A, B and C are presented in Tables 11-13. The data are divided into three groups for each site; those up the groundwater gradient from the landfill, those under the landfill and those down the groundwater gradient from the landfill. The three groups of samples at each site show different means for the parameters measured and initial statistical analysis indicated widely different variances. Because of these inhomogeneous variances, the restricted number of samples in each group, and the large number of determinations that fall below the limits of detection, a non-parametric (distribution-free) analysis of variance techniques was used to determine if differences between means of parameters measured were significant. The statistical technique employed was the Kruskal-Wallis one-way analysis of variance (12,13). This test requires only that data have an underlying continuous distribution and that the data can be ranked. This test does not require that the data have a normal distribution or be homogeneous with regard to variance. Because of the differences in numbers of samples at different sites, two different levels of significance (95.4% and 96.8%) were used.

The analysis of variance results are given in Table 14. Strong influence of the type of geologic material at each site is evident in the differences in background levels of metals present. Site A was underlain by clean glacial outwash consisting primarily of quartz sand. The upgradient groundwater

TABLE 11. CHEMICAL COMPOSITION OF GROUNDWATER OBTAINED FROM BORINGS AT LANDFILL A

Parameters	Up groundwater gradient			Under landfill			Down groundwater gradient	
	Boring 4	Boring 5	Boring 8	Boring 1	Boring 3	Boring 2	Boring 6	Boring 7
SO ₄	<8	<8	<8	25	47	23	26	35
SO ₃	<1	<1	<1	<1	<1	<1	<1	<1
Cl	<5	<5	<5	5	5	5	5	5
NO ₃ -N	<0.01	<0.01	<0.01	0.38	0.02	<0.01	<0.01	<0.01
NO ₂ -N	<0.01	<0.01	<0.01	0.09	0.03	0.04	0.04	0.03
CN	<0.01	<0.01	<0.05	<0.01	0.01	<0.01	<0.01	<0.01
TOC	<1	<1	<1	21	48	50	20	27
Ca	<0.03	<0.03	<0.03	34.3	69.0	127.0	35.0	35.5
Fe	<0.05	<0.05	<0.05	3.5	10.5	18.6	22.0	22.0
Mg	<0.03	<0.03	<0.03	17.10	48.50	39.50	35.00	35.50
Mn	<0.03	<0.03	<0.03	3.2	3.0	4.9	8.3	10.3
Na	<0.03	<0.03	<0.03	19.80	72.10	63.20	41.00	7.80
As	0.005	0.003	0.006	0.002	0.003	0.007	0.006	0.003
B	<0.02	<0.02	<0.02	0.02	0.02	0.02	0.02	0.02
Be	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cd	<0.03	<0.03	<0.003	<0.03	<0.03	<0.03	<0.03	
Cr	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cu	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hg	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Ni	<0.03	<0.03	<0.03	0.04	0.07	0.13	0.12	0.21
Pb	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Se	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zn	<0.03	<0.03	<0.03	0.35	0.24	1.36	0.29	0.44

Note: All values are in mg/l.

TABLE 12. CHEMICAL COMPOSITION OF GROUNDWATER OBTAINED FROM BORINGS AT LANDFILL B

Parameters	Up groundwater gradient			Under landfill			Down groundwater gradient	
	Boring 4	Boring 5	Boring 6	Boring 1	Boring 2	Boring 3	Boring 7	Boring 8
SO ₄	<8	<8	<8	240	44	190	24	14
SO ₃	<1	<1	<1	<1	12	10	<1	<1
Cl	<5	<5	<5	<5	12	10	<5	<5
NO ₃ -N	0.78	2.02	0.86	0.03	0.02	0.14	2.30	2.00
NO ₂ -N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CN	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TOC	8	20	14	32	22	148	10	21
Ca	160.0	75.0	95.0	210.0	170.0	190.0	180.0	190.0
Fe	0.2	0.2	0.2	20.0	0.2	0.2	0.2	0.2
Mg	78.0	30.0	39.0	111.0	6.8	130.0	117.0	120.0
Mn	0.567	0.016	0.030	11.300	0.983	2.000	2.35	8.97
Na	32.00	22.00	20.00	75.00	35.00	33.00	37.00	33.00
As	0.008	0.004	0.002	0.210	0.008	0.007	0.010	0.004
B	0.30	0.03	0.03	0.23	0.15	0.04	0.04	0.10
Be	0.0460	0.0005	0.0006	0.0540	0.0470	0.0510	0.0350	0.041
Cd	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cr	0.05	0.05	<0.03	0.04	0.04	0.04	<0.03	<0.03
Cu	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hg	0.0010	<0.0002	0.0007	<0.0002	0.0002	0.0003	0.0009	<0.0002
Ni	0.536	0.225	0.270	0.630	0.539	0.573	0.450	0.540
Pb	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Se	0.005	0.002	0.002	0.004	0.007	0.006	0.007	0.007
Zn	0.05	<0.03	<0.03	0.70	0.14	0.03	<0.03	0.10

Note: All values are in mg/l

TABLE 13. CHEMICAL COMPOSITION OF GROUNDWATER OBTAINED FROM BORINGS AT LANDFILL C

Parameters	Up groundwater gradient				Under landfill			Down groundwater gradient	
	Boring 6	Boring 7	Boring 8	Boring 9	Boring 1	Boring 2	Boring 3	Boring 4	Boring 5
SO ₄	<8	<8	<8	<8	9	24	8	8	8
SO ₃	<1	<1	<1	<1	1	<1	2	<1	1
Cl	20	5	15	5	5	415	15	365	25
NO ₃ -N	0.03	0.02	0.68	0.11	0.04	0.03	0.02	<0.01	0.01
NO ₂ -N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CN	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01
TOC	5	1	4	2	95	208	16	30	8
Ca	8.0	2.6	1.6	7.9	37.0	34.0	10.0	72.0	7.0
Fe	0.10	0.07	0.12	0.13	4.90	18.20	0.08	2.77	0.09
Mg	7.50	1.50	2.30	1.20	16.00	56.00	4.4	68.00	7.50
Mn	0.20	0.15	0.50	0.06	7.12	12.30	0.19	31.90	5.19
Na	12.00	5.90	6.00	2.90	7.50	220.00	6.70	71.00	5.90
As	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.002
B	0.04	<0.02	<0.02	0.06	0.12	1.45	1.06	1.04	<0.02
Be	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cd	0.03	0.70	0.12	0.04	<0.03	<0.03	<0.03	0.05	0.09
Cr	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cu	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hg	0.0081	0.0039	0.0013	0.0018	0.0012	0.0014	0.0018	0.0012	0.0012
Ni	0.08	0.05	0.08	0.38	1.61	0.42	0.07	0.06	0.08
Pb	0.173	0.114	0.111	0.133	0.274	0.368	0.140	0.493	0.163
Se	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zn	0.03	0.69	0.12	0.07	2.73	0.64	0.06	0.20	0.09

Note: All values are in mg/l

TABLE 14. RESULTS OF ANALYSIS OF VARIANCE FOR GROUNDWATER CHEMISTRY

Parameter	Site A*	Site B*	Site C**
SO ₄	S	S	S
SO ₃	N	NS	NS
Cl	S	NS	NS
NO ₃ -N	NS	S	S
NO ₂ -N	NS	N	N
CN	NS	N	S
TOC	S	NS	S
Ca	S	NS	NS
Fe	S	NS	NS
Mg	S	NS	NS
Mn	S	NS	NS
Na	S	NS	NS
As	NS	NS	NS
B	S	NS	NS
Be	NS	NS	N
Cd	N	N	NS
Cr	NS	NS	N
Cu	N	N	N
Hg	N	NS	NS
Ni	S	NS	NS
Pb	N	N	NS
Se	N	NS	N
Zn	NS	NS	NS

S = Significant difference in means.

NS = No significant difference in means.

N = No present in measurable quantities in any sample.

* = Tested at 96.8% confidence level.

** = Tested at 95.4% confidence level.

samples (Wells A-4, A-5, A-8) contain very low levels of many elements. Therefore the contrast with the sub-landfill samples is strong and the number of statistically significant differences in averages is large. Site B and site C show higher background levels in the upgradient wells reflecting the more complex chemical composition of the materials in the area (clays at site B; weathered metamorphic rocks at site C). Therefore, the contrast between the upgradient groundwater samples and the sub-landfill samples is correspondingly weaker and the number of statistically significant differences in mean values for chemical parameters is lower.

The most consistent effect of leachate contamination observed in the groundwater is the increased sulfate noted in wells under the landfill as contrasted with upgradient wells. This increase was observed at all three landfills that were investigated. Increases in nitrate, or total organic carbon were observed in the sub-landfill groundwater samples in two out of the three sites. At site A, probably because of this site's low background levels, significant contrasts could also be found in chloride, calcium, iron, magnesium, sodium, boron, and nickel. Site C showed a significant contrast in cyanide levels under and upgradient from the landfill.

The results of this investigation agree with previous investigations in indicating that increased levels of sulfate, nitrate and organic carbon levels are related to pollution from landfill leachate (3,4,14). Cyanide measurements are not usually made on groundwater in municipal landfill areas, but as indicated by site C, cyanide may be a worthwhile measurement to make on leachate-contaminated water.

CHEMICAL ANALYSES OF DISTILLED WATER EXTRACTS

The goal of distilled water extraction was to determine the availability of the potential pollutants in the soil samples to water in contact with the soil. The availability of particular materials in sub-landfill soil to a distilled water extract may vary greatly from site to site. The content of this soil extract depends upon the:

- a) original constituents in the soil and their solubilities,
- b) way in which the original constituents have reacted with the weak organic acids in leachate and the solubilities of new products produced,
- c) extent to which the water-soluble and leachate-soluble materials have been removed from the soil through solution,
- d) solubilities of materials that are precipitated, filtered, or adsorbed from the leachate passing through the soil,
- e) pH and redox conditions in the soil, especially as this effects the solubility of iron and manganese, the survival of nitrates and sulfates, and the production of sulfide, and

f) amount and character of the interstitial water present in the sample.

Comparison of Distilled Water Extracts from Beneath and Outside the Landfills

The tabulation of analyses of distilled water extracts of soil samples is given in Tables 15-20. Many of the analyses are close to or below the limits of detection indicating that in general very little material is available to contacting water in soils either under or away from the landfills. A statistical comparison was made between analyses of extracts obtained from samples immediately under the landfill and those collected at comparable depths below the surface (but above the water table) outside the landfill. A randomization procedure was used to test the significance of differences between means of the two sample sets. Using five samples, an 80% significance level can be obtained in a two-tailed test. The results of the randomization test are given in Table 21.

Only sulfate levels show a significant difference between means of samples obtained inside and outside the landfill at all three sites. There is, however, no consistent relationship in the behavior of sulfate between sites. At sites A and B the sulfate levels are slightly higher in the water leach from soil under the landfill. At site C the reverse is true. At all three sites, sulfate is moving from the landfill through the sub-refuse soil as shown by the increased sulfate levels in groundwater. At site C, sulfate from the leachate may be moving through the soil without being stopped or sulfate trapped in the soil may be reduced to sulfide through the activity of anaerobic bacteria decomposing organic materials in the leachate.

Chloride levels in soil extracts were significantly different inside and outside the landfills at sites B and C. At site C the sub-landfill soil extract was high in chloride compared to the samples outside the fill. At site B the reverse was true. Groundwater analyses indicated that chloride levels increased significantly only under landfill site C. The increased chloride in the soil sample at site C is to be expected from the increased supply of chloride from leachate. Chloride ion is not readily adsorbed to solid materials and does not readily precipitate. The increased chloride observed in the water extract from soil below the landfill at site C is probably due to chloride in solution in the water associated with the wet sample. At site B the decrease in chloride in extract from soil under the landfill is consistent with the low chloride levels seen in the groundwater.

Nitrate levels were significantly different inside and outside of the landfill only at site C. Very low nitrate levels were observed inside the landfill and higher levels outside. The nitrogen present in soil under the landfill might be converted from nitrate to ammonium ion through bacterial activity associated with the leachate; reducing nitrate below levels observed in similar surrounding soils. Published analyses indicate much of the nitrogen in leachate is present as ammonium ion (1), not as nitrate, indicating nitrate reduction can occur, and that nitrogen added to the sub-landfill soil probably is in the form of ammonium ion.

Cyanide levels varied significantly only at site B. The analyses are mostly at or very near the limits of detection for this constituent and so

TABLE 15. ANALYSES OF DISTILLED WATER EXTRACTS OF SOIL SAMPLES FROM EXPERIMENTAL BORINGS AT SITE A

Boring and sample	2C4	2C5	2C6	3C1	3C2	3C3	3C4	3C5	3C6
Elevation (m)	243.00	237.11	232.08	250.53	249.53	247.60	240.27	235.72	230.73
Depth below mw/soil interface (m)	7.99	13.87	18.90	0.00	1.01	2.93	10.26	14.81	19.80
Ht. above water table (m)	11.99	6.10	1.07	19.31	18.31	16.38	9.05	4.50	-0.49
Conc. (mg/l)									
SO ₄	9	8	9	9	9	9	9	9	9
SO ₃	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cl	<5	<5	<5	<5	<5	<5	<5	<5	<5
NO ₃ -N	0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NO ₂ -N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CN	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TOC	6	6	7	7	4	5	2	7	5
Ca	0.18	0.15	2.24	0.54	0.77	0.55	2.23	1.53	0.44
Fe	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mg	0.10	0.12	0.80	0.22	0.14	0.23	1.31	0.92	0.13
Mn	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Na	0.42	0.94	0.70	2.29	6.47	3.58	0.19	2.97	1.90
As	0.002	0.002	0.002	0.006	0.010	0.004	0.002	0.004	0.002
B	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Be	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cd	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cr	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cu	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	<0.03	<0.03	<0.03	0.07	0.04	<0.03	<0.03	<0.03	<0.03
Pb	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Se	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zn	0.21	1.39	0.38	0.35	0.22	1.12	0.06	0.21	1.14

ND = Not determined

TABLE 15. (continued)

Boring and sample	1C1	1C2	1C3	1C4	1C5	1C6	1C7	2C1	2C2	2C3
Elevation (m)	250.57	249.77	247.58	242.08	234.81	230.83	230.83	250.98	250.14	247.99
Depth below mw/soil interface (m)	0.00	0.82	3.02	8.52	15.78	19.77	19.77	0.00	0.84	2.99
Ht. above water table (m)	18.06	17.24	15.05	9.55	2.28	-1.70	-1.70	19.97	19.13	16.98
Conc. (mg/l)										
SO ₄	9	10	9	10	9	42	9	9	9	9
SO ₃	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cl	<5	<5	<5	5	5	5	<5	<5	<5	<5
NO ₃ -N	0.30	0.01	<0.01	0.03	<0.01	0.13	<0.01	0.38	0.06	<0.01
NO ₂ -N	<0.01	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	0.09	<0.01	<0.01
CN	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TOC	9	11	8	8	6	8	5	10	9	10
Ca	0.31	1.40	0.35	0.70	0.59	3.03	1.22	0.41	3.58	0.95
Fe	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mg	0.48	0.97	0.33	0.67	0.18	1.69	0.29	0.30	0.68	0.20
Mn	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.07	0.06	<0.03
Na	2.94	1.40	1.10	2.62	0.93	0.53	1.78	3.20	1.82	1.94
As	0.006	0.002	0.001	0.002	0.001	0.008	0.001	0.002	0.002	0.001
B	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Be	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02
Cd	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.03	<0.03	<0.03	<0.03
Cr	<0.03	<0.03	<0.03	0.03	<0.03	0.05	<0.03	0.28	<0.03	0.03
Cu	0.03	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	0.17	<0.02	0.02
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	0.09	<0.03	<0.03	0.08	<0.03	0.05	0.07	2.62	<0.03	<0.03
Pb	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Se	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zn	0.78	1.10	0.11	0.38	0.13	0.82	0.29	4.65	0.10	0.46

(continued)

TABLE 16. ANALYSES OF DISTILLED WATER EXTRACTS OF SOIL SAMPLES FROM CONTROL BORINGS AT SITE A

Boring and sample	6C1	6C2	6C3	6C4	6C5	6C6	7C1	7C2	7C3	7C4	7C5	7C6
Elevation (m)	251.09	250.20	248.08	242.05	236.86	230.84	250.49	250.15	247.99	242.23	236.37	233.32
Ht. above water table (m)	19.99	19.10	16.98	10.95	5.76	-0.26	14.97	14.63	12.47	6.71	-0.85	-2.20
Conc. (mg/l)												
SO ₄	9	10	8	8	8	8	8	8	8	9	10	10
SO ₃	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cl	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
NO ₃ -N	0.02	0.01	0.01	0.16	0.06	<0.01	0.05	0.04	0.27	0.02	0.05	0.20
NO ₂ -N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CN	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TOC	3	<1	3	2	2	<1	<1	<1	<1	5	5	3
Ca	0.37	0.30	1.26	0.46	0.30	0.18	0.51	0.72	0.98	0.87	1.24	2.02
Fe	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mg	0.16	0.23	0.51	0.28	0.21	0.16	0.14	0.35	0.33	0.35	0.54	0.91
Mn	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	0.03	0.06	0.03	0.04
Na	0.27	0.21	0.30	0.32	0.39	0.49	0.73	0.39	0.70	0.61	0.37	0.33
As	0.004	0.002	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002
B	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Be	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cd	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cr	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cu	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Pb	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Se	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zn	0.91	0.14	0.25	<0.03	0.68	0.27	0.35	0.09	0.22	<0.03	0.20	0.39

ND = Not determined

NOTE: All borings are positioned downdip on the groundwater gradient.

TABLE 17. ANALYSES OF DISTILLED WATER EXTRACTS OF SOIL SAMPLES FROM EXPERIMENTAL BORINGS AT SITE B

Boring and sample	1C1	1C2	2C1	2C2	2C3	3C1	3C2	3C3
Elevation (m)	55.93	54.06	56.77	55.85	53.72	56.74	55.74	53.50
Depth below soil/nw interface (m)	0.00	1.87	0.00	0.92	3.05	0.00	1.00	3.24
Ht. above water table (m)	1.57	-0.30	5.83	4.91	2.78	3.51	2.51	0.27
Conc. (mg/l)								
SO ₄	<8	25	<8	<8	<8	9	<8	13
SO ₃	<1	<1	<1	<1	<1	<1	<1	<1
Cl	5	8	<5	<5	8	<5	<5	<5
NO ₃ -N	0.04	0.07	0.02	0.05	0.05	0.27	0.17	<0.01
NO ₂ -N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CN ⁻	0.01	0.01	0.01	0.01	<0.01	0.02	0.01	<0.01
TOC	14	10	16	14	6	27	12	4
Ca	20.00	13.00	21.00	18.00	19.00	6.50	15.00	21.00
Fe	0.50	0.48	0.25	0.20	0.05	0.40	0.10	0.11
Mg	11.70	5.60	8.50	8.00	6.60	4.10	12.00	9.90
Mn	0.30	0.99	0.04	0.11	<0.03	<0.03	0.26	<0.03
Na	21.00	6.70	30.00	13.00	3.00	66.00	9.40	4.10
As	ND	ND	ND	ND	ND	ND	ND	ND
B	0.05	0.06	0.15	0.09	<0.02	<0.02	<0.02	<0.02
Be	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cd	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cr	0.05	0.05	0.07	0.05	<0.03	<0.03	<0.03	<0.03
Cu	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hg	ND	ND	ND	ND	ND	ND	ND	ND
Ni	0.10	0.08	0.13	0.11	0.05	0.06	0.05	0.07
Pb	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Se	ND	ND	ND	ND	ND	ND	ND	ND
Zn	<0.03	<0.05	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

ND = Not determined.

TABLE 18. ANALYSES OF DISTILLED WATER EXTRACTS OF SOIL SAMPLES FROM CONTROL BORINGS AT SITE B

Boring and sample	5C1	5C2	5C3	6C1	6C2	6C3	7C3
Elevation (m)	55.28	54.38	52.44	54.26	53.35	51.22	42.00
Ht. above water table (m)	1.93	1.03	-0.91	4.11	3.20	1.07	0.10
Position in groundwater gradient	updip	updip	updip	updip	updip	updip	downdip
Conc. (mg/l)							
SO ₄	<8	<8	<8	<8	<8	<8	<8
SO ₄ ³	<1	<1	<1	<1	<1	<1	<1
Cl ³	8	5	12	8	13	31	<5
NO ₃ -N	1.56	0.25	0.09	0.24	2.11	0.05	0.08
NO ₂ -N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CN	0.01	0.01	<0.01	<0.01	0.01	0.01	0.01
TOC	3	10	6	4	6	20	10
Ca	36.00	33.00	27.00	27.00	34.00	40.00	35.00
Fe	0.14	0.10	0.10	0.10	0.20	0.10	0.14
Mg	10.50	11.50	9.20	10.20	12.00	14.00	17.00
Mn	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	0.14
Na	3.30	3.50	3.60	4.30	4.30	4.30	23.00
As	ND	ND	ND	ND	ND	ND	ND
B	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.06
Be	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cd	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cr	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03
Cu	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hg	ND	ND	ND	ND	ND	ND	ND
Ni	0.12	0.11	0.10	0.10	0.12	0.14	0.15
Pb	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	1.00
Se	ND	ND	ND	ND	ND	ND	ND
Zn	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.06

ND = Not determined.

TABLE 19. ANALYSES OF DISTILLED WATER EXTRACTS OF SOIL SAMPLES FROM EXPERIMENTAL BORINGS AT SITE C

Boring and sample	1C1	1C2	1C3	2C1	2C2	2C3	3C1	3C2	3C3
Elevation (m)	131.41	130.48	128.34	127.46	126.55	124.41	125.50	124.57	123.20
Depth below mw/soil interface (m)	0.00	0.93	3.07	0.00	0.91	3.05	0.00	0.93	2.30
Ht. above water table (m)	4.40	3.47	1.33	0.20	-0.71	-2.85	2.48	1.55	0.18
Conc. (mg/l)									
SO ₄	9	<8	<8	8	<8	<8	<8	<8	<8
SO ₃	<1	<1	<1	<1	<1	<1	<1	<1	<1
Cl ³	5	5	5	10	5	10	10	5	10
NO ₃ -N	0.03	0.03	0.02	0.01	0.06	0.02	0.02	0.03	0.02
NO ₂ -N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CN	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TOC	21	18	4	8	1	8	8	4	2
Ca	0.60	2.10	3.00	1.60	1.30	1.20	0.70	0.80	0.80
Fe	0.09	0.15	0.09	0.07	0.06	0.07	0.05	<0.05	<0.05
Mg	1.60	1.30	1.90	1.30	1.00	0.90	1.80	0.45	0.70
Mn	0.60	0.27	0.05	0.05	0.06	0.61	0.60	0.74	<0.03
Na	2.20	2.00	2.40	3.90	2.80	9.20	4.90	5.50	2.10
As	ND	ND	ND	ND	ND	ND	ND	ND	ND
B	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	0.02	0.02	<0.02
Be	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cd	0.04	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cr	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cu	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	0.06	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	0.06	0.20	0.27	0.05	0.09	0.06	0.04	0.03	0.05

ND = Not determined.

TABLE 20. ANALYSES OF DISTILLED WATER EXTRACTS OF SOIL SAMPLES FROM CONTROL BORINGS AT SITE C

Boring and sample	6C1	6C2	6C3	6C4	6C5	7C4	8C3	9C1	9C2	9C3	9C4	9C5	4C6	5C4
Elevation (m)	132.46	131.54	129.41	127.88	126.06	121.80	130.14	143.47	142.57	140.44	136.17	131.91	124.74	126.92
Ht. above water table (m)	5.42	4.50	2.37	0.84	-0.98	0.09	-0.36	11.47	10.57	8.44	4.17	-0.09	-0.66	-0.12
Position in groundwater gradient	Updip	Updip	Updip	Updip	Updip	Updip	Updip	Updip	Updip	Updip	Updip	Updip	Downdip	Downdip
Conc. (mg/l)														
SO ₄	12	<8	11	<8	<8	<8	<8	20	10	16	16	<8	<8	<8
SO ₃	<1	<1	<1	<1	<1	<1	<1	2	<1	2	<1	<1	<1	<1
Cl	5	5	10	5	20	20	30	5	15	5	5	15	75	30
NO ₃ -N	1.34	1.69	1.75	3.06	1.54	0.87	1.91	1.91	1.82	1.57	0.07	1.98	<0.01	1.27
NO ₂ -N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CN	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TOC	14	13	14	6	2	1	5	6	6	1	6	6	4	6
Ca	6.90	1.10	1.40	2.10	2.60	2.20	2.70	10.00	23.00	7.40	2.30	2.70	14.00	3.80
Fe	0.89	0.34	5.26	0.10	0.10	0.05	0.08	7.95	0.08	0.06	0.05	<0.05	0.12	0.09
Mg	1.50	1.20	1.50	1.00	1.00	1.80	3.90	2.20	2.50	2.90	0.50	1.00	8.00	1.80
Mn	1.76	<0.03	<0.03	<0.03	<0.03	<0.03	0.14	0.03	<0.03	0.05	<0.03	<0.03	3.31	0.26
Na	2.60	4.60	8.10	6.60	3.20	3.60	2.30	2.80	2.20	2.10	1.90	2.10	6.70	2.10
As	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.10	0.04	0.04	0.04	<0.02	0.02	0.02
Be	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cd	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cr	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cu	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	0.04	<0.03	<0.03	<0.03	0.03	<0.03	0.05	0.05	0.10	0.05	<0.03	<0.03	0.10	0.03
Pb	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	1.40	0.10	0.20	0.10	<0.10	1.59	<0.10	<0.10
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	0.13	0.07	0.07	0.08	0.27	0.11	0.18	0.07	0.34	0.23	0.15	0.08	0.13	0.15

ND = Not determined.

TABLE 21. RESULTS OF RANDOMIZATION TEST ON DISTILLED WATER EXTRACTS OF SOIL SAMPLES DIRECTLY UNDER THE LANDFILLS AND AT COMPARABLE DEPTHS OUTSIDE THE LANDFILLS

Parameters	Site A	Site B	Site C
SO ₄	S	S	S
SO ₃	N	N	N
Cl	N	S	S
NO ₃ -N	NS	NS	S
NO ₂ -N	N	N	N
CN	N	S	N
TOC	S	S	NS
Ca	NS	S	S
~~Fe~~	ND	S	S
Mg	S	NS	NS
Mn	N	S	NS
Na	S	S	NS
As	NS	ND	ND
B	N	S	NS
Be	N	N	N
Cd	N	N	N
Cr	S	S	N
Cu	S	N	N
Hg	ND	ND	ND
Ni	S	NS	NS
Pb	N	N	ND
Se	N	ND	ND
Zn	NS	N	S

N = Too few samples above detection limit.

ND = Not determined.

NS = Not significant at 80% level.

S = Significant at 80% level.

cannot be regarded as firm evidence of increased cyanide levels under the landfill at site B.

Total organic carbon (TOC) analyses show a pronounced difference between sub-landfill and control samples at both sites A and B. Samples below the landfills were consistently higher in TOC than those outside the landfill. All of the analyses under the landfills were well above the detection limits and at least double the analyses of control samples from outside the landfill. The groundwater analyses also indicated higher TOC levels in some borings beneath each landfill. These increased organic carbon levels can be attributed to material derived from the refuse.

Calcium levels in extracts from soils below the landfills at sites B and C are significantly lower than those extracts obtained from similar samples outside the landfills. However, calcium levels in the groundwater showed an increase under each landfill. These analyses indicate that the calcium availability is significantly decreased at sites B and C due to removal of soluble calcium compounds by landfill leachate or the production of insoluble calcium compounds by reaction with leachate.

Total iron levels were significantly different in soil extracts obtained below and outside the landfills at sites B and C. At site B the soil under the landfill showed more water-extractable iron than the soil samples outside the landfill. Site C showed the reverse trend. The availability of iron to contacting water is related to the redox conditions present, the complexing properties of organic materials in the soil, and the presence of anions such as sulfide, etc. that can produce insoluble iron compounds. The lack of extractable iron under the landfill at site C is consistent with the evidence of sulfate reduction discussed above.

Magnesium in water extracts showed a significant difference only at site A. Magnesium availability was only slightly higher in soil under the landfill than in soil outside the landfill.

Manganese levels were very slightly higher in soil extracts obtained under the landfill at site B as compared to samples outside the landfill. However, the observed levels are close to the analytical limits of detection.

Sodium in the water extracts showed a significant difference between control and experimental samples at sites A and B. At both sites, the available sodium increased under the landfill as compared to samples outside the landfill area. Sodium is a common constituent in municipal landfill leachate; it does not really precipitate and is only weakly adsorbed.

Boron and the trace metals chromium, copper and nickel show higher levels in water extracts from soils under the landfills as compared to soils outside the landfill. These elements may be either freed from the soil by organic acids from the leachate or introduced in a soluble form in the leachate.

Zinc levels obtained from water extracts of soil samples at site C showed significant differences between samples collected under the landfill and those collected outside the landfill. The extracts from outside the landfill were

slightly higher suggesting zinc was less available in the area affected by landfill leachate. Zinc is the only trace metal that could be shown to be extracted in greater concentrations outside the landfill than below the landfill. The immobilization of zinc may be related to sulfide production at site C.

The major factors that control availability of contaminants to a distilled water extract in sub-landfill soils studied are the supply of materials moving from the refuse to the soil, and the decrease in soluble constituents that occurs in the soil either due to leaching or production of insoluble compounds by reaction with leachate. Sulfate, if it is not reduced to sulfide, is more available under the landfill due to influx from the refuse. Chloride, total organic carbon, sodium and magnesium and all of the trace metals with the exception of zinc can appear in greater quantities in water extracts probably due to greater supply of these materials in a soluble form in the incoming leachate. Calcium in two cases showed a decrease of availability in sub-refuse soil possibly due to prior removal by solution or the formation of insoluble calcium compounds (possibly calcium salts of fatty acids). Iron and zinc at one site (site C) showed decreased availability in water extracts that can probably be attributed to formation of sulfides of these metals.

Vertical Variation of Constituents in the Distilled Water Extracts of Soil Samples

For those elements at each site that did show a significant difference in means between control (outside landfill) samples and experimental (inside landfill) samples, a test was made for a significant relationship between the available concentration of a particular constituent and sample elevation (or sample depth). The model suggests that those materials derived from the refuse would show a positive correlation with elevation in the experimental borings (below the landfill). Soil constituents that are being dissolved by the landfill leachate and moved down out of the soil and into the groundwater should, in the model situation, show a significant negative correlation with sample elevation. Outside the landfill the distribution of available soil constituents depends on weathering processes and the concentration and solubility of the particular material and could therefore have a significant positive or negative correlation with elevation, or no significant correlation at all.

The Spearman rank correlation was used to judge the strength of association because this technique could be used with small sample numbers where the statistical distribution is not known. In several cases, the small number of samples having detectable quantities of a particular constituent made it impossible to judge the significance of the correlation coefficients obtained. The results of the statistical tests are given in Tables 22-24. Plots of concentration versus sample elevation for all constituents that showed statistically significant relations with elevation in experimental borings are presented in Figures 7-18. Plots of significant relationships in control holes are included for contrast. The only significant correlation with sample elevation in borings through the landfill at site A (Borings 1, 2, and 3) involves total organic carbon. The correlation is positive as would be expected for a constituent derived from the refuse in the landfill. No significant correlation between sample elevation and total organic carbon could be observed in the control holes.

TABLE 22. CORRELATION OF CHEMICAL ANALYSES OF DISTILLED WATER EXTRACTS OF SOIL SAMPLES WITH SAMPLE ELEVATION AT SITE A

Boring No.	Experimental			Control	
	1	2	3	6	7
SO ₄	NS	NS	NS	SP	SN
TOC	SP	NS	NS	NS	NS
Mg	NS	NS	NS	NS	SN
Na	NS	NS	NS	SN	SP
Cr	*	*	*	*	*
Cu	*	*	*	*	*
Ni	NS	*	NS	*	*

SP = Significant positive correlation at 95% level.

SN = Significant negative correlation at 95% level.

NS = Not significant.

* = Too few samples above detection limit.

TABLE 23. CORRELATION OF CHEMICAL ANALYSES OF DISTILLED WATER EXTRACTS
OF SOIL SAMPLES WITH SAMPLE ELEVATION AT SITE B

Boring No.	Experimental			Control	
	1	2	3	5	6
SO ₄	---**	*	NS	*	*
Cl	--	*	*	NS	SN
CN	--	*	SP	*	*
TOC	--	SP	SP	NS	SN
Ca	--	NS	SN	SP	SN
Fe	--	SP	NS	NS	NS
Mn	--	NS	*	*	*
Na	--	SP	SP	SN	NS
B	--	SP	*	*	*
Cr	--	SP	*	*	*
Zn	--	SP	*	*	*

SP = Significant positive correlation at 95% level.

SN = Significant negative correlation at 95% level.

NS = Not significant correlation.

* = Too few samples above detection limits.

** = Too few samples for significant test for this boring.

TABLE 24. CORRELATION OF CHEMICAL ANALYSES OF DISTILLED WATER EXTRACTS OF SOIL SAMPLES WITH SAMPLE ELEVATION AT SITE C.

Boring No.	Experimental			Control	
	1	2	3	6	9
SO ₄	*	*	*	SP	NS
Cl	NS	NS	NS	NS	NS
NO ₃	NS	NS	NS	NS	NS
Ca	SN	SP	NS	NS	NS
Fe	NS	NS	*	NS	SP
Zn	SN	NS	NS	NS	NS

SP = Significant positive correlation at 95% level.

SN = Significant negative correlation at 95% level.

NS = Not significant.

* = Too few samples above detection limit.

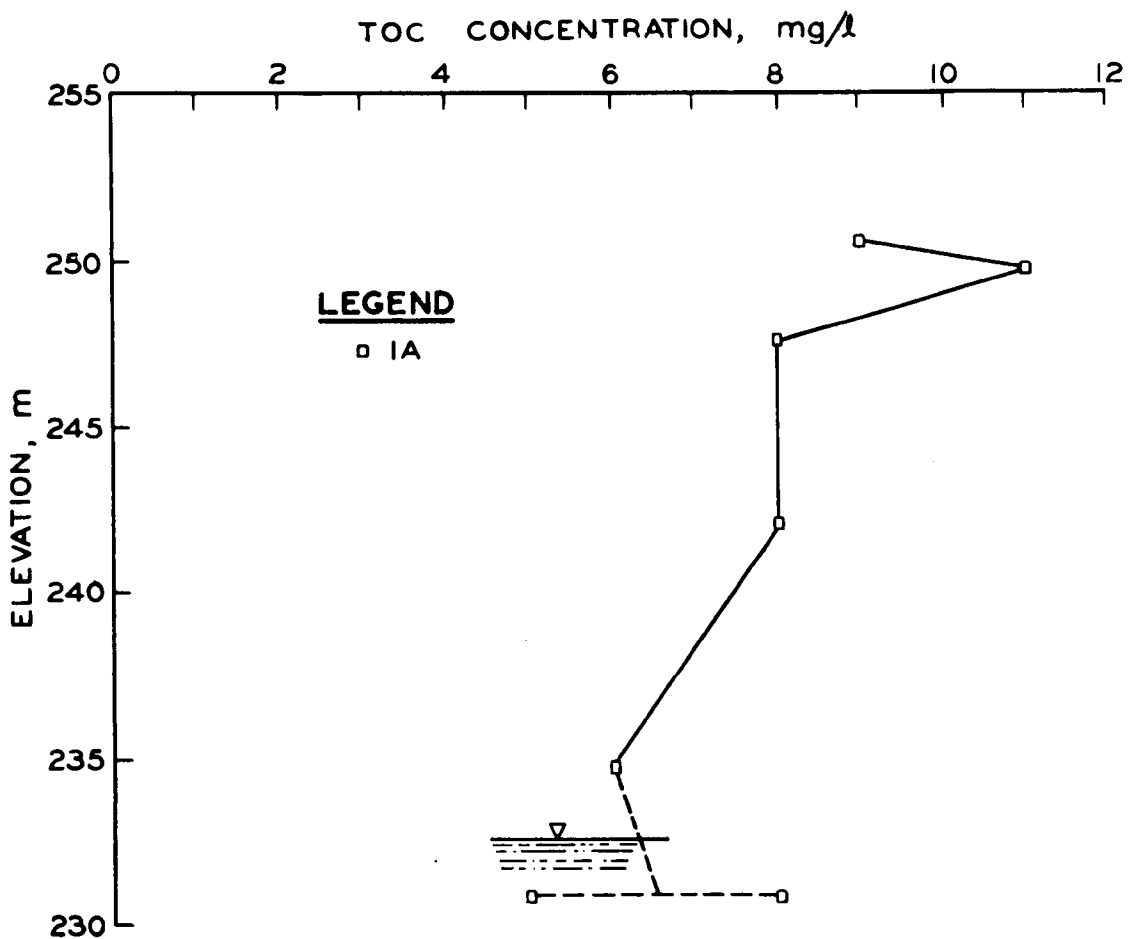


Figure 7. Variation of total organic carbon (TOC) concentration in distilled water extracts of soil/sediment samples with elevation in boring 1 at site A. Inverted triangle symbol indicates water table.

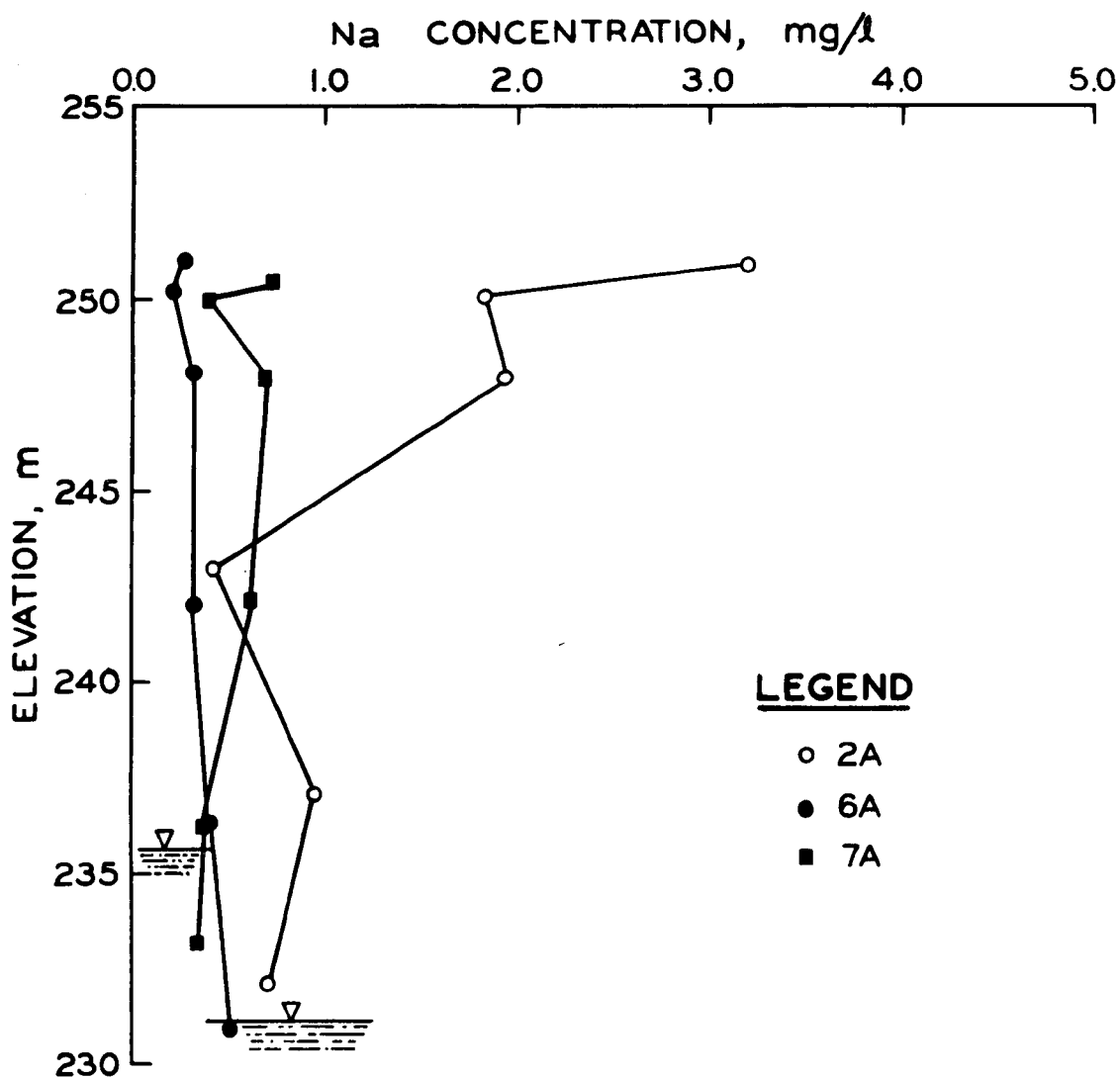


Figure 8. Variation of sodium concentration in distilled water extracts of soil/sediment samples with elevation in borings 2, 6, and 7 at site A. Inverted triangle symbols indicates water table in each boring.

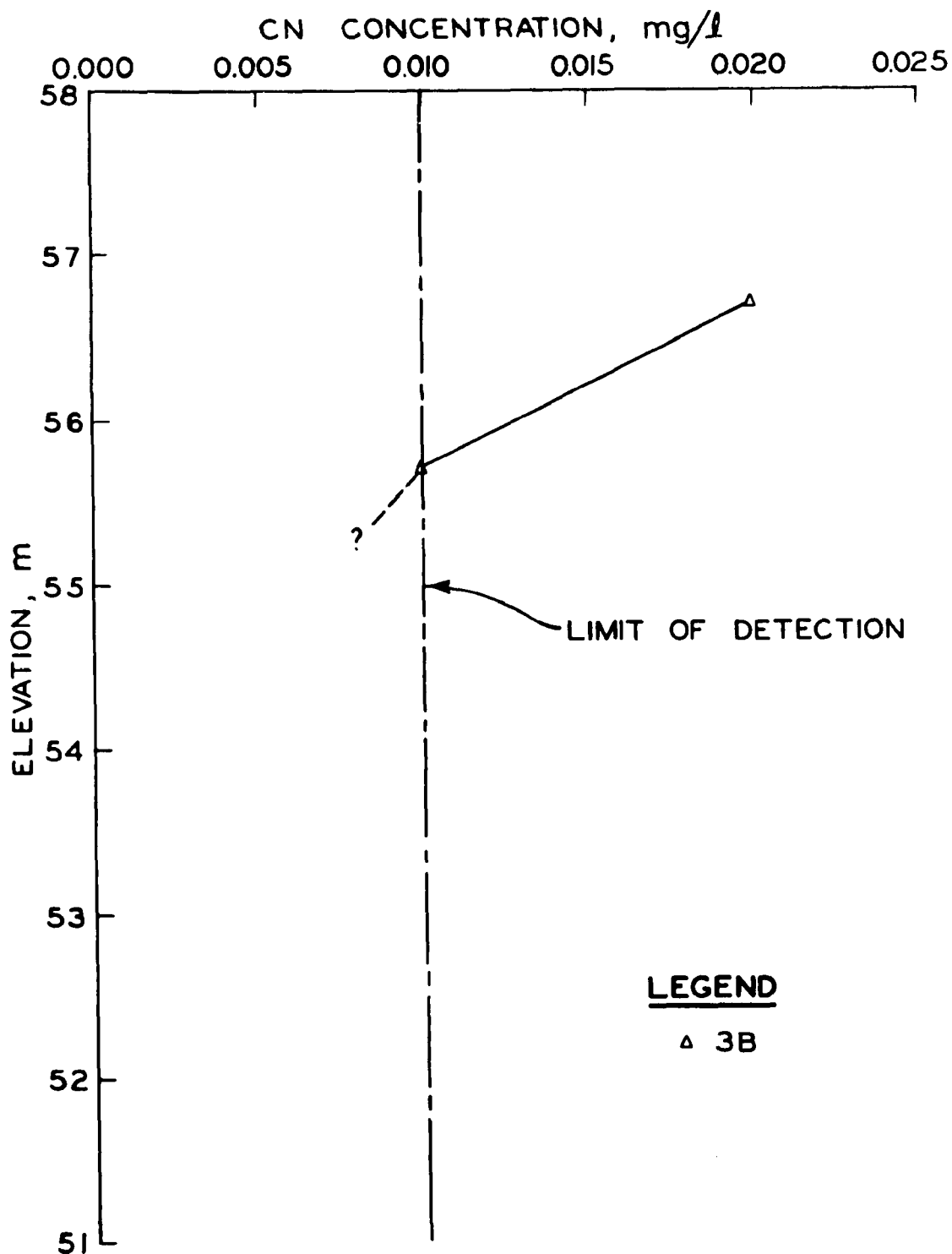


Figure 9. Variation of cyanide concentration in distilled water extracts of soil/sediment samples with elevation in boring 3 at site B.

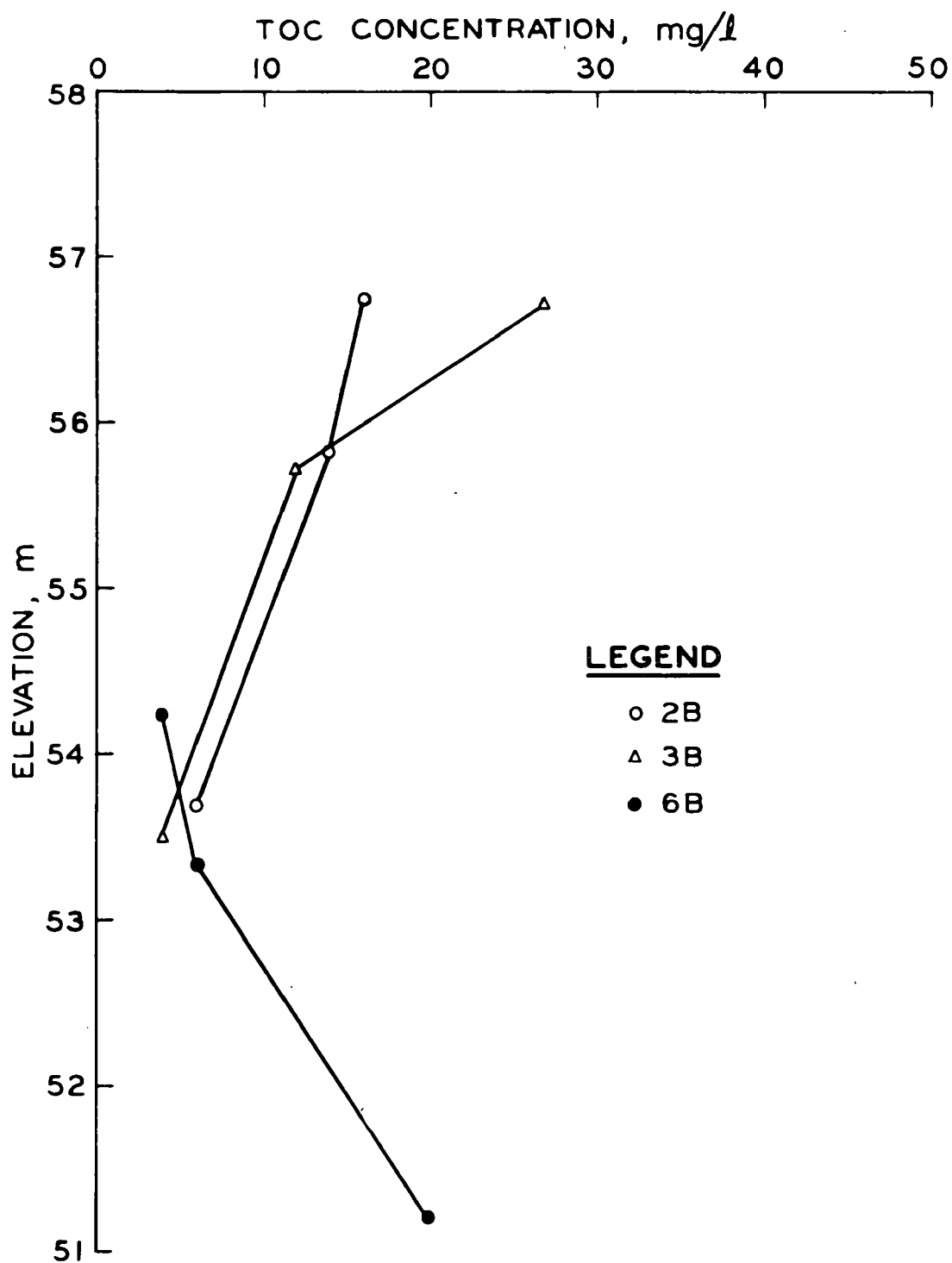


Figure 10. Variation in total organic carbon (TOC) concentration in distilled water extracts of soil/sediment samples with elevation in borings 2, 3, and 6 at site B.

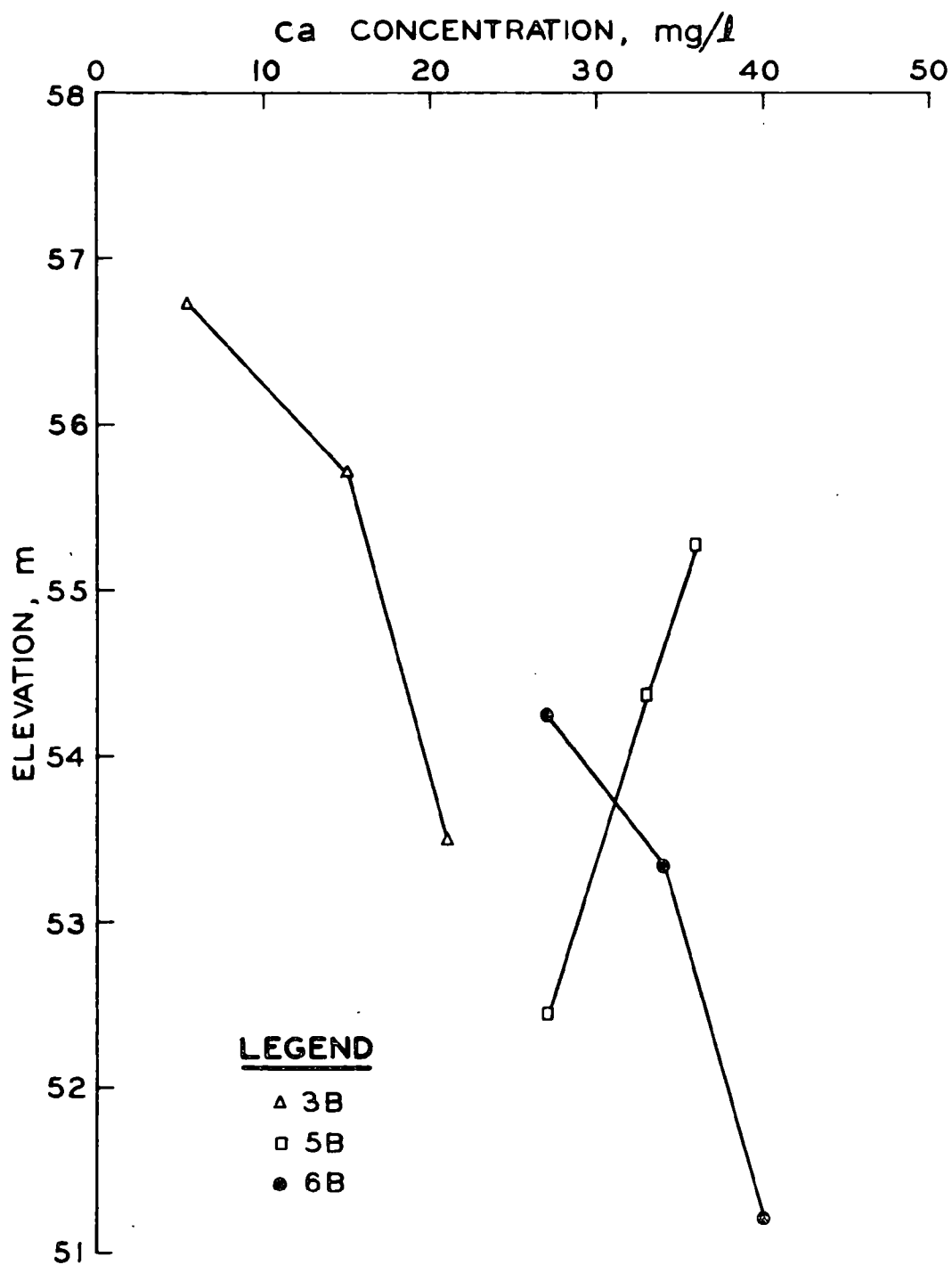


Figure 11. Variation of calcium concentration in distilled water extracts of soil/sediment samples with elevation in borings 3, 5, and 6 at site B.

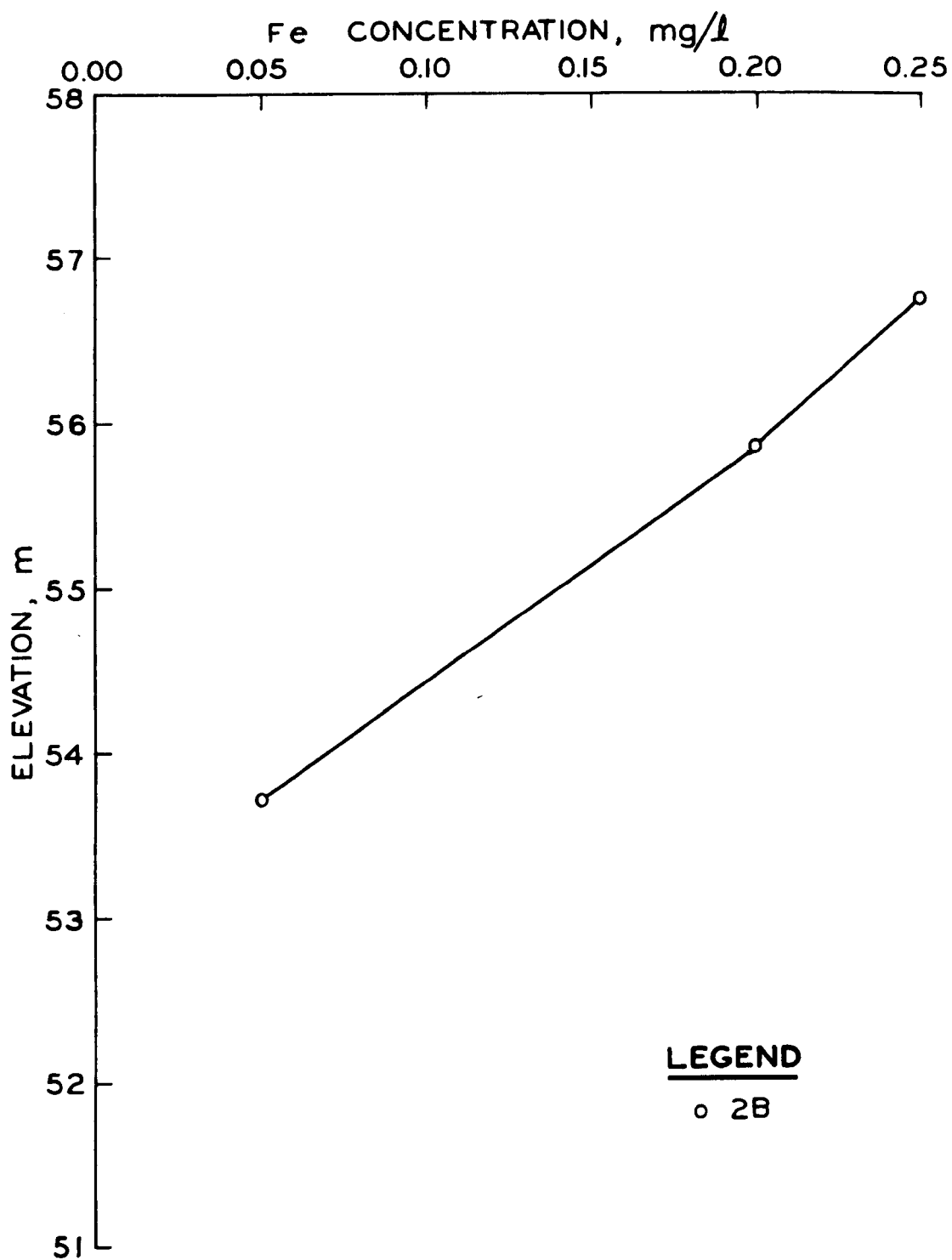


Figure 12. Variation of iron concentration in distilled water extracts of soil/sediment samples with elevation in boring 2 at site B.

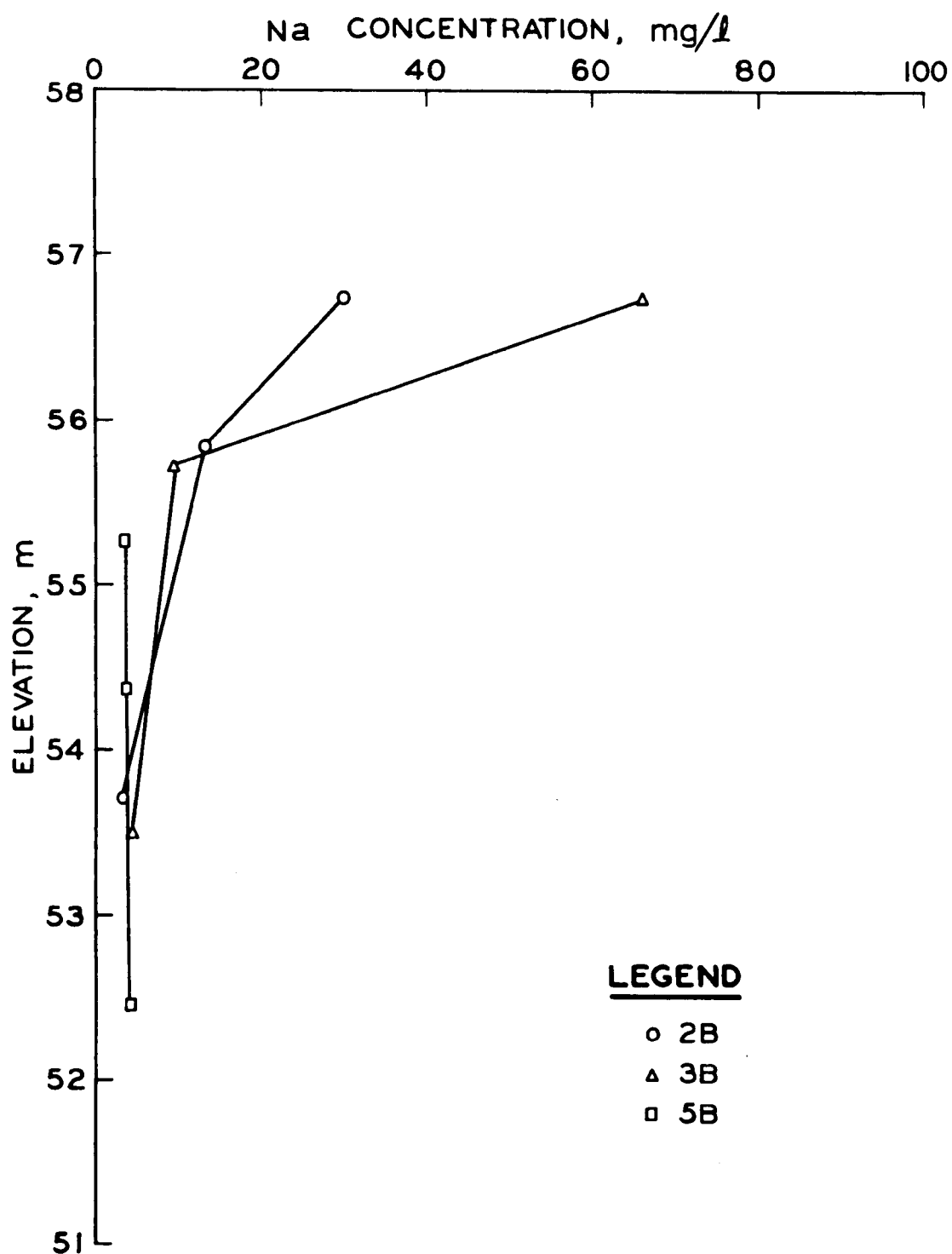


Figure 13. Variation of sodium concentration in distilled water extracts of soil/sediment samples with elevation in borings 2, 3, and 5 at site B.

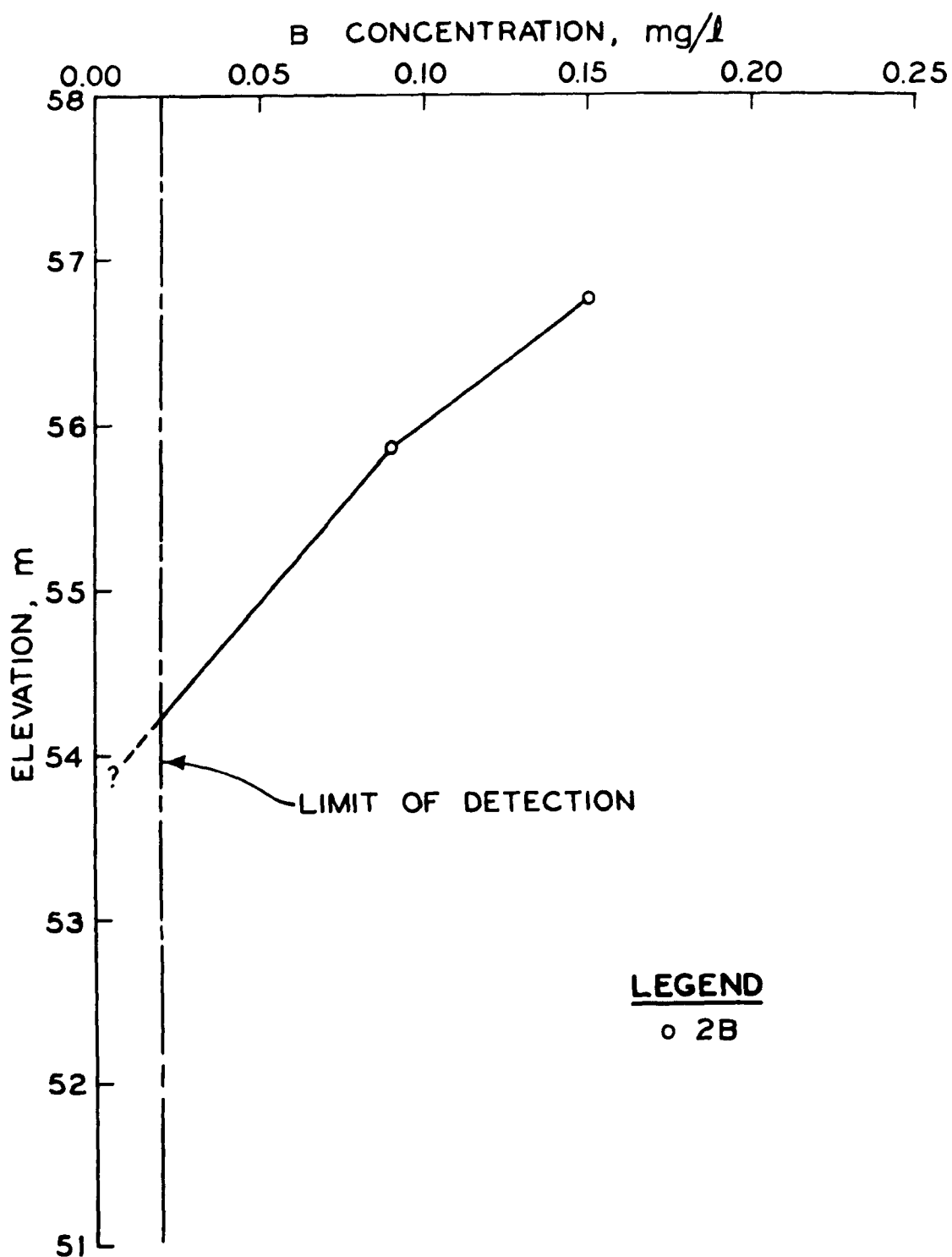


Figure 14. Variation of boron concentration in distilled water extracts of soil/sediment samples with elevation in boring 2 at site B.

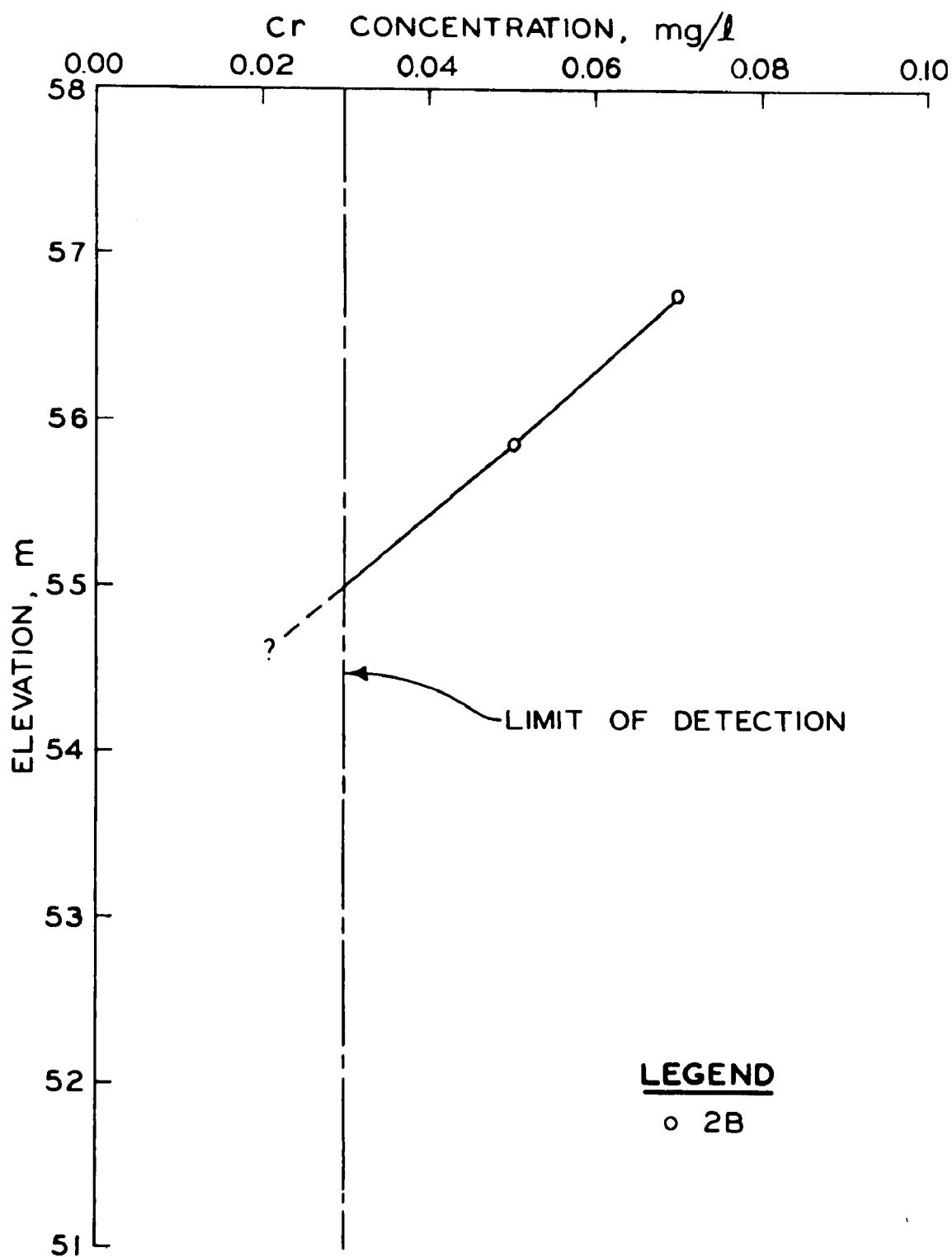


Figure 15. Variation of chromium concentration in distilled water extracts of soil/sediment samples with elevation in boring 2 at site B.

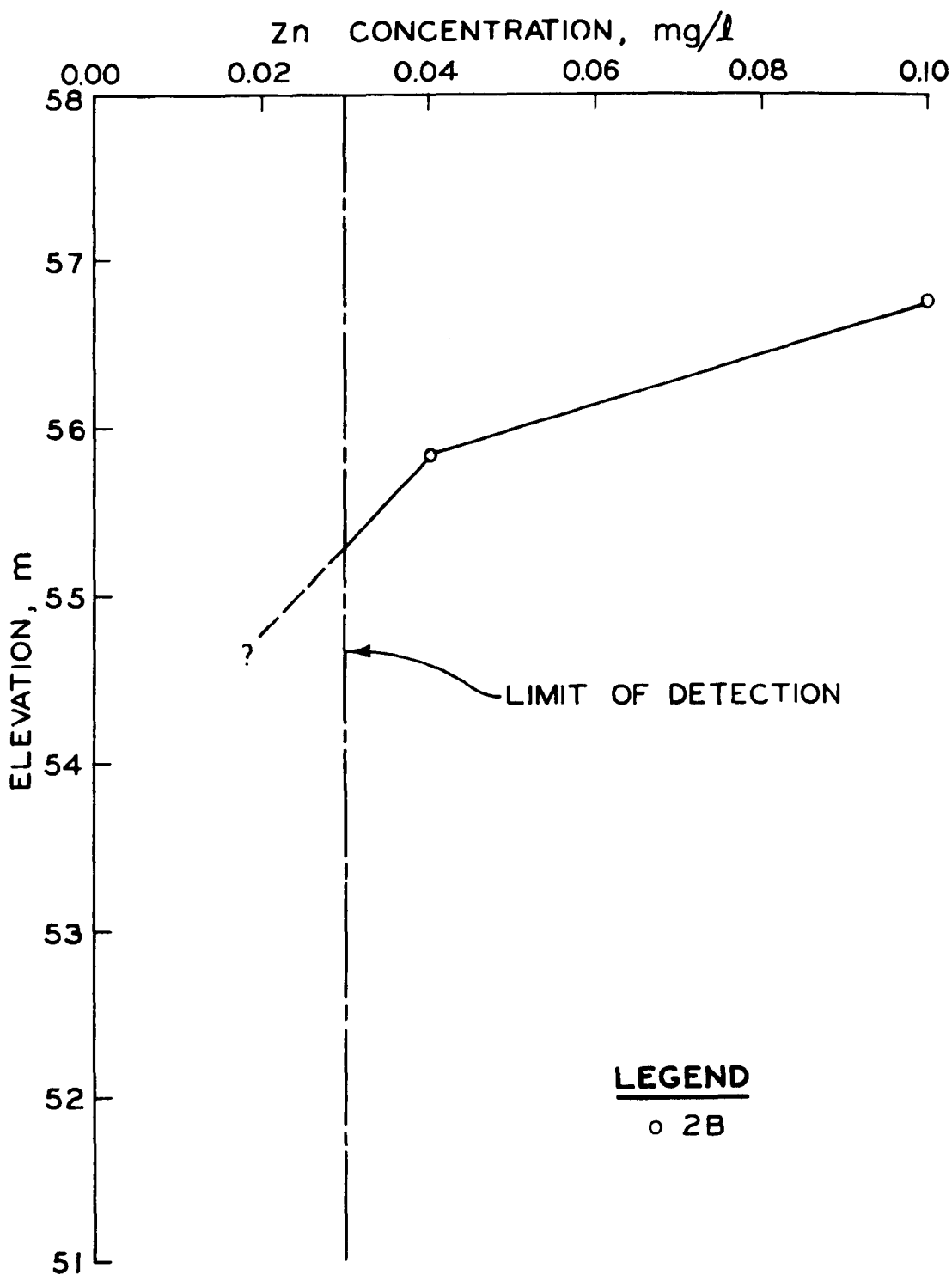


Figure 16. Variation of zinc concentration in distilled water extracts of soil/sediment samples with elevation in boring 2 at site B.

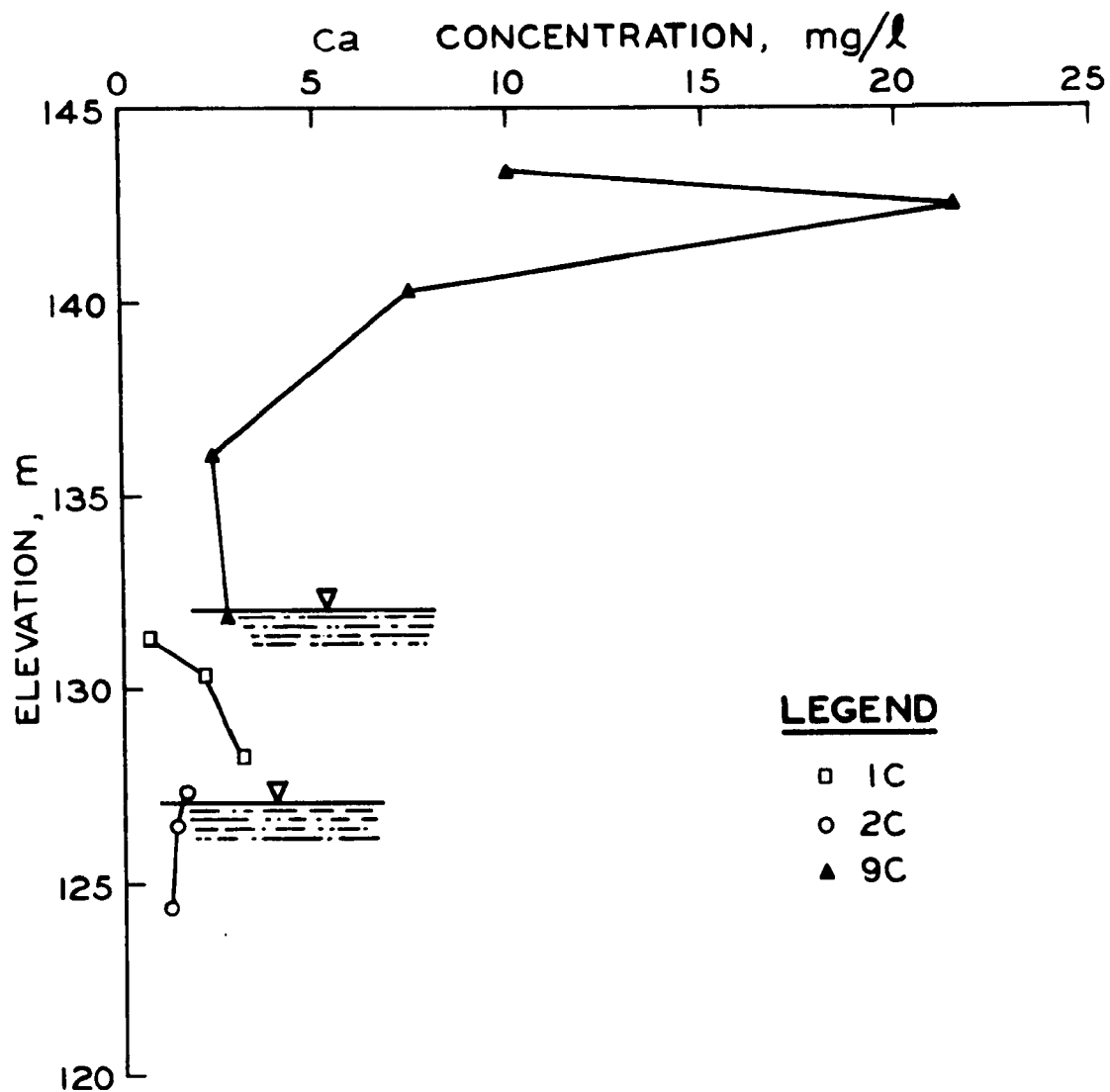


Figure 17. Variation of calcium concentration in distilled water extracts of soil/sediment samples with elevation in borings 1, 2, and 9 at site C. Inverted triangle symbols indicate water table in each boring.

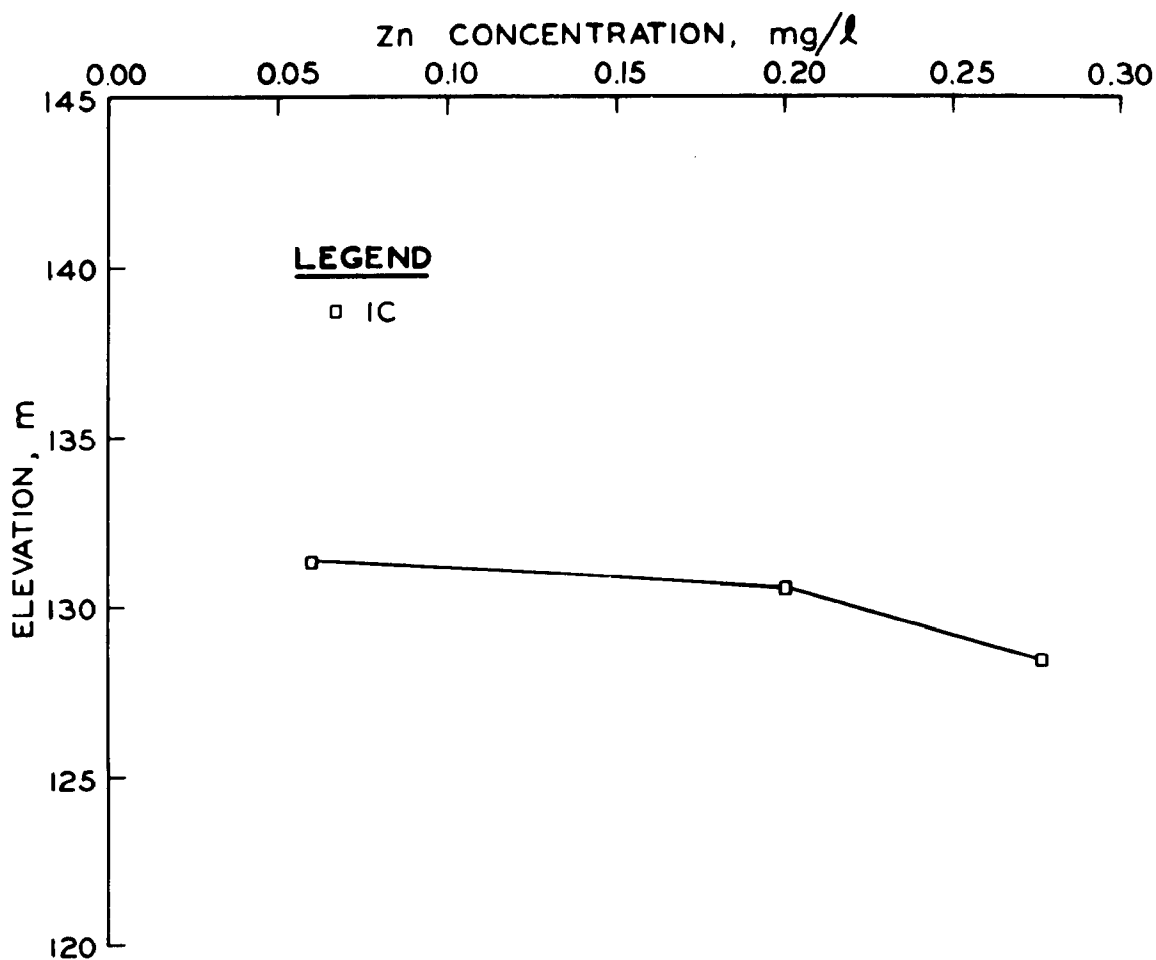


Figure 18. Variation of zinc concentration in distilled water extracts of soil/sediment samples with elevation in boring 1 at site C.

At site B, significant positive correlations with sample elevation were observed with cyanide, total organic carbon, iron, sodium, boron, chromium, and zinc. A positive correlation is expected for constituents derived from the landfill. The control holes showed significant correlations with depth only for total organic carbon and sodium. Both of these correlations were negative indicating these constituents were being leached away in a normal weathering situation.

Calcium at site B showed a significant negative correlation with sample elevation in borings under the landfill. Calcium is probably being leached away or is forming less soluble compounds under the landfill. In control holes both significant positive and negative correlations with depth are found.

At site C, zinc showed a significant negative correlation with elevation under the landfill indicating that it is becoming more available with increasing depth. Control holes indicated no significant relationship in zinc content between water extracts and elevation. Calcium showed a positive correlation with elevation in one of the holes through the landfill and a negative correlation in a second hole indicating there may be both an increase and decrease in calcium availability under the landfill. This may be due to the variation in the age or character of refuse placed in different parts of the landfill. No significant relationship between sample depth and calcium concentration in water extracts could be seen in the control holes.

Patterns observed in the composition of distilled water extracts for samples taken from these landfill areas indicate that the availability of total organic carbon, iron, sodium, boron, and chromium to contacting waters increases under a landfill. The availability of calcium generally decreases under the landfill at site C.

Griffin and others (15) demonstrated that municipal leachate can remove calcium from clays. Calcium was the major exchangeable cation present in the clays used in their experimental leachate attenuation system and was displaced by other cations from the leachate such as sodium, or ammonium ion. The calcium level was higher in the effluent coming out of the clays than in the original leachate. Municipal leachate is mildly acid and contains carbon dioxide in solution. Calcium in the soil in the form of carbonate could be taken directly into solution by the leachate and removed from the soil below the refuse.

Horizontal Variation in Distilled Water Extracts of Sediment/Soil Samples Near the Water Table

According to the model for leachate movement under a landfill (Figure 1) horizontal movement of contaminants takes place below the water table. The model suggests that upgradient samples should have low levels of contamination. The highest levels of contamination should occur below the landfill, and a gradual decrease should occur down the groundwater gradient from the landfill. The decrease in contaminant concentration is related to the dilution effects of the groundwater and the filtration and adsorption in the soil/sediment. The distilled water extracts measure availability of the chemical constituents

to contacting water. The concentration of any constituent in the distilled water extract depends not only on the amount of contaminant present; but also on the solubility of the contaminant under the pH and redox conditions present in the soil/sediment sample. Chemical analyses of distilled water extracts of soil samples collected near the existing water table were examined to determine if any pattern of contaminant distribution in the extracts could be related to the direction of movement of groundwater.

The number of samples available at each site was too small to allow the use of analysis of variance. Graphs showing concentration of various constituents versus relative position of the boring with respect to the landfill are given in Figures 19-21.

At site A, maximum levels for sulfate, nitrite, total organic carbon (TOC), calcium, magnesium, sodium, arsenic, cadmium, nickel and zinc occurred in distilled water extracts taken from samples under the landfill. The amounts available decreased down the groundwater flow gradients. This is the pattern expected for materials added from the refuse. Manganese levels were below detection limits under the landfill at site A and increased downgradient from the landfill. The unusually low levels of manganese below the landfill may be related to its chemical reduction to the soluble manganous ion and its loss into water percolating through the soil.

At site B, maximum levels for sulfate, cyanide, TOC, iron, manganese, boron and chromium were observed in distilled water leaches from samples taken under the landfill. Chloride showed a maximum level in a boring located up-gradient from the fill. Chloride may be depleted under the fill due to slightly increased infiltration through the refuse. Calcium, magnesium, sodium, nickel, lead, and zinc showed maximum levels in the distilled water leaches in downgradient wells. The maxima observed in downgradient wells may represent materials transported in the groundwater and deposited in surrounding soil.

At site C, the maximum levels for nitrate, TOC, calcium, iron, magnesium, manganese, sodium, and boron were all found in extracts from borings down the groundwater gradient from the landfill. No maxima were found under the landfill. Lead and zinc were both more concentrated in distilled water leaches from sediment/soil samples obtained from upgradient borings. The high levels in downgradient holes may represent materials displaced from the landfill and moved downgradient. Lead and zinc may have been made less soluble in the sub-landfill and downdip holes by precipitation in some insoluble form such as sulfide.

There is evidence at sites B and C of displacement of materials from the area under the refuse down the groundwater flow gradient. In slow flow through a porous medium such as sediment/soil, some separation of constituents can be expected due to differing affinities for the solid phases present (clays carbonates, etc.) and participation in solution/precipitation reactions. Zones of high concentrations of various contaminants (as seen in water extractions) may be displaced by this type of chromatographic activity. Recharge events such as heavy rainfall at the landfill may further add to the uneven pattern observed in contaminant distribution. The sulfides associated with some of

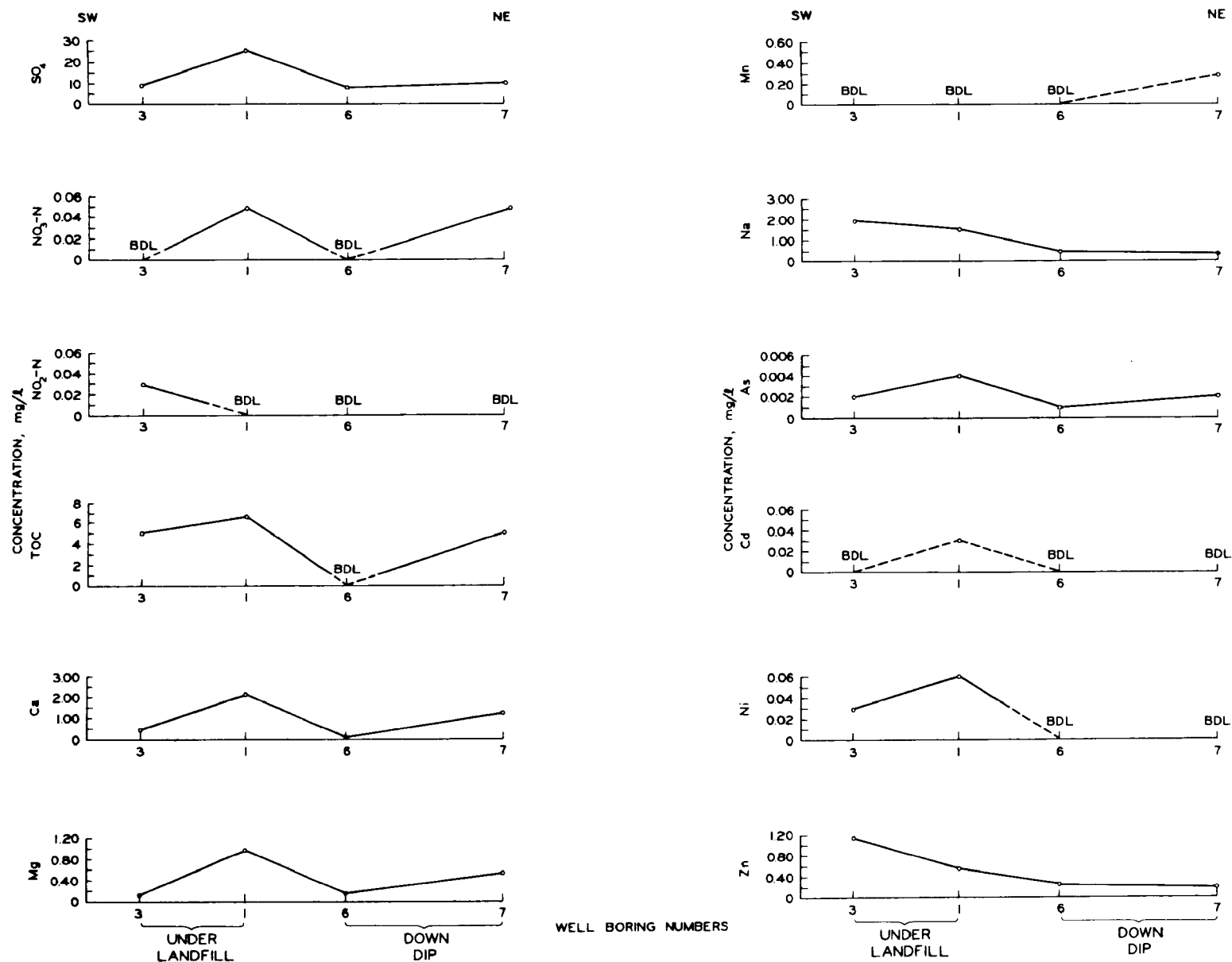


Figure 19. Horizontal variation in chemical composition of distilled water extracts at site A. BDL indicates below detection limits.

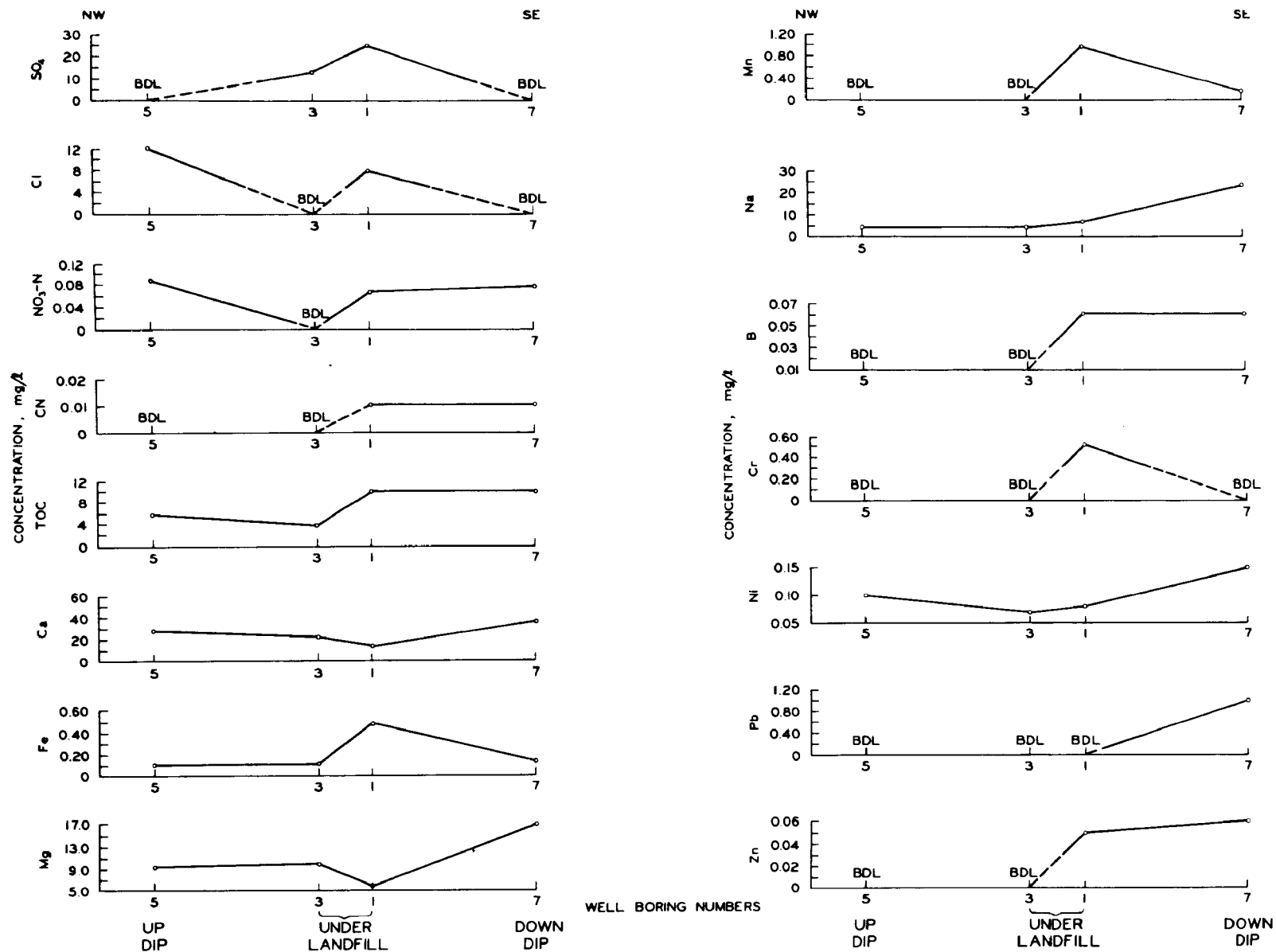


Figure 20. Horizontal variation in chemical composition of distilled water extracts at site B. BDL indicates below detection limits.

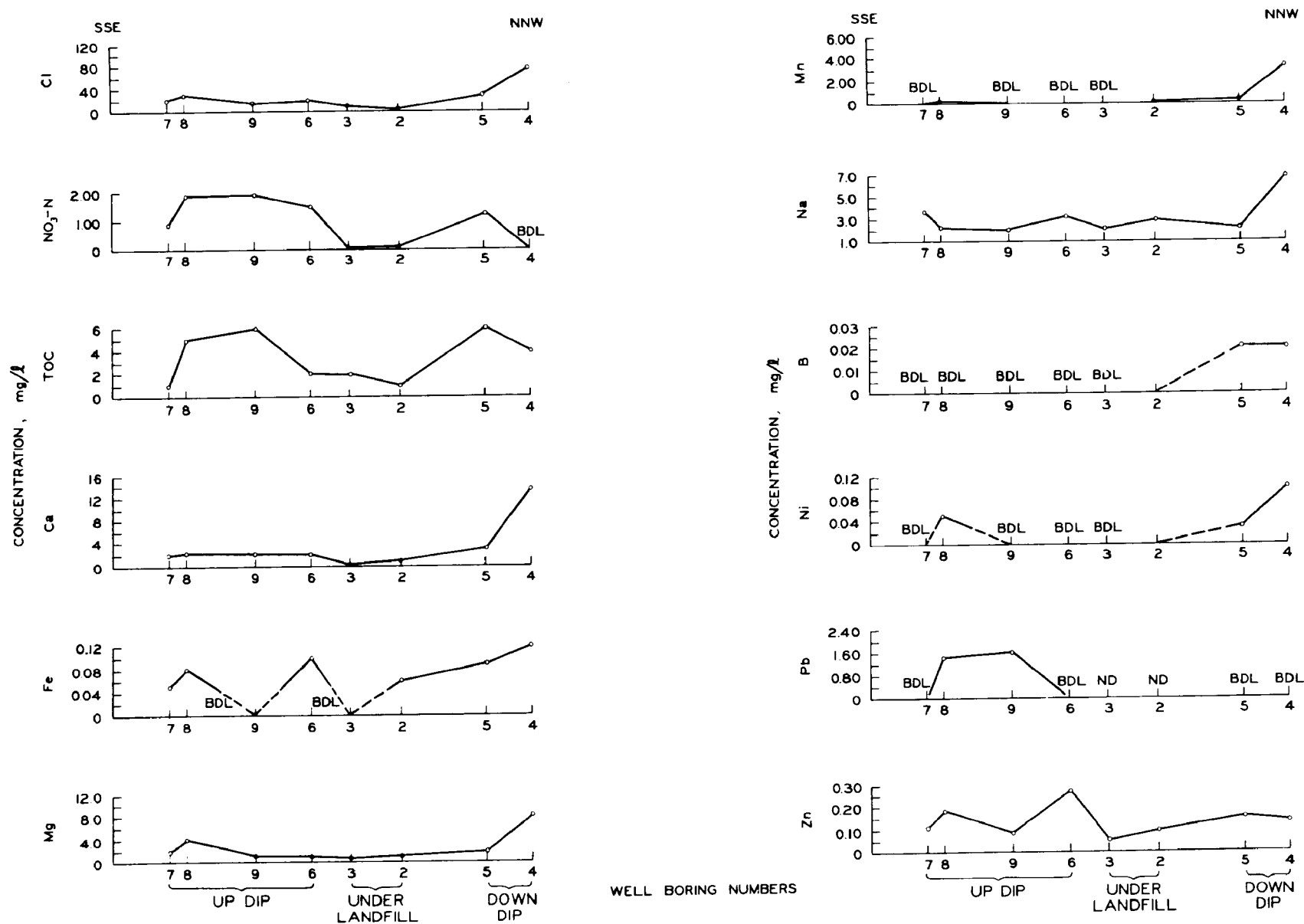


Figure 21. Horizontal variation in chemical composition of distilled water extracts at site C. BDL indicates below detection limits.

the landfills may also reduce the level of some metals in water extracts below the concentrations found in sediment/soil samples up the groundwater gradient from the landfill.

CHEMICAL ANALYSES OF NITRIC ACID EXTRACTS

The goal of the nitric acid digest was to determine the concentration of pollutants that could be released under the most extreme conditions of weathering. The concentration of materials in the nitric acid digest depends upon:

- a) the original constituents in the soil and their reactivity with the hot acid,
- b) the extent to which water-soluble and leachate-soluble materials have been removed from the soil by solution in rainwater or leachate, and,
- c) the solubility in acid of materials which have been precipitated, filtered or absorbed from the leachate passing through the soil.

The analyses of nitric acid digests are given in Tables 25-30. The analytical results are expressed in milligrams per kilogram dry weight of sample.

Comparison of Nitric Acid Digests from Beneath and Outside the Landfills

Soil samples from directly below the landfill (experimental samples) and samples taken at comparable depths outside the landfill (control samples) were digested in nitric acid and the digests were analyzed for selected cations. Care was taken to select samples outside the landfill that were above the water table so that the samples were not contaminated by horizontal movement of leachate from the landfill.

A randomization test was used to evaluate the significance of any differences in means observed between experimental samples and control samples. This procedure was used to avoid the assumption of normal distribution and homogeneous variance required by the more commonly used t-test. With the small sample size, five samples at each site, the highest level of significance that could be assigned to a two-tailed, randomization test was 80%. The results of the randomization tests are presented in Table 31.

In the majority of cases, the nitric acid digests of soil samples from below the landfills showed higher metal content than the nitric acid digest of soil outside the landfills. The increased metal content in the soil represents material filtered, absorbed or precipitated from the leachate (i.e. attenuated) on its contact with the sub-landfill soil.

At site A, significant differences in concentration in the acid digests of samples beneath and outside the landfill occurred with arsenic, boron, beryllium, nickel and selenium. Boron and beryllium showed higher concentrations in the nitric acid digests from samples taken from below the landfill. The levels of arsenic, nickel and selenium in the sub-landfill soil were

TABLE 25. ANALYSES OF NITRIC ACID DIGESTS OF SOIL SAMPLES FROM EXPERIMENTAL BORINGS AT SITE A

Boring and sample	1C1	1C2	1C3	1C4	1C5	1C6	1C7	2C1	2C2	2C3
Elev (m)	250.57	249.77	247.58	242.08	234.81	230.83	230.83	250.98	250.14	247.99
Depth below mw/soil interface (m)	0.00	0.82	3.02	8.52	15.78	19.77	19.77	0.00	0.84	2.99
Ht above water table (m)	18.06	17.24	15.05	9.55	2.28	-1.70	-1.70	19.97	19.13	16.98
Conc. (mg/kg dry wt)										
Fe	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mn	302.25	399.52	444.63	462.02	593.04	287.36	320.14	894.94	374.26	579.75
As	0.10	0.17	0.15	0.14	0.14	0.22	0.17	0.16	0.14	0.14
B	2.90	4.10	3.54	2.99	2.10	2.87	1.60	2.07	1.29	1.63
Be	0.07	0.11	0.08	0.09	0.11	0.30	0.09	0.08	0.06	0.07
Cd	0.27	0.42	0.35	0.49	0.41	0.47	0.36	0.29	0.28	0.30
Cr	2.96	2.73	3.13	2.85	2.58	5.75	2.02	2.96	1.94	2.90
Cu	8.06	6.52	8.65	7.34	9.95	10.54	6.74	9.77	5.42	10.99
Hg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ni	5.04	5.57	6.01	6.79	5.93	6.70	4.38	5.23	4.00	5.80
Pb	25.19	17.87	26.35	16.31	21.04	28.74	21.90	11.34	12.26	8.48
Se	0.32	0.46	0.53	0.68	0.44	0.50	0.39	0.26	0.40	0.34
Zn	17.95	10.93	10.54	7.88	7.36	11.97	8.17	7.44	6.13	7.97

(continued)

TABLE 25. (continued)

Boring and sample	2C4	2C5	2C6	3C1	3C2	3C3	3C4	3C5	3C6
Elev (m)	243.00	237.11	232.08	250.53	249.53	247.60	240.27	235.72	230.73
Depth below mw/soil interface (m)	7.99	13.87	18.90	0.00	1.00	2.93	10.26	14.81	19.80
Ht. above water table (m)	11.99	6.10	1.07	19.31	18.31	16.38	9.05	4.50	-0.49
Conc. (mg/kg dry wt)									
Fe	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mn	340.26	618.55	366.97	312.12	1015.93	741.15	410.14	356.57	209.50
As	0.14	0.16	0.16	0.16	0.47	0.40	0.26	0.28	0.19
B	1.24	1.29	0.86	1.35	1.39	1.50	0.75	0.84	1.00
Be	0.06	0.06	0.10	0.11	0.08	0.07	0.06	0.06	0.05
Cd	0.24	0.30	0.22	0.33	0.32	0.32	0.27	0.28	0.22
Cr	2.27	2.45	1.65	2.48	2.99	3.44	2.61	2.34	1.86
Cu	6.80	10.44	8.13	7.38	7.17	9.75	8.70	9.02	7.86
Hg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ni	4.76	5.54	4.16	5.25	5.84	6.24	5.59	4.90	4.00
Pb	9.64	11.60	10.40	12.77	11.83	11.70	12.43	10.03	9.05
Se	0.27	0.30	BDL	0.31	0.31	0.32	0.31	0.28	0.27
Zn	6.24	12.50	6.18	36.18	54.97	7.80	6.84	6.68	10.23

BDL = Below detection limits.

ND = Not determined.

TABLE 26. ANALYSES OF NITRIC ACID DIGESTS OF SOIL SAMPLES FROM CONTROL BORINGS AT SITE A

Boring and sample	6C1	6C2	6C3	6C4	6C5	6C6	7C1	7C2	7C3	7C4	7C5	7C6
Elev (m)	251.09	250.20	248.08	242.05	236.86	230.84	250.49	250.15	247.99	242.23	236.37	233.32
Ht. above water table (m)	19.99	19.10	16.98	10.95	5.76	-0.26	14.97	14.63	12.47	6.71	-0.85	-2.20
Conc. (mg/kg dry wt)												
Fe	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mn	566.29	503.83	546.34	417.92	632.26	295.05	447.30	561.80	986.56	810.06	72.08	96.42
As	0.51	0.64	0.60	0.49	0.55	0.50	0.41	0.50	0.75	0.51	0.26	0.24
B	1.08	1.08	1.34	0.82	0.86	0.72	0.95	1.24	1.50	1.29	0.79	0.56
Be	0.06	0.07	0.07	0.07	0.07	0.05	0.07	0.06	0.06	0.07	0.04	0.05
Cd	0.27	0.27	0.27	0.29	0.28	0.19	0.31	0.33	0.27	0.35	0.30	0.24
Cr	2.95	3.32	3.46	2.88	3.23	1.79	2.78	3.66	7.52	3.86	0.92	0.81
Cu	7.83	9.76	10.26	9.59	11.46	6.75	7.05	9.21	12.45	12.02	0.92	1.67
Hg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ni	5.72	6.38	6.07	6.17	6.45	3.84	5.96	6.73	7.28	7.91	1.44	1.41
Pb	8.43	10.85	8.92	9.59	9.87	7.15	11.52	12.41	8.93	12.22	6.55	6.00
Se	0.36	0.36	0.31	0.30	0.32	0.25	0.36	0.27	0.34	0.29	0.43	0.46
Zn	7.59	8.54	17.28	8.22	9.48	4.52	6.78	10.06	9.67	10.22	2.29	1.71

Note: All borings are positioned downdip on the groundwater gradient.

BDL = Below detection limits.

ND = Not determined.

TABLE 27. ANALYSES OF NITRIC ACID DIGESTS OF SOIL SAMPLES FROM EXPERIMENTAL BORINGS AT SITE B

Boring and sample	1C1	1C2	2C1	2C2	2C3	3C1	3C2	3C3
Elev (m)	55.93	54.06	56.77	55.85	53.72	56.74	55.74	53.50
Depth below mw/soil interface (m)	0.00	1.87	0.00	0.92	3.05	0.00	1.00	3.24
Ht above water table (m)	1.57	-0.30	5.83	4.91	2.78	5.51	2.51	0.27
Conc. (mg/kg dry wt)								
Fe	18007.	15241.	14425.	15552.	11351.	17246.	10028.	12099.
Mn	945.76	1443.93	559.55	450.69	342.08	505.12	343.56	306.60
As	4.81	4.30	5.25	3.84	2.10	4.43	1.75	1.19
B	5.63	4.53	6.96	6.57	5.14	8.66	5.39	6.78
Be	1.05	1.03	1.76	1.74	1.41	1.70	1.57	1.56
Cd	0.15	0.54	0.23	0.21	0.15	0.43	0.19	0.13
Cr	8.78	7.49	7.46	9.19	7.60	8.08	7.83	7.60
Cu	13.47	12.30	11.31	9.61	8.68	11.55	10.16	11.47
Hg	0.08	0.08	0.04	0.03	0.02	0.04	0.05	0.03
Ni	21.56	22.26	29.23	21.70	17.87	22.37	20.38	25.33
Pb	10.59	9.36	58.46	8.30	7.19	8.66	7.76	7.60
Se	2.95	2.95	2.20	1.52	1.28	1.80	1.94	1.65
Zn	50.54	61.23	54.28	45.97	38.47	57.72	40.11	39.28

TABLE 28. ANALYSES OF NITRIC ACID DIGESTS OF SOIL SAMPLES FROM CONTROL BORINGS AT SITE B

Boring and sample		5C1	5C2	5C3	6C1	6C2	6C3	7C3
Elev (m)		55.28	54.38	52.44	54.26	53.35	51.22	42.00
Ht. above water table (m)		1.93	1.03	-0.91	4.11	3.20	1.07	0.10
Position in groundwater gradient		updip	updip	updip	updip	updip	updip	downdip
Conc. (mg/kg dry wt)								
Fe		13054.	11336.	13214.	12924.	13486.	8692.	4062.
Mn		497.27	352.03	233.26	428.78	445.18	113.75	2784.25
As		3.95	3.04	2.46	3.04	3.41	0.89	BDL
B		7.32	5.55	5.78	5.12	5.54	3.68	73.73
Be		1.77	1.52	1.51	1.46	1.80	1.26	1.20
Cd		0.26	0.18	0.16	0.20	0.22	0.25	0.21
Cr		7.80	6.62	9.79	6.64	8.48	8.00	15.00
Cu		9.88	9.72	9.57	8.01	9.13	9.04	23.25
Hg		0.06	0.04	0.03	0.02	0.03	0.03	BDL
Ni		29.72	24.58	24.29	23.77	26.90	21.86	32.12
Pb		7.73	7.75	7.49	7.60	7.97	6.95	39.54
Se		3.00	2.03	1.12	1.52	0.94	1.44	BDL
Zn		42.68	39.26	37.77	35.83	48.00	35.91	42.23

TABLE 29. ANALYSES OF NITRIC ACID DIGESTS OF SOIL SAMPLES FROM EXPERIMENTAL BORINGS AT SITE C

Boring and sample	1C1	1C2	1C3	2C1	2C2	2C3	3C1	3C2	3C3
Elev (m)	131.41	130.48	128.34	127.46	126.55	124.41	125.50	124.57	123.20
Depth below mw/soil interface (m)	0.00	0.93	3.07	0.00	0.91	3.05	0.00	0.93	2.30
Ht. above water table (m)	4.40	3.47	1.33	0.20	-0.71	-2.85	2.48	1.55	0.18
Conc. (mg/kg dry wt)									
Fe	25871.0	24824.	23065.	22119.	28710.	24573.	27563.	24723.	36287.
Mn	869.23	585.91	431.75	386.14	642.77	339.37	710.84	409.30	84.28
As	0.52	0.72	0.48	0.52	0.72	0.52	0.76	0.77	0.73
B	226.31	230.89	217.17	209.19	235.07	207.82	232.60	210.14	292.87
Be	1.36	1.36	1.89	2.03	1.47	1.27	0.90	0.79	1.94
Cd	2.08	2.22	2.12	2.24	1.93	1.77	2.00	1.74	2.92
Cr	19.29	21.82	16.79	15.42	10.65	9.59	9.38	16.13	11.36
Cu	40.22	34.17	45.87	55.36	42.36	41.56	11.12	31.11	17.71
Hg	0.03	0.05	0.02	0.03	0.03	0.05	0.04	0.04	0.03
Ni	28.29	29.10	36.13	33.94	32.93	34.03	10.40	15.60	14.79
Pb	21.71	21.35	18.71	23.51	22.83	17.08	18.09	17.86	18.79
Se	0.57	0.50	0.39	0.37	0.39	0.16	0.16	0.37	0.31
Zn	60.07	66.07	78.78	96.69	91.21	85.41	31.38	35.30	55.79

TABLE 30. ANALYSES OF NITRIC ACID DIGESTS OF SOIL SAMPLES FROM CONTROL BORING AT SITE C

Boring and sample	6C1	6C2	6C3	6C4	6C5	7C4	8C3	9C1	9C2	9C3	9C4	9C5	4C6	5C4
Elev (m)	132.46	131.54	129.41	127.88	126.06	121.80	130.14	143.47	142.57	140.44	136.17	131.91	124.74	126.92
Ht. above water table (m)	5.42	4.50	2.37	0.84	-0.98	0.09	-0.36	11.47	10.57	8.44	4.17	-0.09	-0.66	-0.12
Position in groundwater gradient	Updip	Updip	Updip	Updip	Updip	Updip	Updip	Updip	Updip	Updip	Updip	Updip	Downdip	Downdip
Conc. (mg/kg dry wt)														
Fe	17938.	22378.	12745.	30634.0	12124.7	18140.	15277.	21340.	20419.	23658.	22352.	15584.	23137.	12719.
Mn	46.21	13.90	20.85	160.59	194.73	121.83	231.70	118.74	71.71	110.27	210.50	76.39	655.94	149.64
As	1.12	0.97	0.49	0.75	0.54	0.81	0.53	1.14	0.89	0.41	0.57	0.79	0.72	1.49
B	180.68	337.89	141.55	298.24	102.35	137.00	116.13	180.03	182.31	205.84	211.94	122.23	182.29	107.47
Be	0.54	0.66	1.05	2.26	0.84	0.95	1.97	0.69	1.05	0.89	1.10	0.92	1.39	1.12
Cd	1.89	3.10	1.60	2.96	2.08	2.12	1.90	2.10	2.28	2.55	2.42	2.14	2.30	1.50
Cr	14.10	19.28	7.87	9.99	10.60	15.54	7.72	14.01	10.63	14.63	8.39	5.02	13.79	14.2
Cu	11.50	17.67	24.14	46.33	15.22	21.93	15.28	18.99	49.95	51.26	29.37	16.58	37.63	63.12
Hg	0.03	0.06	0.05	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.07	0.02
Ni	6.63	7.64	14.70	32.30	19.11	25.50	13.25	9.47	14.28	7.42	7.01	5.00	31.78	21.42
Pb	11.37	15.12	11.98	22.67	14.07	12.56	13.30	20.79	23.82	24.39	18.24	7.94	26.64	11.09
Se	0.24	0.19	0.23	0.21	0.30	0.15	0.16	0.11	0.17	0.25	0.25	0.30	0.16	0.29
Zn	21.25	24.53	30.01	81.42	49.13	89.89	47.52	17.56	17.74	16.77	13.09	11.31	85.69	67.34

TABLE 31. RESULTS OF RANDOMIZATION TEST ON NITRIC ACID DIGESTS OF SOIL SAMPLES DIRECTLY UNDER THE LANDFILLS AND AT COMPARABLE DEPTHS OUTSIDE THE LANDFILLS

Parameter	Site A	Site B	Site C
Fe	ND	S	S
Mn	NS	S	S
As	S	S	S
B	S	NS	S
Be	S	NS	S
Cd	NS	NS	NS
Cr	NS	NS	NS
Cu	NS	S	NS
Hg	N	NS	S
Ni	S	NS	S
Pb	NS	S	NS
Se	S	NS	NS
Zn	NS	S	S

S = Significant at 80% level.

NS = Not significant at 80% level.

ND = Not determined.

N = Not detected in any sample.

lowered possibly by leaching effects due to the organic acids and chemically reducing conditions produced by the landfill.

At site B, significant differences in concentrations in acid digests were found for iron, manganese, arsenic, copper, lead and zinc. All of these metals showed increased levels in soil beneath the landfill as would be expected from consideration of the model (Figure 1).

At site C, significant differences were found in the concentration of iron, manganese, arsenic, boron, beryllium, mercury, nickel and zinc. Only arsenic showed a decrease in concentration beneath the landfill. Arsenic is behaving at site C as it did at site A and is being depleted in the soil immediately below the landfill.

If the number of metals that are found in significantly higher quantities under a landfill is used as a rough index of attenuation, the sand and gravel at site A is definitely poorer in attenuation than is the loess clay at site B or the deep, residual soil at site C. The material at site A would have both poorer filtering qualities because of its larger grain size and lower adsorption properties because of the lack of clay minerals.

None of the metals determined was shown to have a significant increase in the sub-landfill samples at all three sites. Iron, manganese, boron, beryllium and zinc all showed significant accumulation below the landfills at two of the three sites. These differences in metal levels probably reflect the differing composition of leachates at the three sites.

Vertical Variation of Constituents in Nitric Acid Digests of Soil Samples

For those elements that did show a significant difference in means between sub-landfill samples and samples from comparable depths outside the landfill, a test was made for a significant relationship between the concentration of a particular cation and the sample elevation in the borings. The model of leachate movement requires that those materials derived from the refuse show a positive correlation with elevation in the borings through the landfill. Outside the landfill the concentration of these materials in a nitric acid digest would depend on the prevailing weathering processes. There could be a positive or negative correlation or no correlation at all between sample elevation and the concentration of metals. In the model situation soil constituents that are being dissolved by the landfill leachate should show a negative correlation with sample elevation for samples from under the landfill. Outside the landfill, these elements may or may not show any correlation with sample elevation depending on their response to local weathering processes.

The Spearman rank correlation coefficient was used to judge the strength of association because this technique could be used with small numbers of samples where the sample distribution is not known. The results of the Spearman rank correlation are given in Tables 32-34. Graphs of concentrations versus sample elevation for all cations that showed statistically significant correlations in experimental borings are given in Figures 22-34. Significant correlations in control holes are shown for contrast.

TABLE 32. CORRELATION OF CHEMICAL ANALYSES OF NITRIC ACID DIGESTS OF SOIL SAMPLES WITH SAMPLE ELEVATION AT SITE A

Boring No.	Experimental			Control	
	1	2	3	6	7
Mn	NS	NS	NS	NS	NS
As	NS	NS	NS	NS	NS
B	SP	SP	NS	SP	NS
Be	NS	NS	SP	NS	NS
Ni	NS	NS	NS	NS	NS
Se	NS	NS	NS	NS	NS

SP = Significant positive correlation at 95% level.

SN = Significant negative correlation at 95% level.

NS = Not significant.

TABLE 33. CORRELATION OF CHEMICAL ANALYSES OF NITRIC ACID DIGESTS OF SOIL SAMPLES WITH SAMPLE ELEVATION AT SITE B

Boring No.	Experimental			Control	
	1*	2**	3	5	6
Fe	--	NS	NS	NS	NS
Mn	--	SP	SP	SP	NS
As	--	SP	SP	SP	NS
Cu	--	SP	NS	SP	NS
Pb	--	SP	SP	NS	NS
Zn	--	SP	SP	SP	NS

SP = Significant positive correlation at 95% level.

SN = Significant negative correlation at 95% level.

NS = Not significant.

* = No critical confidence level available for this size sample.

** = Due to small sample sizes all tests of significance are at 80% confidence level.

TABLE 34. CORRELATION OF CHEMICAL ANALYSES OF NITRIC ACID DIGESTS OF SOIL SAMPLES WITH SAMPLE DEPTH AT SITE C

Boring No.	Experimental			Control	
	1	2	3	6	9
Fe	SP	NS	NS	NS	NS
Mn	SP	NS	SP	NS	NS
As	NS	NS	NS	NS	NS
B	NS	SP	NS	NS	NS
Be	NS	SP	NS	NS	NS
Hg	NS	NS	NS	NS	SP
Ni	SN	NS	NS	SN	SP
Zn	SN	SN	SN	SN	SP

SP = Significant positive correlation at 95% level.

SN = Significant negative correlation at 95% level.

NS = Not significant.

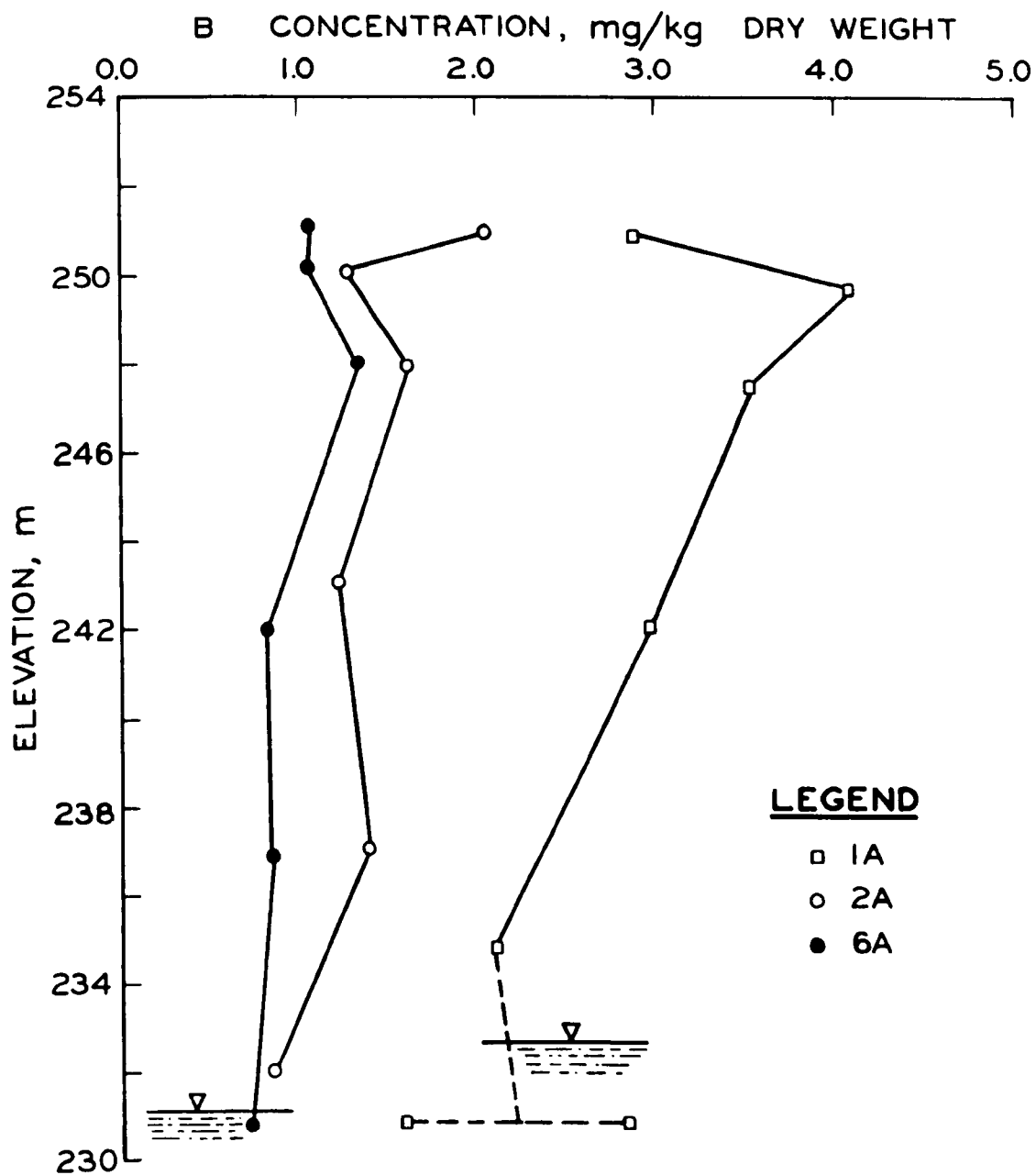


Figure 22. Variation of boron concentration in nitric acid digests of soil/sediment samples with elevation in borings 1, 2, and 6 at site A. Inverted triangle symbols indicate water table in each boring.

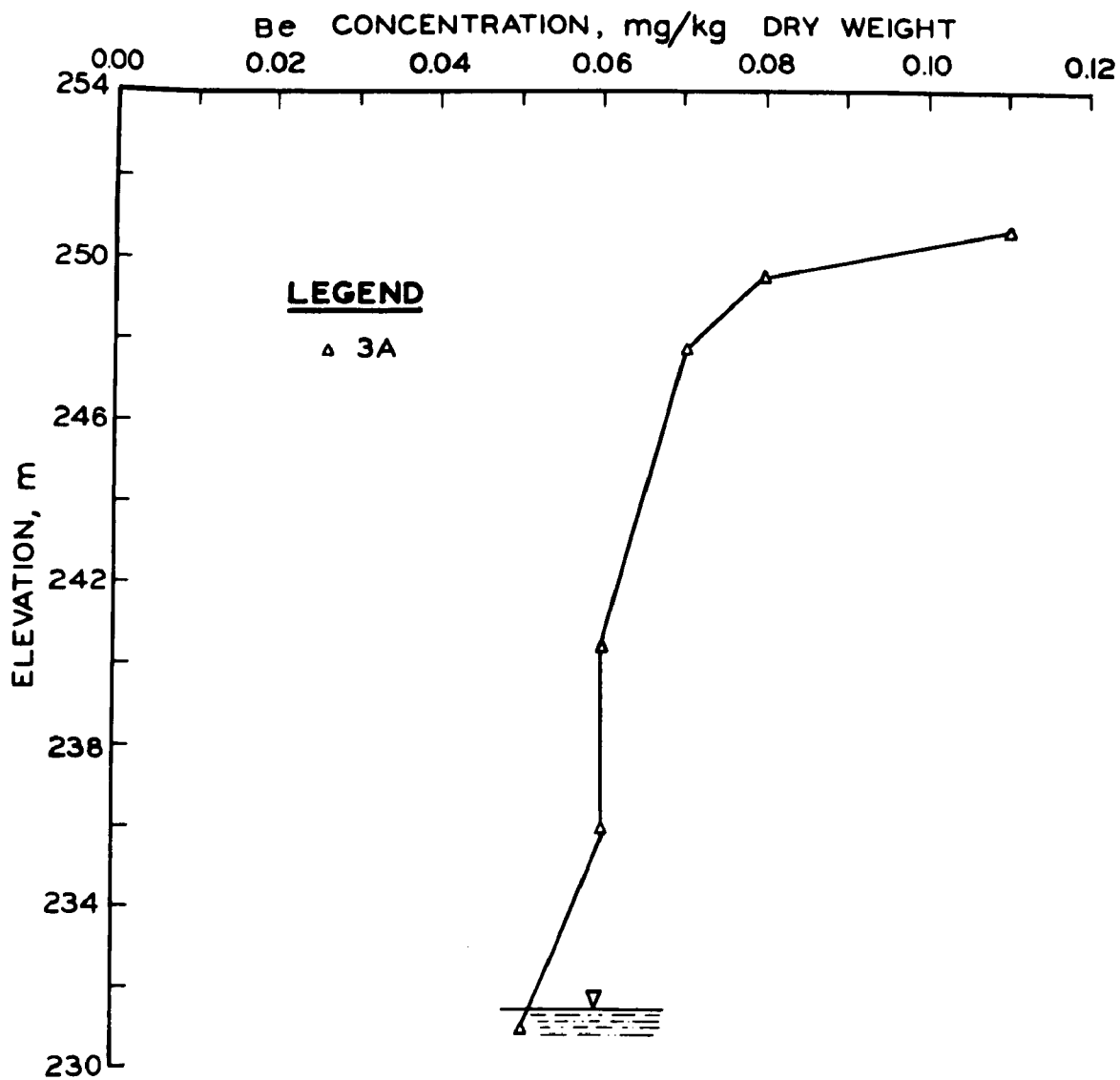


Figure 23. Variation of beryllium concentration in nitric acid digests of soil/sediment samples with elevation in boring 3 at site A. Inverted triangle symbol indicates water table.

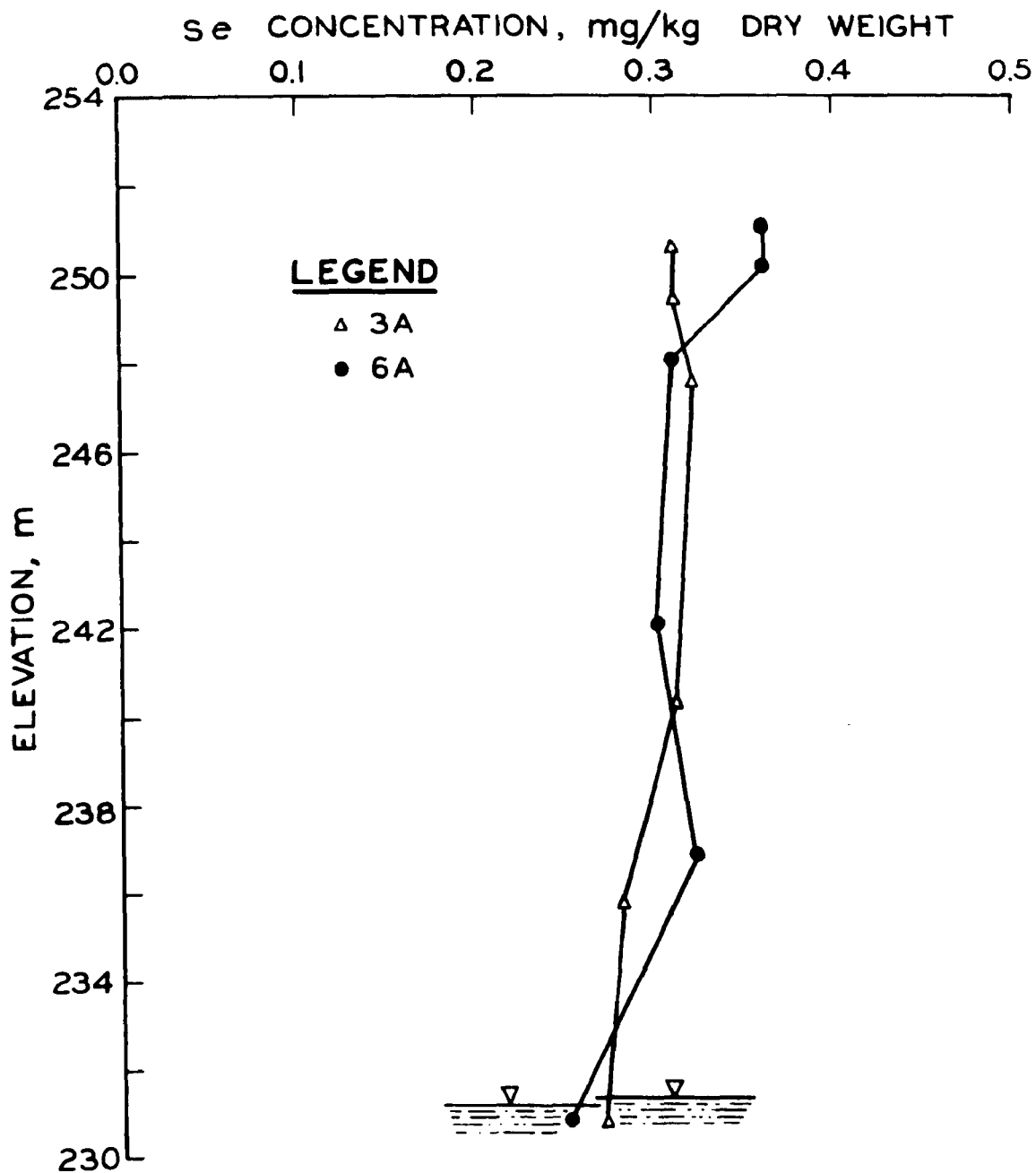


Figure 24. Variation of selenium concentration in nitric acid digests of soil/sediment samples with elevation in borings 3 and 6 at site A. Inverted triangle symbols indicate water table in each boring.

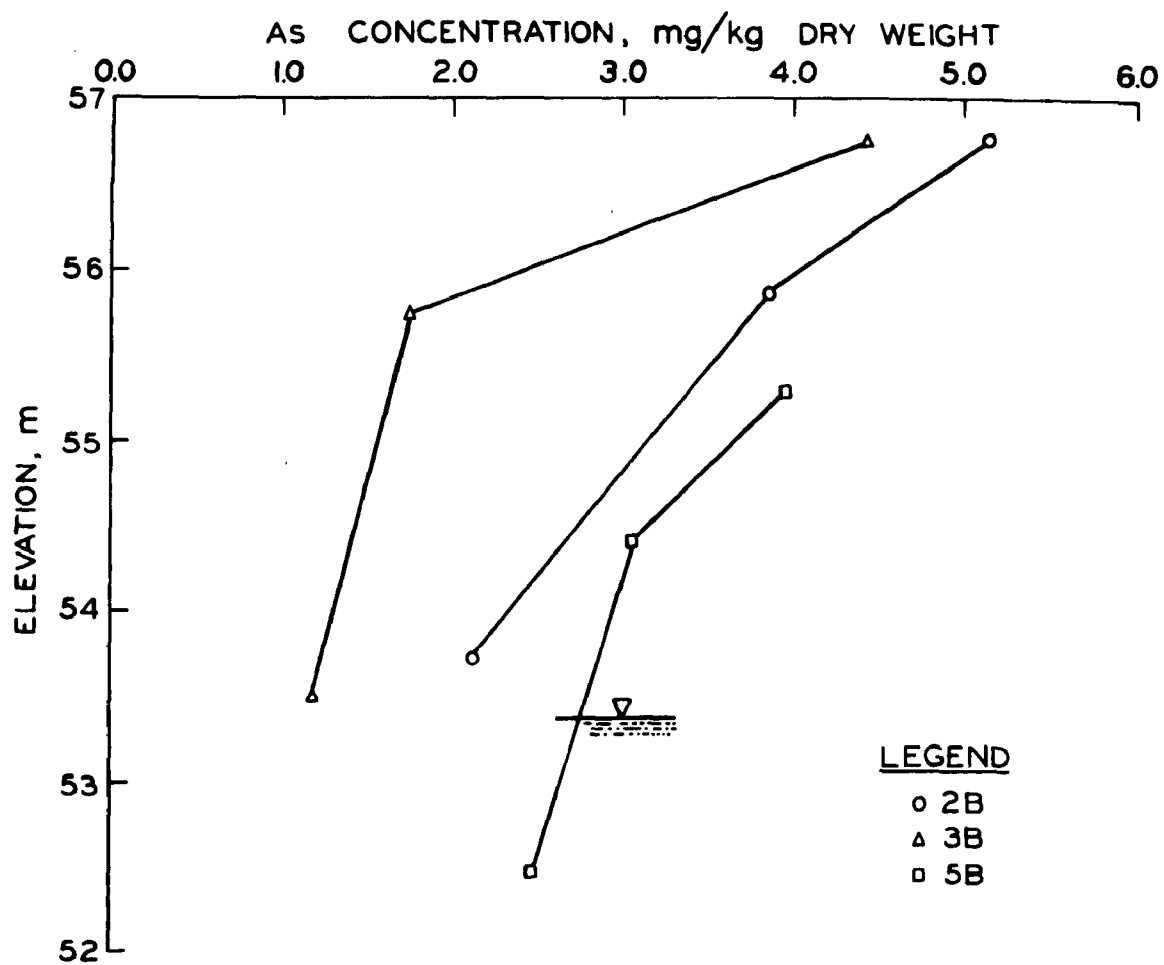


Figure 25. Variation of arsenic concentration in nitric acid digests of soil/sediment samples with elevation in borings 2, 3, and 5 at site B. Inverted triangle symbol indicates water table.

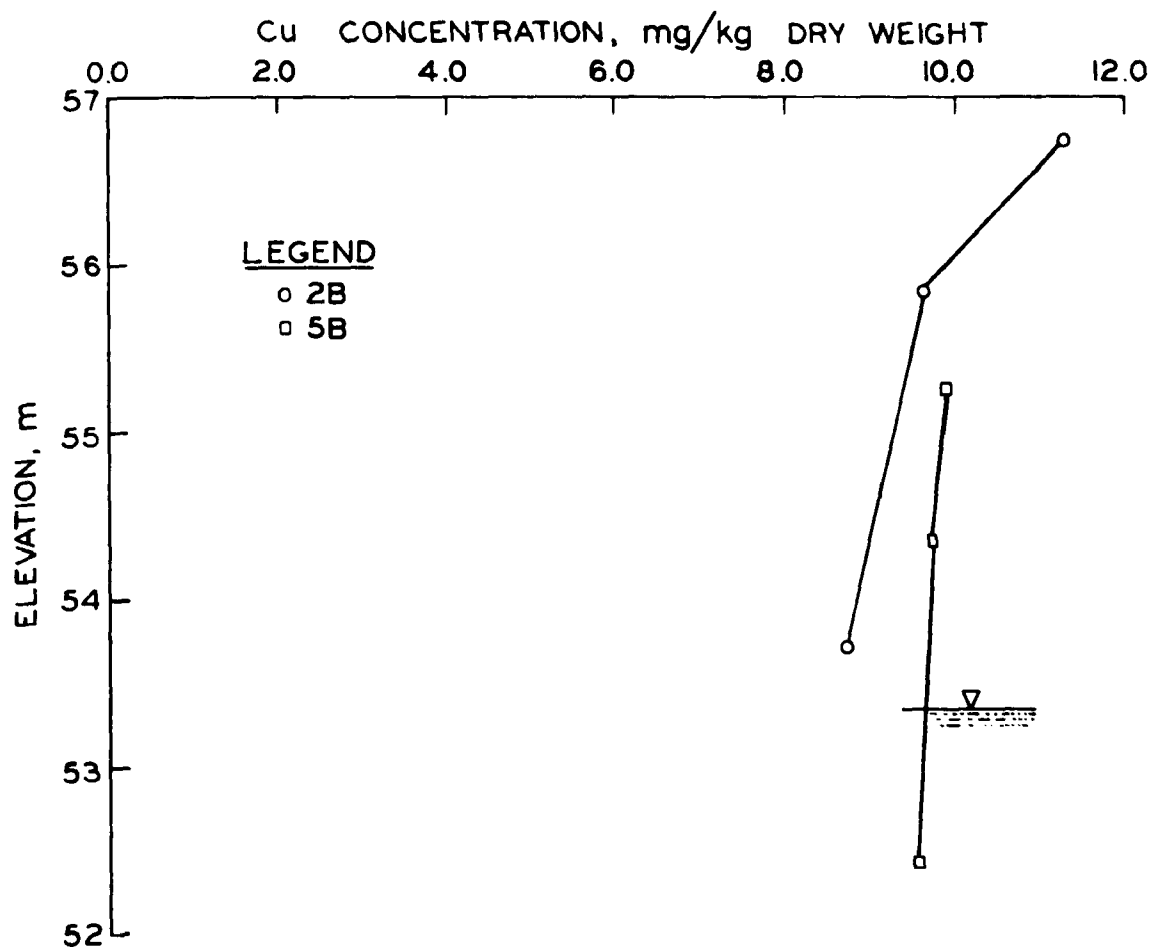


Figure 26. Variation of copper concentration in nitric acid digests of soil/sediment samples with elevation in borings 2 and 5 at site B. Inverted triangle symbol indicates water table.

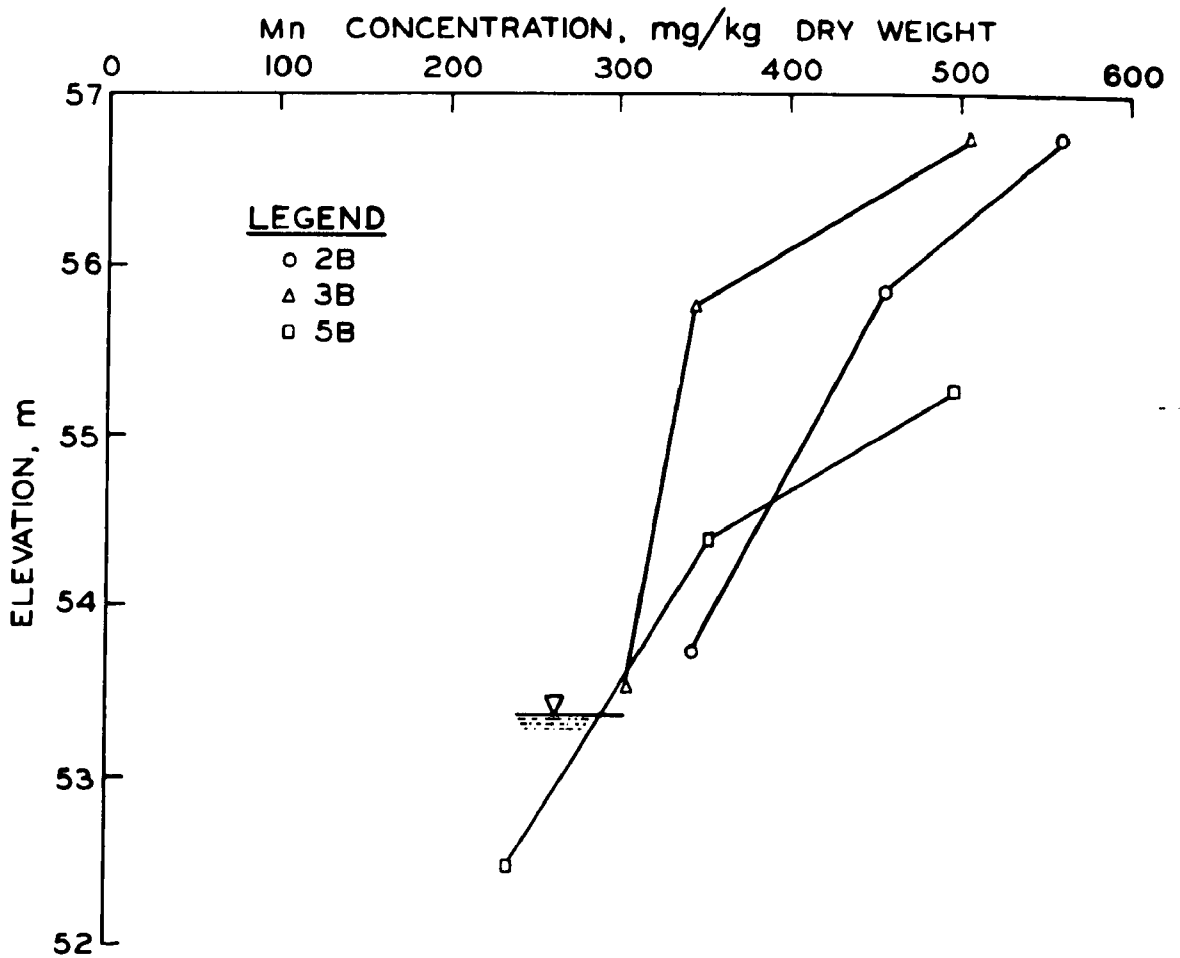


Figure 27. Variation in manganese concentration in nitric acid digests of soil/sediment samples with elevation in borings 2, 3 and 5 at site B. Inverted triangle symbol indicates water table.

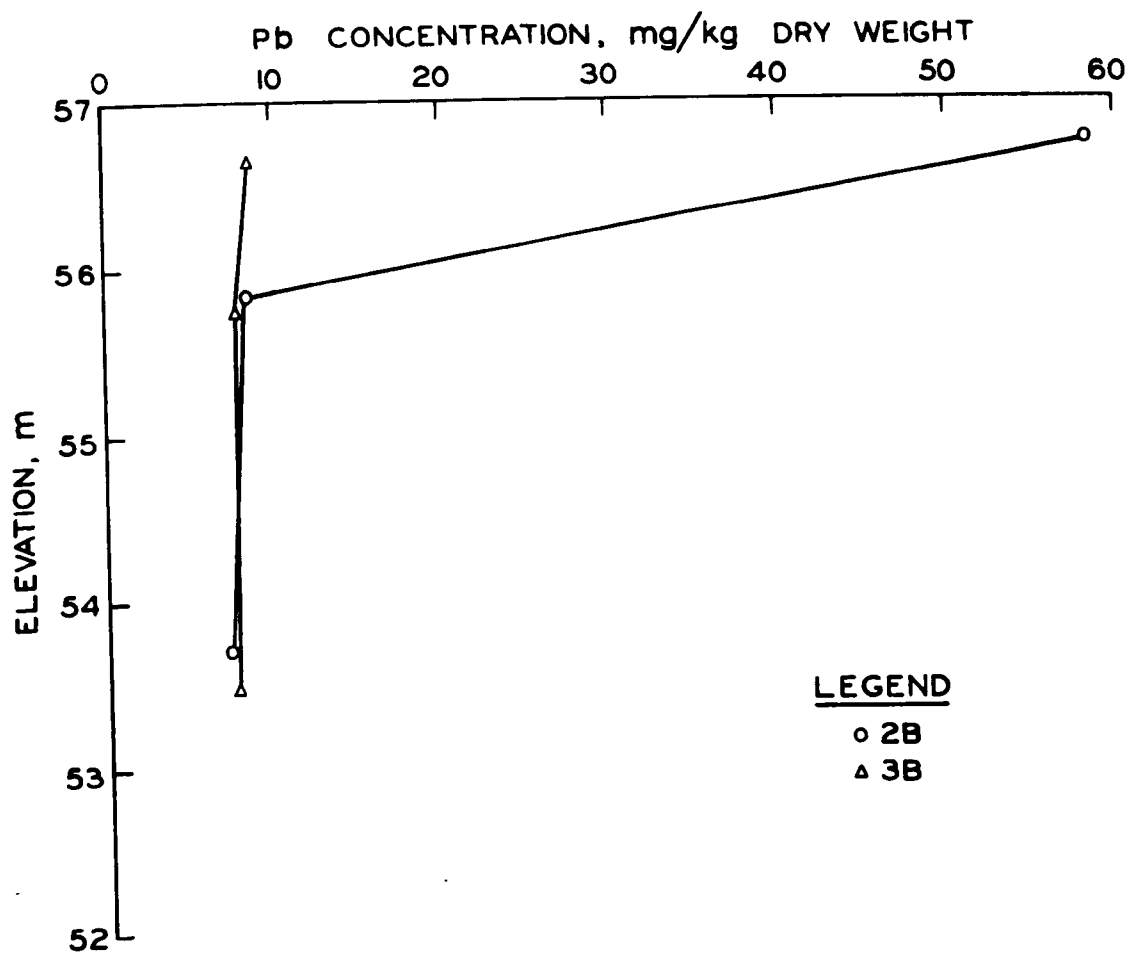


Figure 28. Variation of lead concentration in nitric acid digests of soil/sediment samples with elevation in borings 2 and 3 at site B.

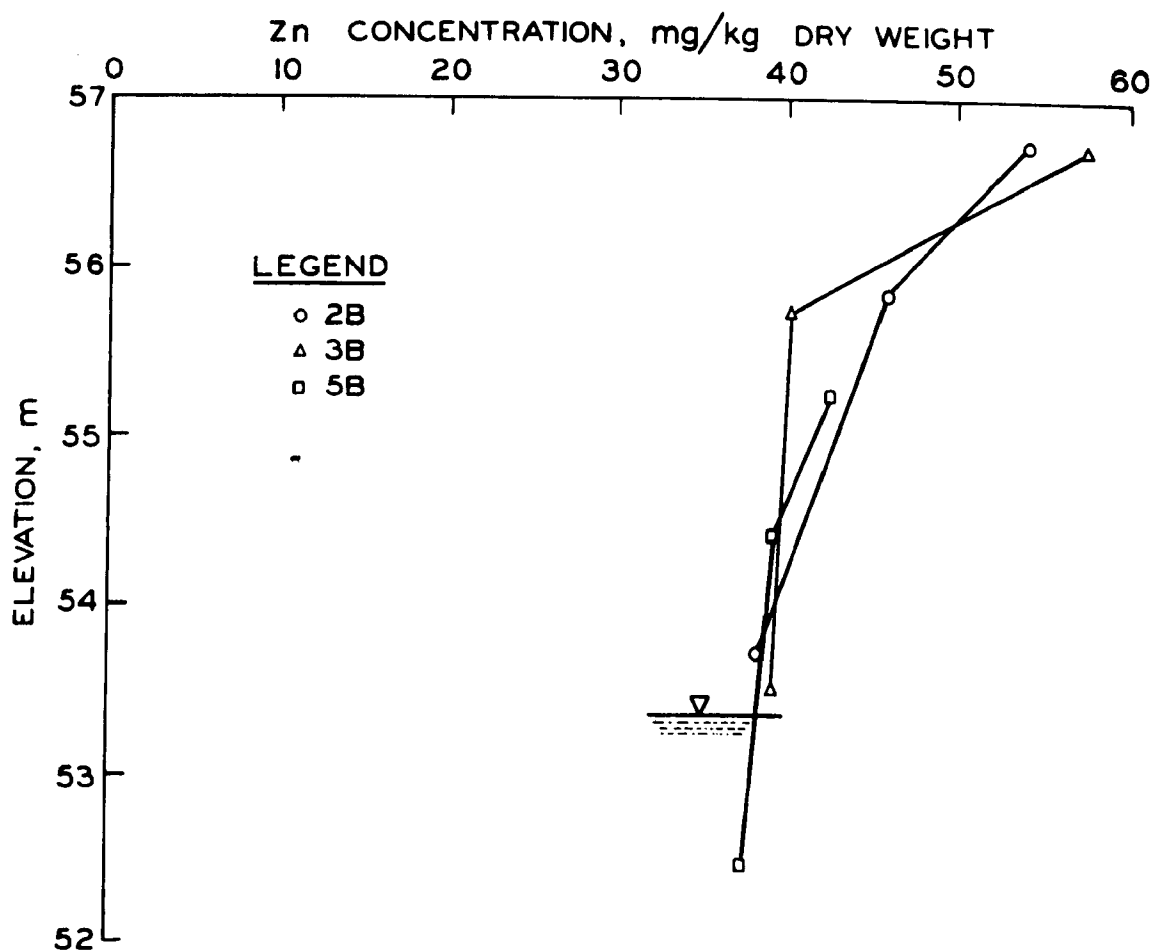


Figure 29. Variation of zinc concentration in nitric acid digests of soil/sediment samples with elevation in borings 2, 3, and 5 at site B. Inverted triangle symbol indicates water table.

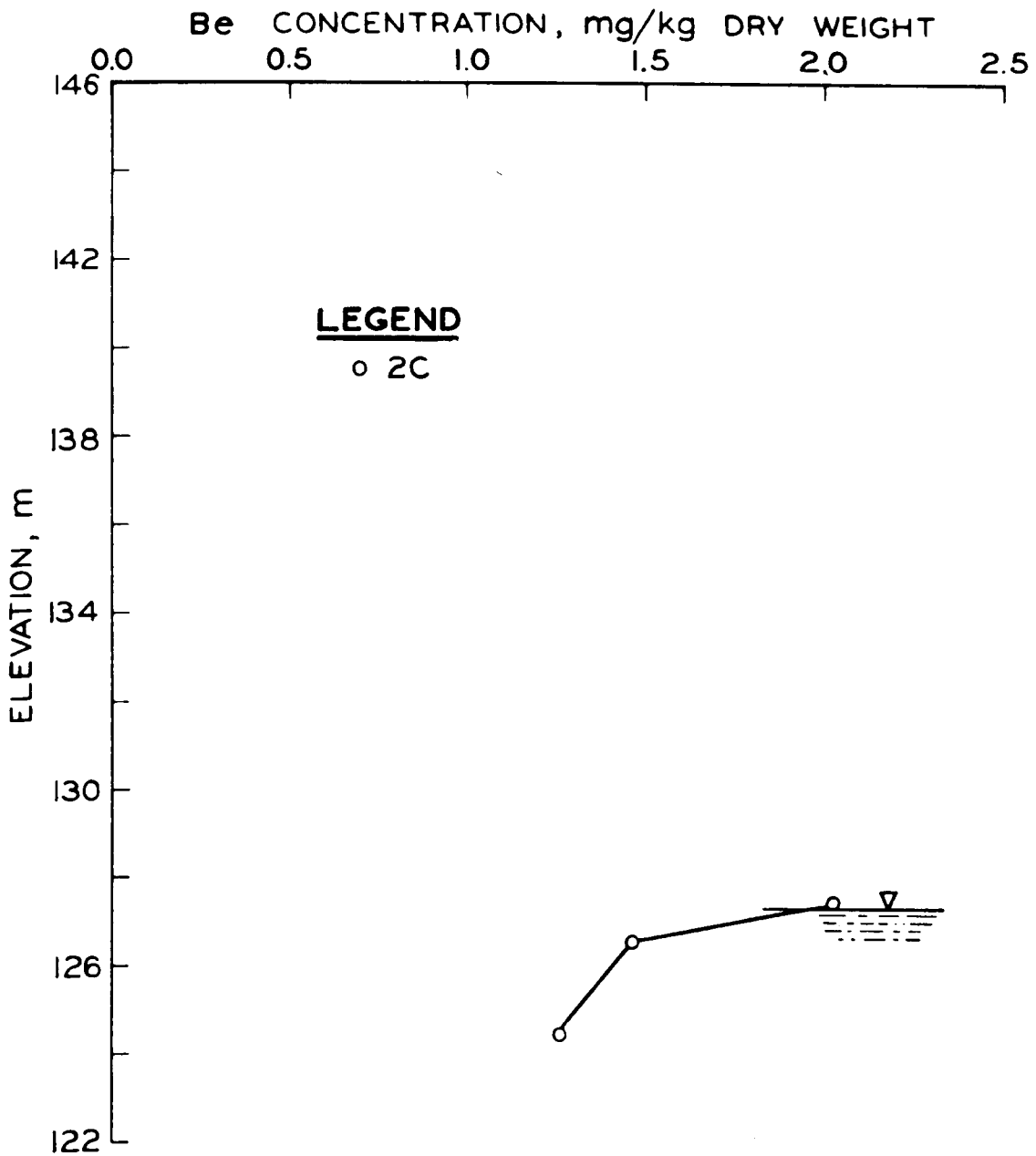


Figure 30. Variation of beryllium concentration in nitric acid digests of soil/sediment samples with elevation in boring 2 at site C. Inverted triangle symbol indicates water table.

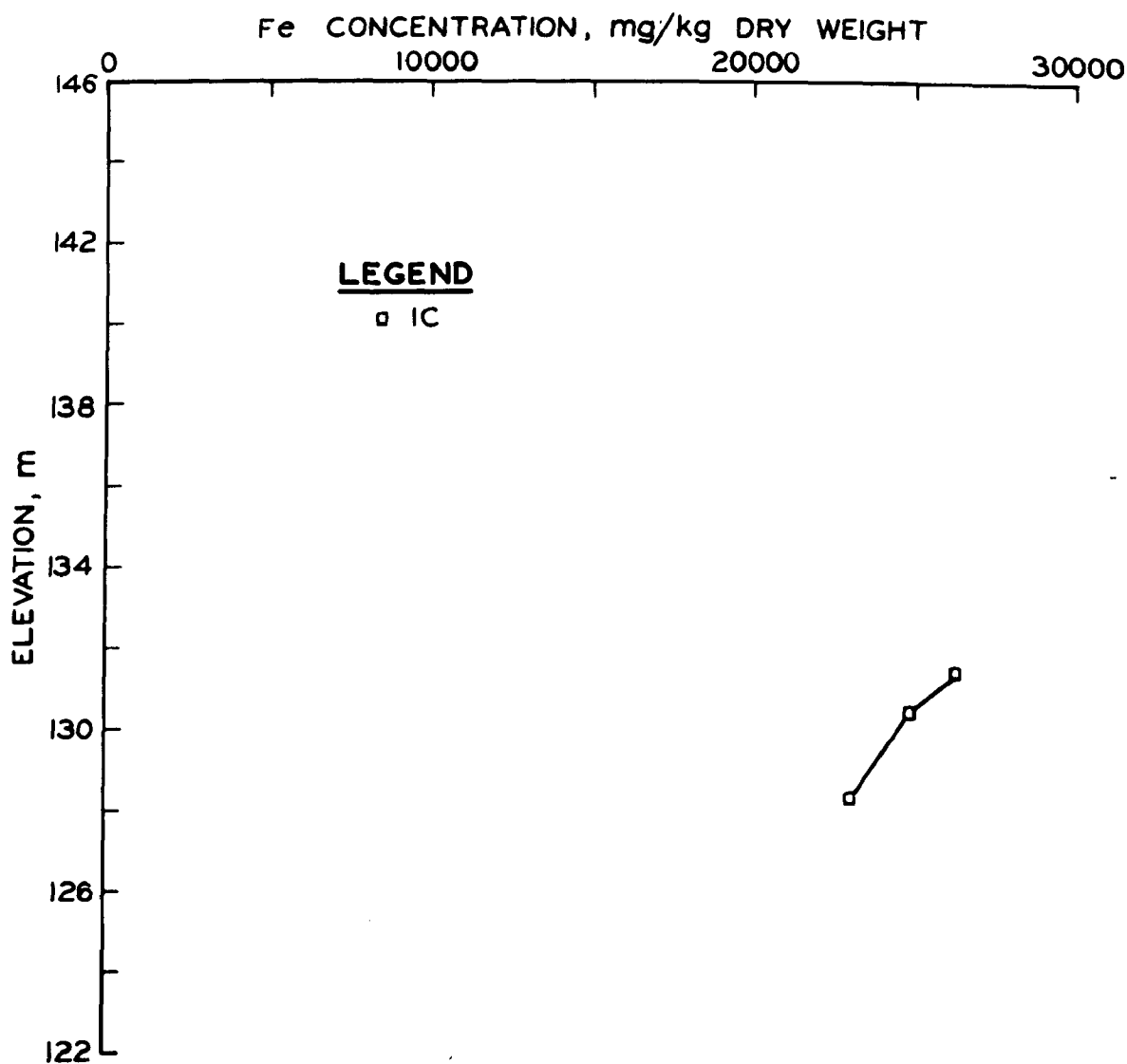


Figure 31. Variation of iron concentration in nitric acid digests of soil/sediment samples with elevation in boring 1 at site C.

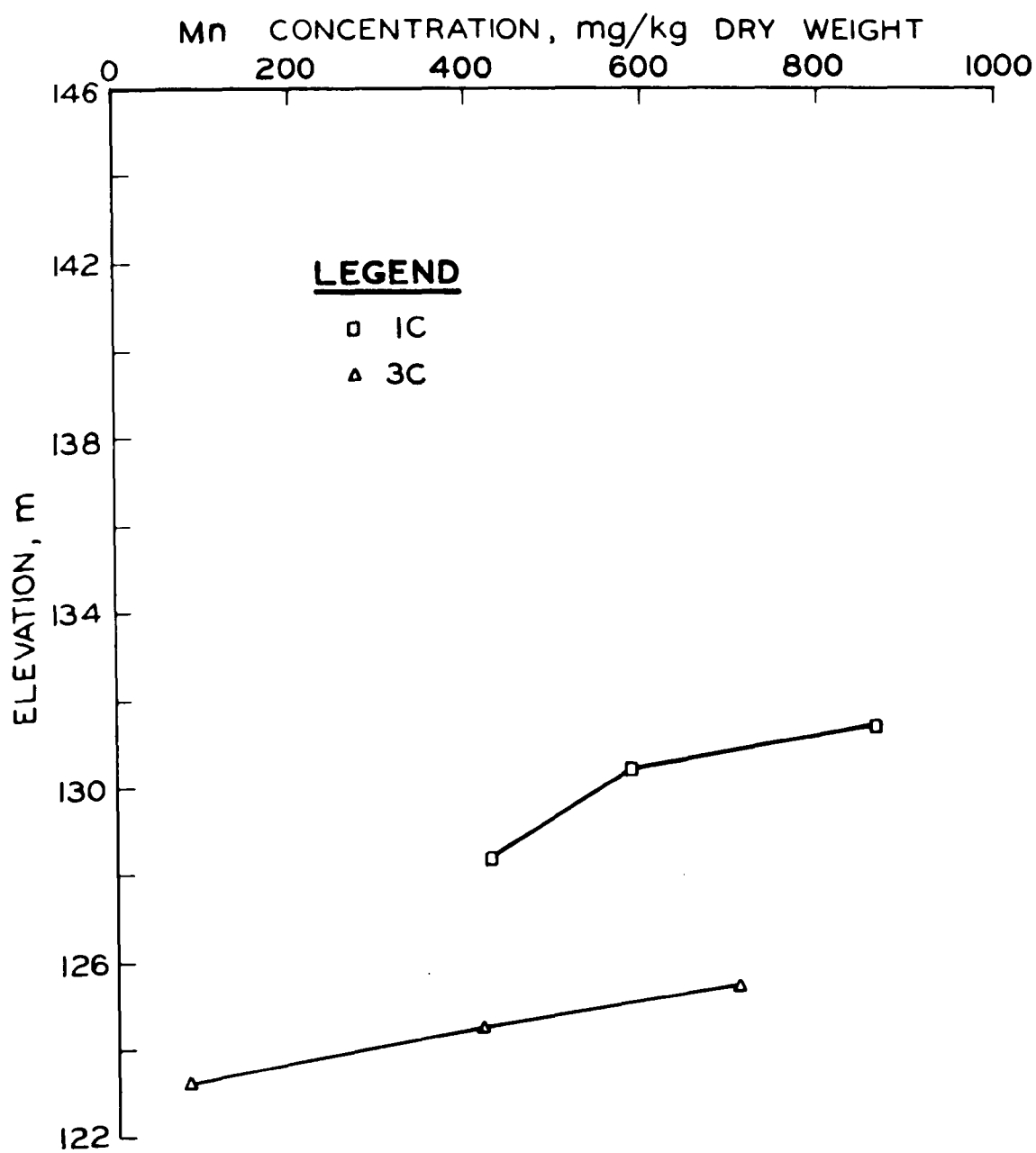


Figure 32. Variation in manganese concentration in nitric acid digests of soil/sediment samples with elevation in borings 1 and 3 at site C.

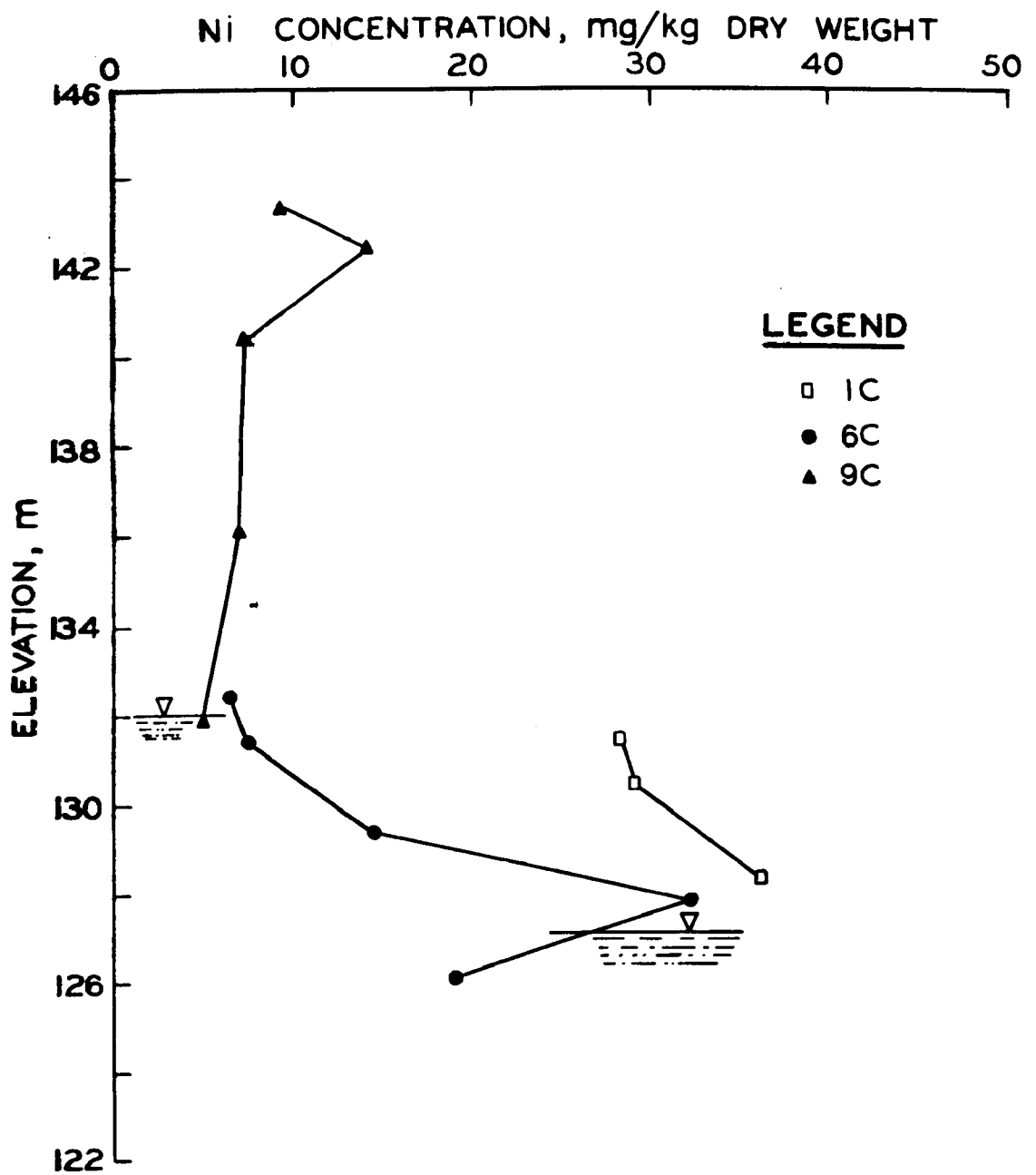


Figure 33. Variation of nickel concentration in nitric acid digests of soil/sediment samples with elevation in borings 1, 6 and 9 at site C. Inverted triangle symbols indicate water table in each boring.

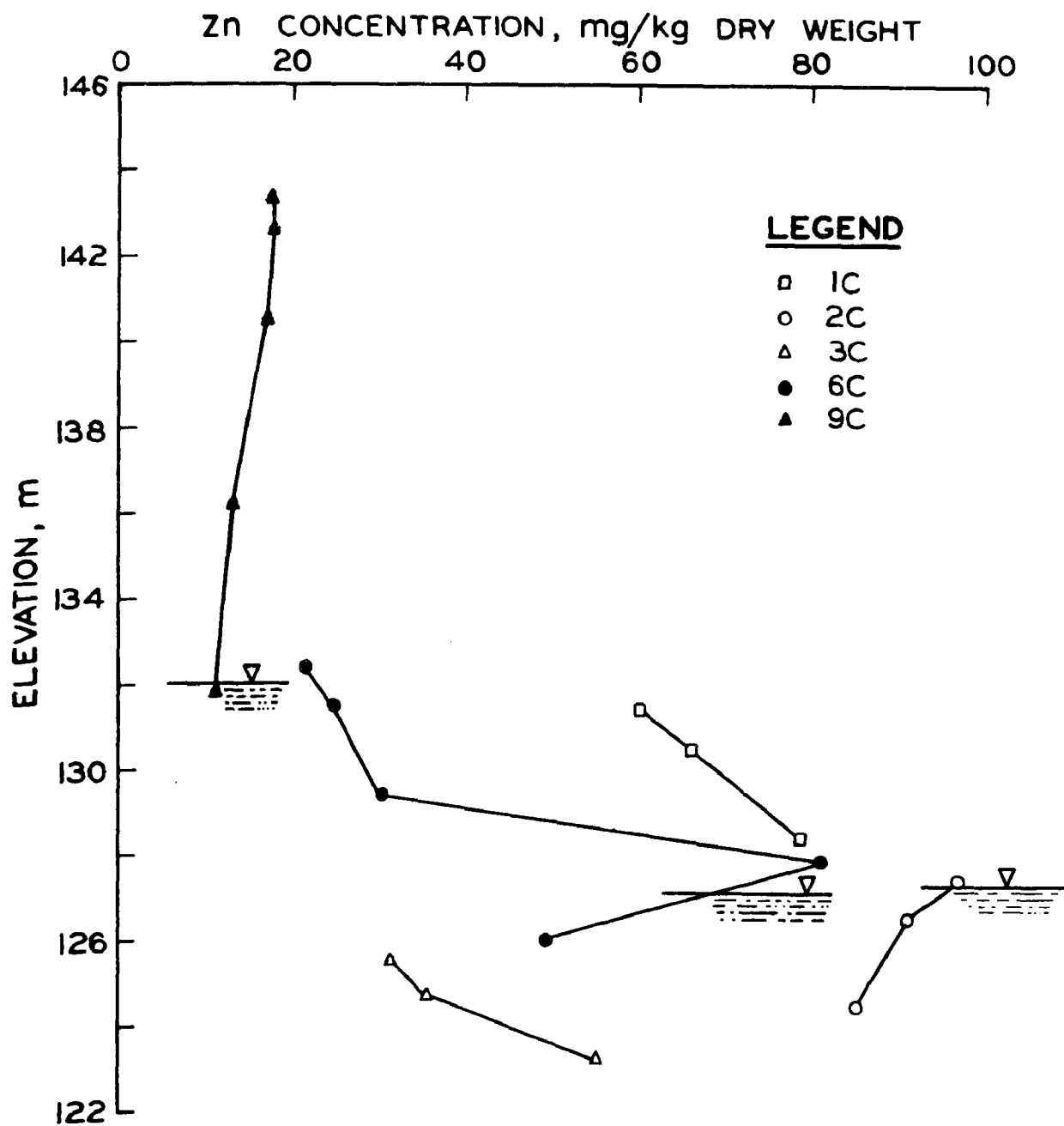


Figure 34. Variation of zinc concentration in nitric acid digests of soil/sediment samples with elevation in borings 1, 2, 3, 6 and 9 at site C. Inverted triangle symbols indicate water table in each boring.

At site A, boron and beryllium showed significant positive correlations with elevation. This correlation, together with their increased abundance under the fill suggests they are being added to the soil by landfill leachate. Selenium shows a positive correlation with elevation, but is not as abundant under the fill as outside the fill. This suggests selenium does leach down from the landfill but is being moved out and is not being held by the soil.

At site B, manganese, arsenic, copper, lead and zinc all showed significant positive correlations with sample elevation. The positive correlations together with the increased levels occurring under the landfill suggest that these constituents are being added to the soil under the landfill and are being retained.

At site C, iron, manganese, and beryllium showed significant positive correlations with sample elevation in borings below the landfill. The increased concentration of these metals under the landfill and the increasing concentrations upward suggest these metals are being leached from the landfill and held by the sub-landfill soil. Nickel and zinc showed a significantly larger concentration of metal under the landfill; but an increasing concentration downward suggests they are leaching from sub-refuse soil.

The ability of landfills to generate metal-rich leachates and the capacity of soils to retain these metals varies greatly from site to site. For the three sites studied, iron, manganese, arsenic, boron, beryllium, copper, lead, selenium and zinc all showed evidence of being derived from the landfills. Selenium, while it did appear to be most available immediately below the landfill at site A, was present in the samples in concentrations below that seen in surrounding soils of comparable depths indicating it was being leached from the landfill; but not being held by soil effectively. At site C, there is an indication that zinc and nickel were present in larger quantities under the landfill than in the area outside the landfill; but both metals showed increasing concentration with increasing depth suggesting they are being moved down into the soil.

Horizontal Variation in Nitric Acid Digests of Sediment/Soil Samples Near the Water Table

The model developed for leachate movement indicates that the major horizontal movement of contaminants from leachate takes place below the water table. If a contaminant is being added to the local soil or sediment by the landfill the highest concentrations should be in the soil below the landfill. Lower concentrations should be found in soil below the water table down the groundwater gradient from the landfill. This decrease in concentration is related to the filtration, absorption or precipitation occurring in the soil or sediment as the groundwater flow moves the leachate away from the landfill. Samples of geologic materials (sediments or soils) were digested to determine if any pattern of contaminant concentration could be related to the direction of movement of groundwater.

At site A, the samples collected near the water table in borings 6 and 7 (downgradient) are from a sandstone unit below the glacial valley-fill material thus some influence of the changing nature of the sediment may be

expected in these acid digests. At site C, one sample taken upgradient (boring 4) and one sample taken downgradient (boring 7) were taken from the surface of the underlying schist. Digests from this less-weathered metamorphic rock would be expected to differ considerable from that of the soil produced by the weathering of the rock. At these two sites some reservations must be taken with regard to interpreting the variation in chemistry as due solely to the influence of the landfill.

The small number of samples precluded use of statistical comparison techniques. Graphs showing the concentration of various metals versus the relative positions of the borings with respect to the landfill are given in Figures 35-37.

At site A, maximum concentrations of manganese, boron, cadmium, chromium, copper, nickel, lead, selenium and zinc occurred in samples taken under the landfill. Samples taken at or near the water table down dip showed decreasing amounts of these constituents. Arsenic is the only contaminant that showed a maximum concentration in a down dip boring.

At site B, iron, arsenic, beryllium, cadmium, mercury, selenium and zinc all reached maximum concentrations in samples collected under the landfill. Manganese, boron, chromium, copper, nickel and lead all reach maximum concentrations in borings down dip from the landfill.

At site C, iron, boron, cadmium, nickel, selenium, and zinc all reached maximum concentrations in samples collected under the landfill. Manganese, arsenic, copper, mercury and lead all reached maximum concentrations in samples collected down dip from the landfill. Beryllium and chromium were found in their greatest concentrations in samples taken up dip from the landfill.

A pattern can be observed in the location of concentration maxima. At all three sites the maximum concentration of arsenic is displayed down dip. At two sites (B and C) maximum concentrations for manganese, copper and lead were found in down dip borings.

DISCUSSION

Physical testing showed no consistent attribute in the soil/sediment samples collected at the landfill sites that could be related to the presence of the landfilled refuse. There was no detectable change in density, permeability, grain size distribution or water content that could be shown to be a response to the movement of leachate. Griffin and others (15) showed that changes in permeability could be observed in experimental columns filled with clay and then subjected to landfill leachate. Permeability changes that occurred probably involved a relatively small volume of the soil at the very top of the soil column. However, in this investigation, field conditions did not always permit recovery of the sample which included only the interface between the refuse and soil/sediment.

Extending the model, the chemical behavior of contaminants in soil under ideal conditions can be broken into three basic types of interactions: flow through, attenuation and mobilization. Flow through is essentially that a re

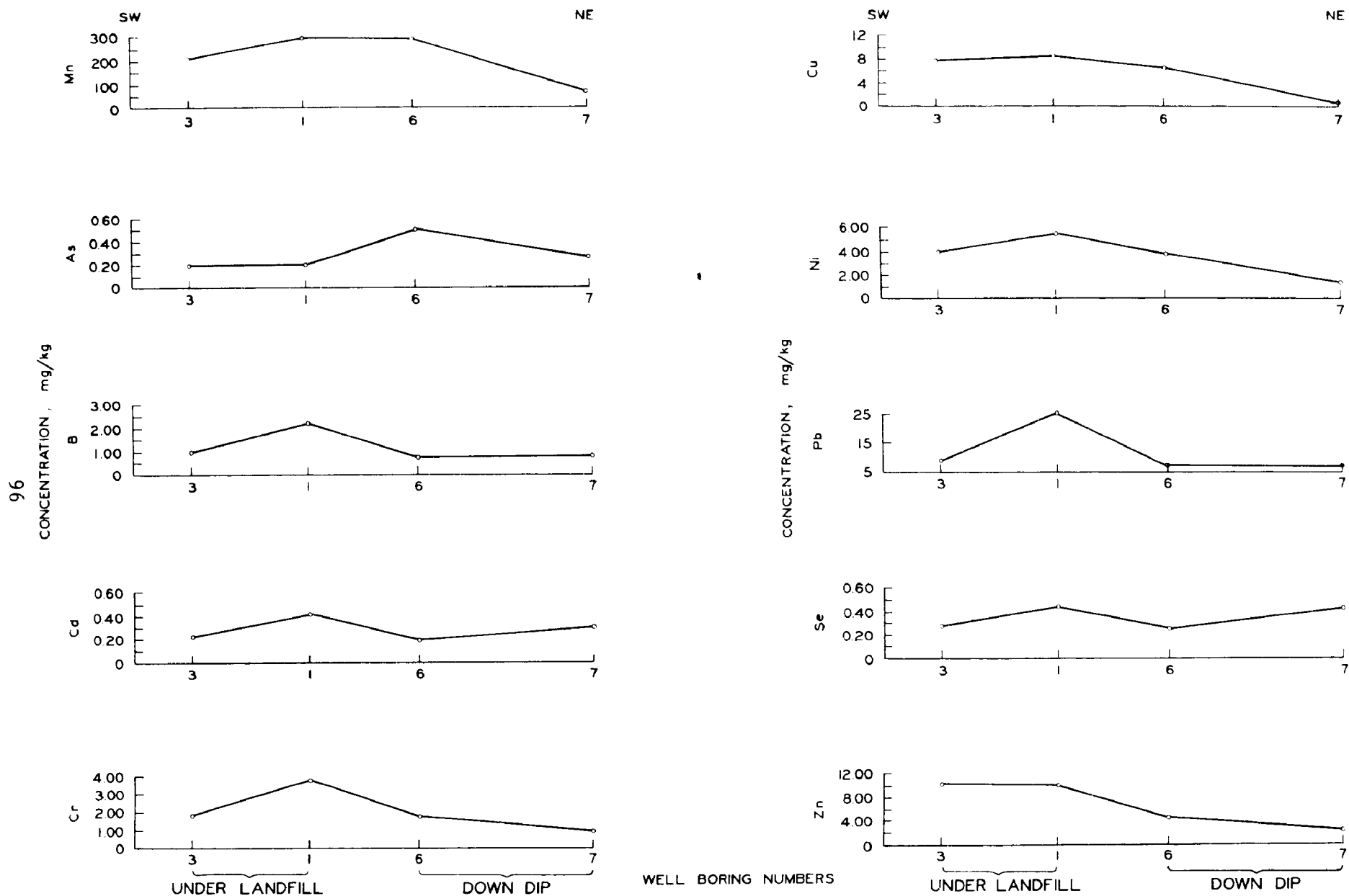


Figure 35. Horizontal variation in chemical composition of nitric acid digests at site A.

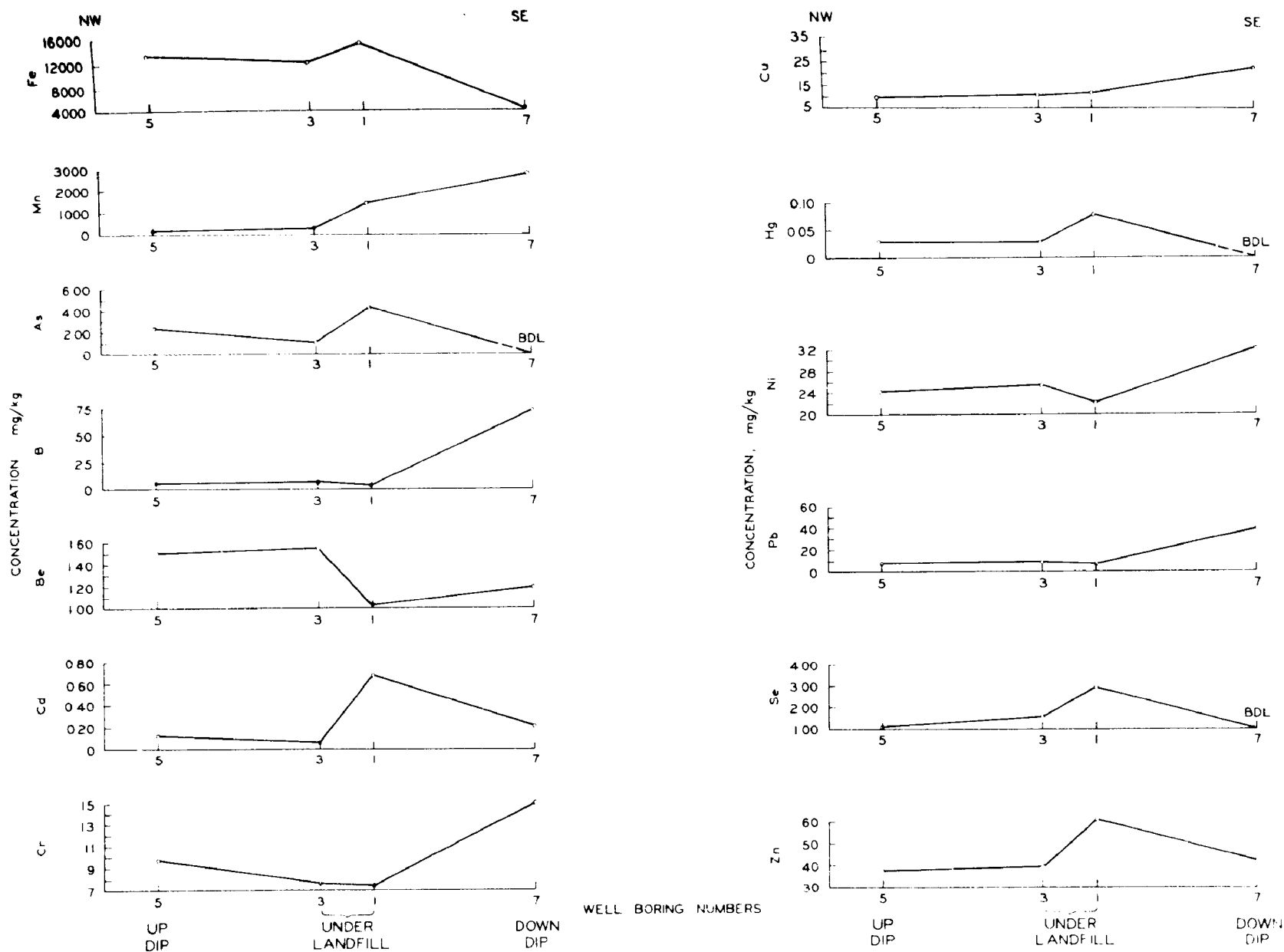


Figure 36. Horizontal variation in chemical composition of nitric acid digests at site B. BDL indicates below detection limits.

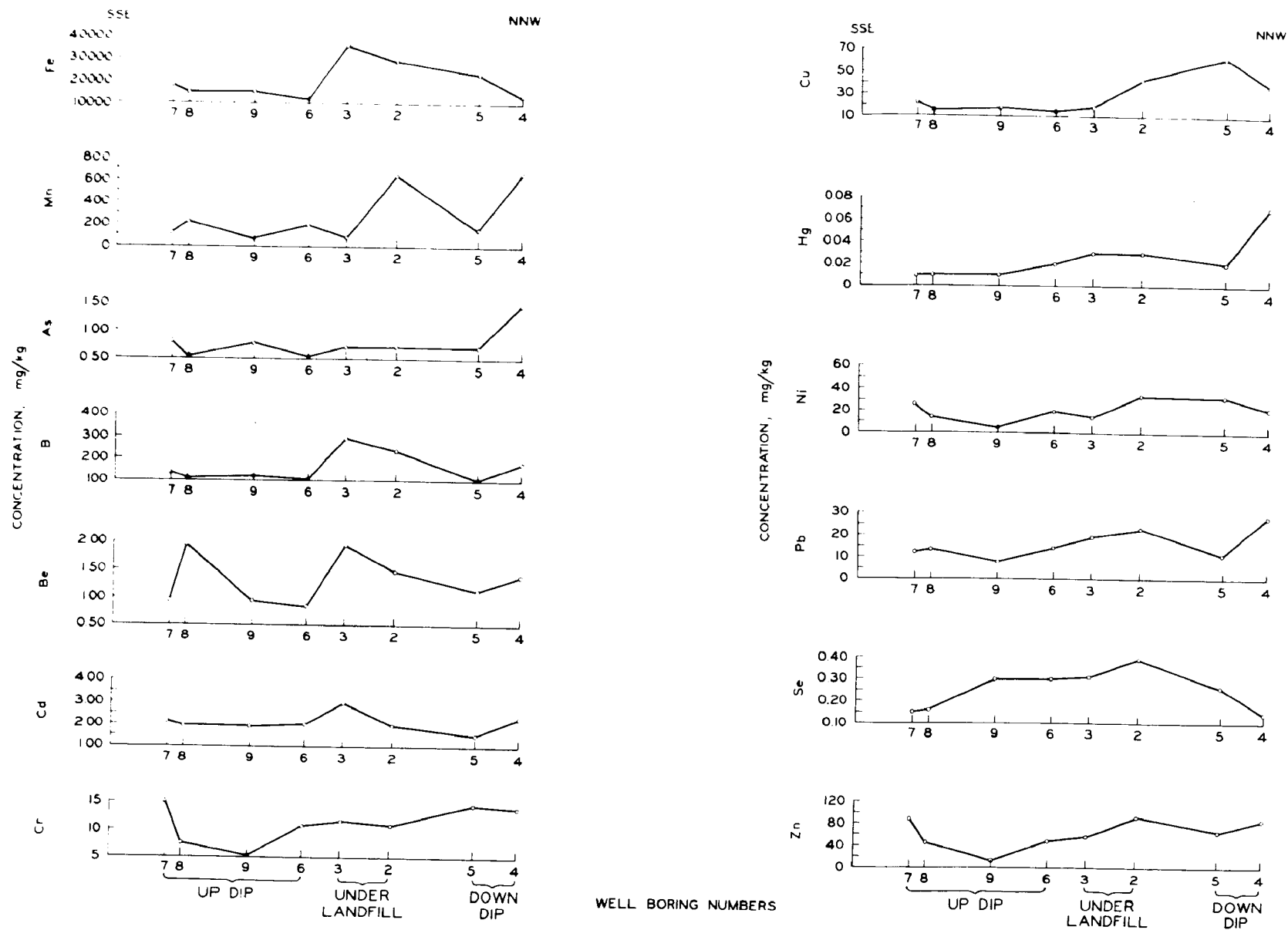


Figure 37. Horizontal variation in chemical composition of nitric acid digests at site C.

where negligible chemical interaction takes place. The porous matrix (soil) is inert and does not effectively filter, absorb or precipitate the contaminants. Therefore, no changes can be detected in the composition of the soil. Cases in which the difference in concentration of contaminants in the nitric acid digests of the soil samples varied less than 25% between samples inside the landfill and outside were judged to be examples of "flow through". The instances of "flow through" are indicated in Table 35 (samples marked "X" in nitric acid digest column). At all three sites cadmium and chromium had essentially the same concentrations in the nitric acid digests of soil inside and outside the landfill. Similarly, nickel (sites A and B), boron (sites B and C), selenium (sites A and B), beryllium (site B), copper (site A), manganese (site A) and mercury (site A) were found in equal concentrations. In most of these cases, the metals are also found in higher concentrations in groundwater collected under the refuse as would be expected. Earlier investigations (15) have indicated that attenuation should be effective in removing toxic metals, the analyses of soil digests given here do not demonstrate a trapping mechanism for most contaminants.

A second type of interaction takes place when the soil removes contaminants by filtration, absorption and/or precipitation. The ability of soil to attenuate contaminants in this manner is limited by the capacity of the soil to contain pollutants. Up to the time when the capacity is reached, the amount of contaminant in the soil increases while the amount passing through to the groundwater is lessened (Table 35). Therefore, the nitric acid digest analyses should show higher levels of contaminants under the refuse and the concentrations in groundwater under and outside the landfill should be nearly equal. After the capacity of the soil for attenuating the contaminant has been reached, concentrations of these contaminants in the groundwater should increase.

Examples of attenuation where soil capacity has not been reached and groundwater concentrations have not increased are beryllium (sites A and C), arsenic (site A), copper (site B) and mercury (site C). Examples of cases where the capacity of the soil to attenuate the contaminant has been reached or exceeded (concentrations in the groundwater have increased under the refuse) are zinc (all three sites), iron and manganese (sites B and C), lead (sites A and C), arsenic (site B), boron (site A) and nickel (site C).

The third possible interaction is the mobilization of soil constituents by the acids typically occurring in the leachate from the refuse. This action brings materials into solution that would normally remain fixed in the soil and brings about a lower concentration of the material in the nitric acid digests of the soil samples from under the landfill when compared with those outside the landfill (Table 35). Only arsenic at site C showed a distribution pattern in the nitric acid digest and the groundwater that would indicate mobilization is occurring.

In some of the samples where attenuation was indicated, this trend was further substantiated by the decreased extractability (into distilled water) observed in samples collected underneath the landfill. While this decreased extractability was not observed in all cases, it might be a useful indicator of the formation of highly insoluble phases during attenuation.

TABLE 35. COMPARISON OF AVERAGE CHEMICAL COMPOSITION OF GROUNDWATER AND SOIL SAMPLES FROM EXPERIMENTAL AND CONTROL BORINGS FOR ALL SITES

Chemical constituents	Groundwater	Site A distilled* water extract	HNO ₃ * digest	Groundwater	Site B distilled water extract	HNO ₃ digest	Groundwater	Site C distilled water extract	HNO ₃ digest
SO ₄	+	X	ND	+					
SO ₃	BDL	BDL	ND	+	BDL	ND	+	-	ND
Cl	+	BDL	ND	+	BDL	ND	BDL	BDL	ND
NO ₃ -N	+	+	ND	-	BDL	ND	+	+	ND
NO ₂ -N	+	BDL	ND	BDL	BDL	ND	BDL	-	ND
CN ²	+	BDL	ND	+	+	ND	+	BDL	ND
TOC	+	+	ND	+	+	ND	+	BDL	ND
Ca	+	X	ND	+	+	ND	+	+	ND
Fe	+	ND	ND	+	+	+	+	-	ND
Mg	+	+	ND	+	+	+	+	-	+
Mn	+	BDL	X	+	X	ND	+	X	ND
Na	+	+	ND	+	+	+	+	-	+
As	X	+	+	+			+	+	ND
B	+	BDL	+	X	ND	+	+	ND	-
Be	-	BDL	+	+	+	X	+	+	X
Cd	+	BDL	X	X	BDL	X	X	BDL	+
Cr	-	+	X	X	BDL	X	+	BDL	X
Cu	X	+	X	X	+	X	BDL	BDL	X
Hg	BDL	ND	BDL	-	BDL	+	BDL	BDL	+
Ni	+	+	X	+	ND	X	-	ND	+
Pb	+	BDL	+	BDL	BDL	+	+	-	+
Se	BDL	BDL	X	+	ND	X	BDL	ND	+
Zn	+	+	+	+	BDL	+	+	-	+

+ = >125% of average control sample.

X = 75% to 125% of average control sample.

- = <75% of average control sample.

BDL = More than one half samples below detection limits.

ND = Not determined.

* Note that soil samples used in averages were those at the interface between refuse and subsoil, and comparable levels outside the landfill.

If the number of metals found in greater abundance in the nitric acid digest from samples taken directly under the landfill is used as an index of overall attenuation; site C shows the most active attenuation. Site B and site A rank second and third respectively, although they are nearly identical.

The character of the soil/sediment in the area of attenuation and the chemical activity within the refuse leachate appear to be of prime importance in the attenuation process. In the present study, the poorest attenuation was associated with an older site having coarse sandy material under the landfill. The most effective attenuation appears in a landfill that is relatively young and underlain by fine-grained material. The high rate of microbial activity associated with this younger landfill should produce a large quantity of hydrogen sulfide in the leachate and precipitate the chalcophile elements (i.e., those having an affinity for sulfur) such as iron, nickel, copper, zinc, mercury and lead.

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APPENDIX A
SUB-SURFACE INFORMATION FOR SITE A

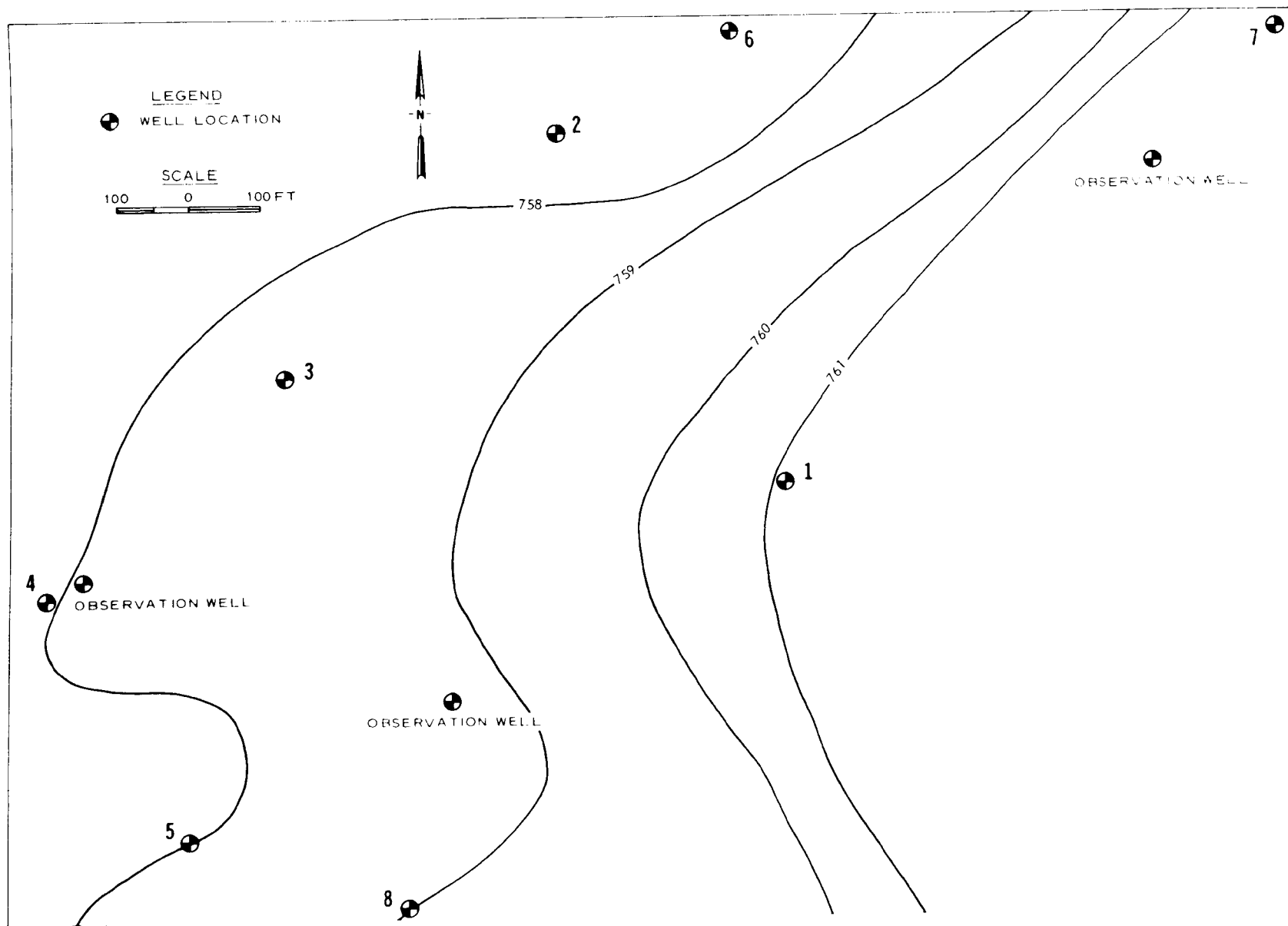


Figure A-1. Water table map of site A (contour lines are elevation of water table in feet above mean sea level). 0.305 m = 1 ft.

TABLE A-1. LOG OF BORING 1 AT SITE A

Elevation above MSL* (m)	Depth (m)	Description
257.96 - 257.29	0.0 - 0.67	Cover material (sand with some large gravel)
257.29 - 250.76	0.67 - 7.20	Fill
250.76 - 247.08	7.20 - 10.88	Sand (SP) medium, light brown with traces of small gravel
247.08 - 235.58	10.88 - 22.38	Sand (SP) medium, light brown
235.58 - 232.53	22.38 - 25.43	Sand (SP) medium to coarse tan with scattered gravel
232.53 - 229.88	25.43 - 28.08	Sand (SP) fine, tan with orange streaks

* MSL = mean sea level

Water table elevation above MSL = 232.53 m

TABLE A-2. LOG OF BORING 2 AT SITE A

Elevation above MSL* (m)	Depth (m)	Description
257.00 - 255.78	0.0 - 1.22	Cover material (sand (SP)) medium to coarse, some gravel
255.78 - 251.24	1.22 - 5.76	Waste
251.24 - 250.32	5.76 - 6.68	Sand (SP) medium, light brown
250.32 - 247.58	6.68 - 9.42	Sand (SP) medium to coarse, light brown with gravel
247.58 - 230.5	9.42 - 26.50	Sand (SP) medium to coarse light brown with gravel

Water table elevation above MSL = 231.01 m

TABLE A-3. LOG OF BORING 3 AT SITE A

Elevation above MSL (m)	Depth (m)	Description
258.57 - 255.52	0.0 - 3.05	Cover material (sand (SP)) medium to coarse brown
255.52 - 250.71	3.05 - 7.86	Fill
250.71 - 236.31	7.86 - 22.26	Sand (SP), medium to coarse, brown with gravel
236.31 - 229.97	22.26 - 28.60	Gravelly sand (SP) medium to coarse, brown

Water table elevation above MSL = 231.22 m

TABLE A-4. LOG OF BORING 4 AT SITE A

Elevation above MSL (m)	Depth (m)	Description
253.60 - 249.49	0.0 - 4.11	Sand (SP) medium to coarse, light brown
249.49 - 247.35	4.11 - 6.25	Sand (SP) medium, brown with some gravel
247.35 - 242.78	6.25 - 10.82	Sand (SP) fine to medium, light brown
242.78 - 241.80	10.82 - 11.80	Sandy gravel (GP), light brown
241.80 - 236.99	11.80 - 16.61	Sand (SP) medium to coarse, light brown with some gravel
236.99 - 236.38	16.61 - 17.22	Sandy gravel (GP), light brown
236.38 - 230.12	17.22 - 23.48	Gravelly sand (SP), medium to coarse

Water table elevation above MSL = 230.91 m

TABLE A-5. LOG OF BORING 5 AT SITE A

Elevation above MSL (m)	Depth (m)	Description
255.02 - 241.91	0.0 - 13.11	Sand (SP), medium to coarse, light brown with gravel
241.91 - 237.18	13.11 - 17.84	Sand (SP), medium to coarse, light brown
237.18 - 236.57	17.84 - 18.45	Gravelly sand (SP), brown
236.57 - 236.06	18.45 - 18.96	Sand (SP), medium to coarse, light brown
236.06 - 231.24	18.96 - 23.78	Sand (SP), medium to coarse, light brown with gravel
231.24 - 230.23	23.78 - 24.79	Sand (SP), medium to coarse, brown

Water table elevation above MSL = 231.10 m

TABLE A-6. LOG OF BORING 6 AT SITE A

Elevation above MSL (m)	Depth (m)	Description
256.01 - 255.77	0.0 - 0.24	Sand (SP) fine-medium, dark brown
255.77 - 254.33	0.24 - 1.68	Sand (SP), fine-medium, brown
254.33 - 242.23	1.68 - 13.78	Sand (SP) medium-coarse, brown with gravel
242.23 - 232.08	13.78 - 23.93	Sand (SP), medium-coarse, light brown scattered small gravel
232.08 - 231.47	23.43 - 24.54	Gravelly sand (SP), brown
231.47 - 231.16	24.54 - 24.85	Sand (SP), medium-coarse, light brown, with gravel
231.16 - 231.10	24.85 - 24.91	Sandstone, tan
231.10 - 229.95	24.91 - 26.06	Sand (SP), medium, brown

Water table elevation above MSL = 231.10 m

TABLE A-7. LOG OF BORING 7 AT SITE A

Elevation above MSL (m)	Depth (m)	Description
255.64 - 254.73	0.0 - 0.91	Sand (SP), fine-medium, dark brown
254.73 - 252.60	0.91 - 3.04	Sand (SP), fine-medium, brown
252.60 - 250.82	3.04 - 4.82	Sand (SP), coarse, light brown with gravel
250.82 - 250.30	4.82 - 5.34	Sand (SP), medium-coarse, light brown
250.30 - 247.16	5.34 - 8.48	Gravelly sand (SP), medium-coarse, brown
247.16 - 240.40	8.48 - 15.24	Sand (SP), medium-coarse, brown with gravel
240.40 - 238.87	15.24 - 16.77	Sandy gravel (GP), brown
238.87 - 237.20	16.77 - 18.44	Sand (SP), medium-coarse, light brown with gravel
237.20 - 235.52	18.44 - 20.12	Sandstone, tan
235.52 - 233.08	20.12 - 22.56	Sand, fine-medium, light brown

Water table elevation above MSL = 235.52 m

TABLE A-8. LOG OF BORING 8 AT SITE A

Elevation above MSL (m)	Depth (m)	Description
265.04 - 264.28	0.0 - 0.76	Sand (SP), fine, dark brown
264.28 - 264.13	0.76 - 0.91	Sand (SP), medium, brown with gravel
264.13 - 258.94	0.91 - 6.10	Sand (SP), coarse, brown with gravel
258.94 - 249.10	6.10 - 15.94	Sand (SP), medium-coarse, brown, trace of gravel
249.10 - 242.18	15.94 - 22.86	Sand (SP), medium-coarse, brown, with gravel
242.18 - 241.72	22.86 - 23.32	Sandy gravel (GP), brown
241.72 - 231.35	23.32 - 33.69	Sand (SP), medium-coarse, brown with gravel
231.35 - 230.34	33.69 - 34.7	Sand (SP), medium-coarse, light brown

Water table elevation above MSL = 235.52 m

TABLE A-9. LIST OF SAMPLES EXAMINED FROM SITE A

Boring	Elevation of top of hole (m)	Elevation of water table (m)	Total depth (m)	Thickness of cover (m)	Thickness of refuse (m)	Elevation MW/soil interface (m)	Sampled depth interval(m)		Elevation of sampled intervals(m)		Type of sample	Sample number
							From	To	From	To		
1	257.96	232.53	28.26	0.67	6.52	250.77	7.20	7.70	250.76	250.26	physical	1C1
							7.37		250.59		chemical	1C2
							8.19		249.77		chemical	1C3
							10.38		247.58		chemical	1C4
							10.94	11.64	247.02	246.32	physical	1P1
							15.88		242.08		chemical	1C5
							22.65	22.84	235.31	235.12	physical	1P2
							23.15		234.81		chemical	1C6
							27.13		230.83		chemical	1C7
							27.13		230.83		chemical	1C8
2	257.01	231.01	29.52	1.22	4.85	250.94	6.03		250.98		chemical	2C1
							6.25	6.68	250.76	250.33	physical	2P1
							6.87		250.14		chemical	2C2
							6.92	7.44	250.09	249.57	physical	2P2
							8.81	9.42	248.20	249.59	physical	2P3
							9.02		247.99		chemical	2C3
							13.87	14.39	243.14	242.62	physical	2P4
							14.01		243.00		chemical	2C4
							19.51	19.87	237.50	237.14	physical	2P5
							19.90		237.11		chemical	2C5
							24.39	24.94	232.62	232.07	physical	2P6
							24.93		232.08		chemical	2C6
3	258.57	231.22	31.80	3.05	4.82	250.70	7.86	8.32	250.71	250.25	physical	3P1
							8.04		250.53		chemical	3C1
							9.04		249.53		chemical	3C2

(continued)

TABLE A-9. (continued)

Boring	Elevation of top of hole (m)	Elevation of water table (m)	Total depth (m)	Thickness of cover (m)	Thickness of refuse (m)	Elevation MW/soil interface (m)	Sampled depth interval(m)		Elevation of sampled intervals(m)		Type of sample	Sample number
							From	To	From	To		
							10.82	11.25	247.75	247.32	physical	3P2
							17.97		240.60		chemical	3C3
							18.30		240.27		chemical	3C4
							22.25	22.53	236.32	236.04	physical	3P3
							22.85		235.72		chemical	3C5
							27.84		230.73		chemical	3C6
4	253.60	230.91	23.48	NA	NA	NA	3.20	3.90	250.4	249.7	physical	4P1
							6.25	6.62	247.35	246.98	physical	4P2
5	257.15	231.10	24.79	NA	NA	NA	4.57	5.29	252.58	251.86	physical	5P1
							7.62	8.20	249.53	248.95	physical	5P2
							18.44	18.83	238.71	238.32	physical	5P3
6	256.01	231.10	26.06	NA	NA	NA	4.72	5.33	251.29	250.69	physical	6P1
							4.92		251.09		chemical	6C1
							5.81		250.20		chemical	6C2
							7.77	8.42	248.24	247.59	physical	6P2
							7.93		248.08		chemical	6C3
							13.96		242.05		chemical	6C4
							19.00	19.48	237.01	236.53	physical	6P3
							19.15		236.86		chemical	6C5
							25.17		230.84		chemical	6C6
7	255.64	235.52	22.56	NA	NA	NA	4.42	4.76	251.22	250.88	physical	7P1
							5.15		250.44		chemical	7C1
							5.49		250.15		chemical	7C2
							7.65		247.99		chemical	7C3
							7.77	8.26	247.87	247.38	physical	7P2
							13.26	13.75	242.38	241.89	physical	7P3

(continued)

TABLE A-9. (concluded)

Boring	Elevation of top of hole (m)	Elevation of water table (m)	Total depth (m)	Thickness of cover (m)	Thickness of refuse (m)	Elevation MW/soil interface (m)	Sampled depth interval(m)		Elevation of sampled intervals(m)		Type of sample	Sample number
							13.41		242.23		chemical	7C4
							19.27		236.37		chemical	7C5
							22.32		233.32		chemical	7C6
8	265.04	231.37	34.70	NA	NA	NA	14.32	15.03	250.72	250.01	physical	8P1
							17.38	17.96	247.66	247.08	physical	8P2
							28.65	28.99	236.39	236.05	physical	8P3

NA = not applicable

APPENDIX B
SUB-SURFACE INFORMATION FOR SITE B

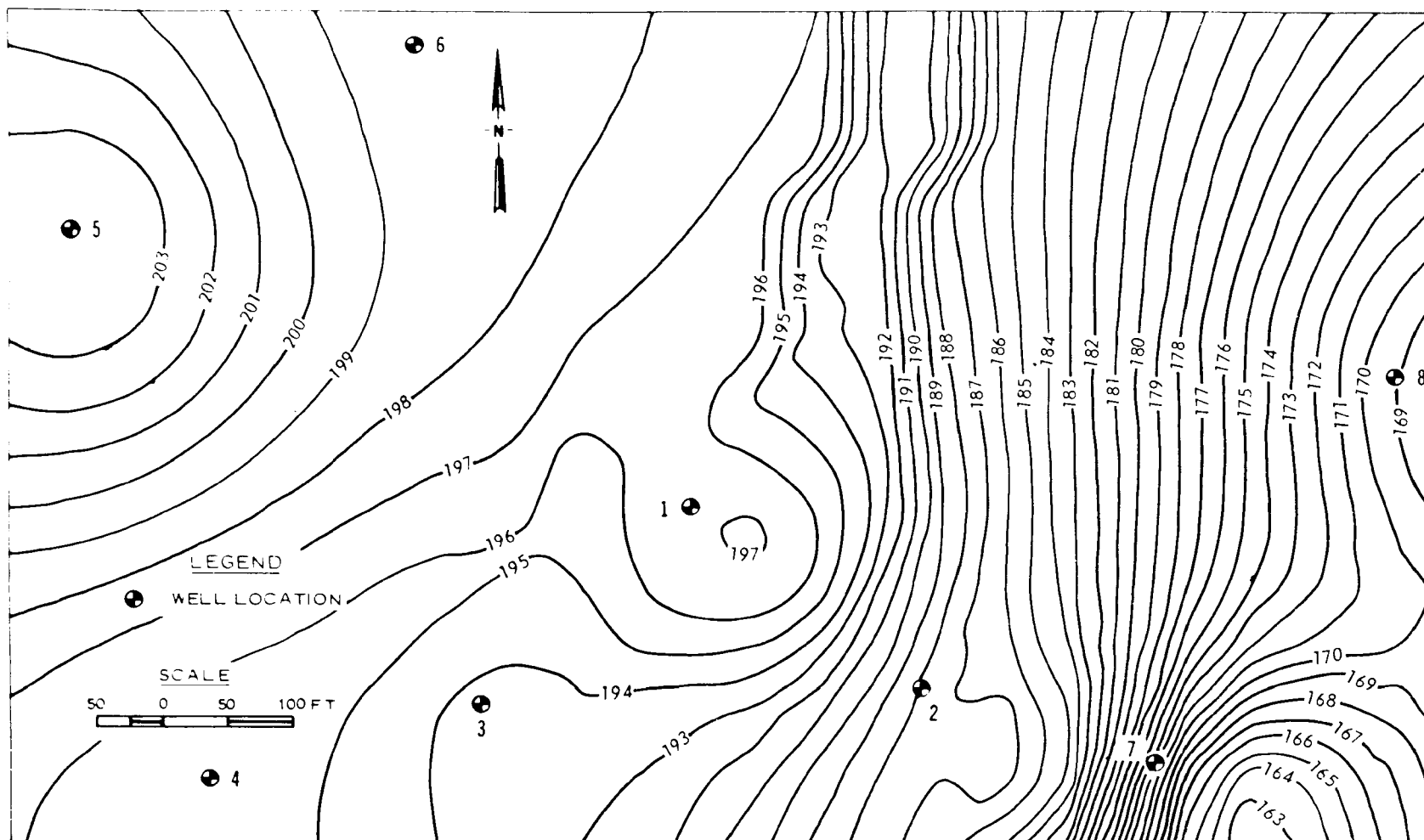


Figure B-1. Water table map of site B (contour lines are elevation of water table in feet above mean sea level). 0.305 m = 1 ft.

TABLE B-1. LOG OF BORING 1 AT SITE B

Elevation above MSL(m)	Depth (m)	Description
60.15 - 54.27	0.0 - 5.88	Refuse
54.27 - 51.74	5.88 - 8.41	Clayey silt (ML), gray
51.74 - 51.03	8.41 - 9.12	Silty clay (CL), gray

Water table elevation above MSL = 54.34 m

TABLE B-2. LOG OF BORING 2 AT SITE B

Elevation above MSL(m)	Depth (m)	Description
57.20 - 57.9	0.0 - 0.30	Backfill
57.90 - 54.46	0.30 - 2.74	Refuse
54.46 - 51.41	2.74 - 5.79	Clayey silt (ML), gray
51.41 - 48.05	5.79 - 9.15	Clayey silt (ML), tan
Water table elevation above MSL = 50.94 m		

TABLE B-3. LOG OF BORING 3 AT SITE B

Elevation above MSL (m)	Depth (m)	Description
58.96 - 58.66	0.0 - 0.30	Topsoil
58.66 - 56.74	0.30 - 2.22	Refuse
56.74 - 56.22	2.22 - 2.74	Silt (ML), gray
56.22 - 52.86	2.74 - 6.10	Silt (ML), tan, wet

Water table elevation above MSL = 53.23 m

TABLE B-4. LOG OF BORING 4 AT SITE B

Elevation above MSL (m)	Depth (m)	Description
59.51 - 55.24	0.0 - 4.27	Silt (ML), tan
55.24 - 51.89	4.27 - 7.62	Silt (ML), tan and grayish tan, wet

Water table elevation above MSL $\approx$ 53.84 m

TABLE B-5. LOG OF BORING 5 AT SITE B

Elevation above MSL (m)	Depth (m)	Description
62.20 - 57.63	0.0 - 4.57	Silt (ML), tan
57.63 - 54.58	4.57 - 7.62	Silt (ML), tan, wet
54.58 - 52.44	7.62 - 9.76	Silt (ML), tan with gray specks, wet
Water table elevation above MSL = 53.35 m		

TABLE B-6. LOG OF BORING 6 AT SITE B

Elevation above MSL (m)	Depth (m)	Description
60.52 - 54.42	0.0 - 6.10	Silt (ML), tan
54.42 - 51.37	6.10 - 9.15	Silt (ML), tan and gray
51.37 - 49.54	9.15 - 10.98	Silt (ML), tan with shells

Water table elevation above MSL = 50.15 m

TABLE B-7. LOG OF BORING 7 AT SITE B

Elevation above MSL (m)	Depth (m)	Description
49.42 - 48.81	0.0 - 0.61	Refuse
48.81 - 45.91	0.61 - 3.51	Silt (ML), gray
45.91 - 41.80	3.51 - 7.62	Silt (ML) tan, moist

Water table elevation above MSL = 42.10 m

TABLE B-8. LOG OF BORING 8 AT SITE B

Elevation above MSL (m)	Depth (m)	Description
50.91 - 46.34	0.0 - 4.57	Silt (ML)
46.34 - 43.29	4.57 - 7.62	Silt (ML), gray, wet
43.29 - 43.08	7.62 - 7.83	Silt (ML), tan
43.08 - 42.65	7.83 - 8.26	Silt (ML), light gray with shells

Water table elevation above MSL = 45.61 m

TABLE B-9. LIST OF SAMPLES EXAMINED FROM SITE B

Boring	Elevation of top of hole (m)	Elevation of water table (m)	Total depth (m)	Thickness of cover (m)	Thickness of refuse (m)	Elevation MW*/soil interface (m)	Sampled depth interval(m)		Elevation of sampled intervals(m)		Type of sample	Sample number
							From	To	From	To		
1	60.15	54.36	9.14	0.0	4.88	55.27	4.22		55.93		chemical	1C1
							6.09		54.06		chemical	1C2
							6.25	6.37	53.90	53.78	physical	1P1
							8.41	8.87	51.74	51.28	physical	1P2
2	57.20	50.94	9.14	0.3	2.44	54.46	0.43		56.77		chemical	2C1
							1.35		55.85		chemical	2C2
							3.48		53.72		chemical	2C3
							3.66	4.15	53.54	53.05	physical	2P1
							5.79	6.52	51.41	50.68	physical	2P2
3	58.96	53.23	6.10	0.3	1.92	56.74	2.22		56.74		chemical	3C1
							3.22		55.74		chemical	3C2
							5.46		53.50		chemical	3C3
4	59.51	53.84	7.62	NA	NA	NA**	--		--		--	--
5	62.20	53.35	9.76	NA	NA	NA	0.20		55.28		chemical	5C1
							0.92		54.38		chemical	5C2
							3.05		52.44		chemical	5C3
6	60.52	50.15	10.98	NA	NA	NA	5.9		54.26		chemical	6C1
							6.10	6.77	54.42	53.75	physical	6P1
							7.17		53.35		chemical	6C2
							9.15	9.85	51.37	50.67	physical	6P2
							9.30		51.22		chemical	6C3
7	49.42	42.10	7.62	0.0	0.61	0.61	4.57	5.27	44.85	44.15	physical	7P1
							7.42		42.00		chemical	7C1
8	50.91	45.61	8.26	NA	NA	NA	6.10	6.68	44.81	44.23	physical	8P1

* municipal waste

** not applicable

-- no sample selected

APPENDIX C

SUB-SURFACE INFORMATION FOR SITE C

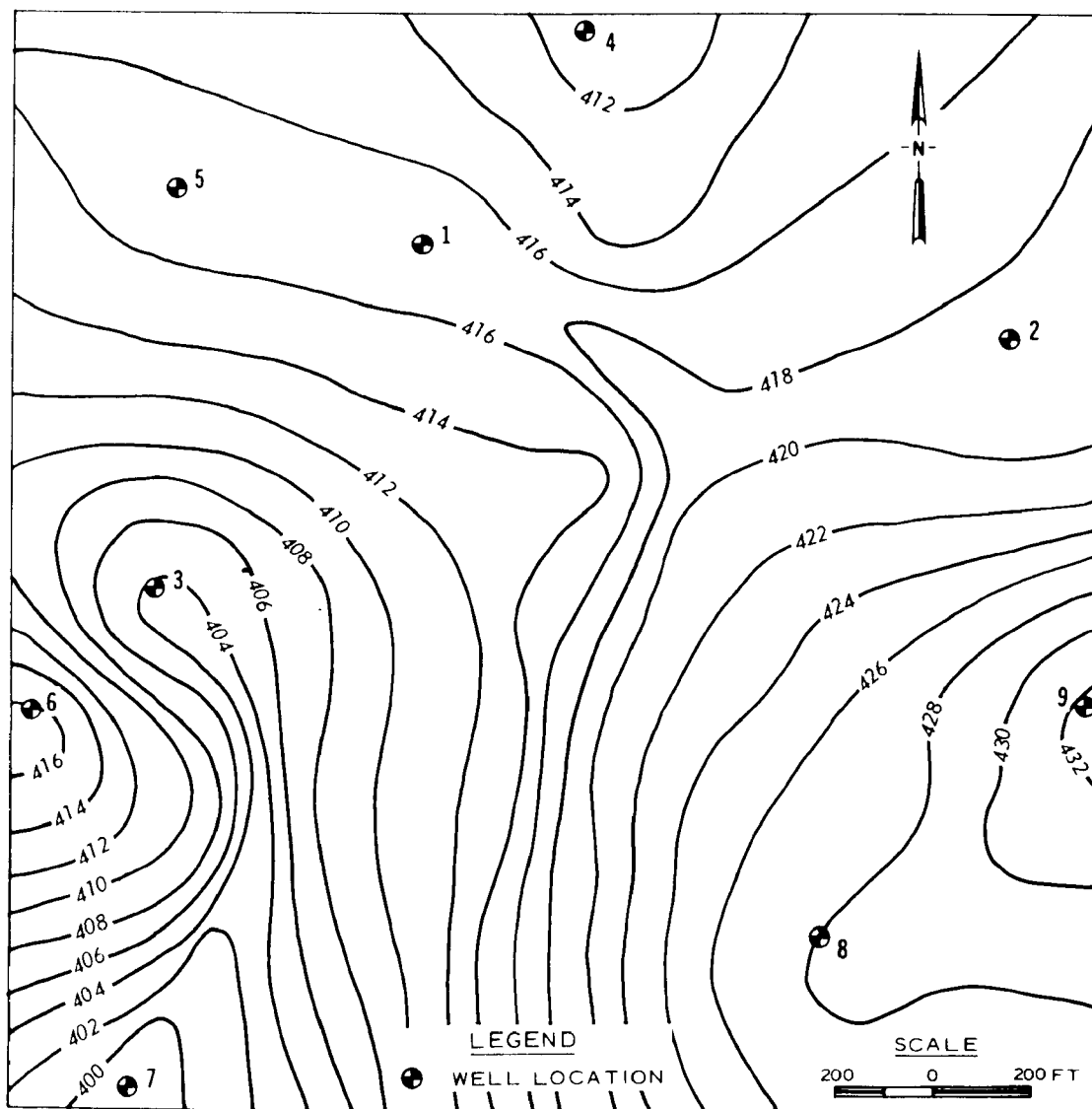


Figure C-1. Water table map of site C (contour lines are elevation of water table in feet above mean sea level). 0.305 m = 1 ft.

TABLE C-1. LOG OF BORING 1 AT SITE C

Elevation above MSL* (m)	Depth (m)	Description
157.40-156.49	0.0 - 0.91	Clay (cover material)
156.49-131.79	0.91-25.61	Refuse
131.79-131.33	25.61-26.07	Silt (ML), tan
131.33-128.38	26.07-29.02	Silt (ML), red
128.38-124.78	29.02-32.62	Silty sand (SM), brown
124.78	32.62	Schist

* MSL = mean sea level

Water table elevation above MSL = 127.01 m

TABLE C-2. LOG OF BORING 2 AT SITE C

Elevation above MSL (m)	Depth (m)	Description
145.85-144.63	0.0 - 1.22	Clay (cover material)
144.63-139.75	1.22- 6.10	Refuse
139.75-137.31	6.10- 8.54	Saturated fill
137.31-128.17	8.54-17.68	Refuse very wet
128.17-126.64	17.68-19.21	Silty sand (SM)
126.64-123.26	19.21-22.59	Sandy silt (ML) -

Water table elevation above MSL = 127.26 m

TABLE C-3. LOG OF BORING 3 AT SITE C

Elevation above MSL (m)	Depth (m)	Description
145.58-145.28	0.0 - 0.30	Cover material
145.28-125.61	0.30-19.97	Refuse
125.61-124.70	19.97-20.88	Clayey sandy silt (ML), light green
124.70-123.32	20.88-22.26	Sandy silt (ML), brown with gravel
123.32-122.72	22.26-22.86	Sandy silt (ML), brown

Water table elevation above MSL = 123.02 m

TABLE C-4. LOG OF BORING 4 AT SITE C

Elevation above MSL (m)	Depth (m)	Description
136.43-135.39	0.0 - 1.04	Backfill
135.39-130.33	1.04- 6.10	Clayey sandy silt (ML), brown
130.33-125.36	6.10-11.07	Sandy silt (ML), brown
125.36-124.91	11.07-11.52	Highly weathered schist

Water table elevation above MSL = 125.40 m

TABLE C-5. LOG OF BORING 5 AT SITE C

Elevation above MSL (m)	Depth (m)	Description
131.61-131.00	0.0 -0.61	Backfill
131.00-130.09	0.61-1.52	Silty clay (CL), dark gray
130.09-127.95	1.52-3.66	Silty clay (CL), tan
127.95-127.04	3.66-4.57	Sandy silt (ML), red, tan
127.04-126.31	4.57-5.30	Sandy silt (ML), red and tan, wet

Water table elevation above MSL = 127.04 m

TABLE C-6. LOG OF BORING 6 AT SITE C

Elevation above MSL (m)	Depth (m)	Description
133.81-132.90	0.0 -0.91	Silty clay (CL), brown
132.90-130.76	0.91-3.05	Clayey sandy silt (ML), tan
130.76-126.71	3.05-7.01	Sandy silt (ML), brown

Water table elevation above MSL = 6.77 m

TABLE C-7. LOG OF BORING 7 AT SITE C

Elevation above MSL (m)	Depth (m)	Description
125.27-122.83	0.0 -2.44	Sandy silt (ML), reddish brown
122.83-121.92	2.44-3.35	Sandy silt (ML) brown, damp
121.92-121.64	3.35-3.63	Silty sand (SM) fine, green

Water table elevation above MSL = 121.71 m

TABLE C-8. LOG OF BORING 8 AT SITE C

Elevation above MSL (m)	Depth (m)	Description
132.38-131.47	0.0 -0.91	Clayey silt (ML), tan with gravel
131.47-130.25	0.91-2.13	Clayey silt (ML), brown
130.25-129.18	2.13-3.20	Sandy silt (ML), brown

Water table elevation above MSL = 130.55 m

TABLE C-9. LOG OF BORING 9 AT SITE C

Elevation above MSL (m)	Depth (m)	Description
145.55-142.70	0.0 - 3.35	Sandy silt (ML), reddish brown
142.70-133.90	3.35-11.65	Sandy silt (ML), brown
133.90-131.53	11.65-14.02	Silty sand (SM), brown

Water table elevation above MSL = 131.95 m

TABLE C-10. LIST OF SAMPLES EXAMINED FROM SITE C

Boring	Elevation of top of hole (m)	Elevation of water table (m)	Total depth (m)	Thickness of cover (m)	Thickness of refuse (m)	Elevation MW/soil interface (m)	Sampled depth interval(m)		Elevation of sampled intervals(m)		Type of sample	Sample number
							From	To	From	To		
1	157.41	127.01	32.62	0.91	24.70	131.80	25.91	26.36	131.50 131.41 130.48	131.05	physical chemical chemical	1P1 1C1 1C2
							28.96	29.40	128.45 128.34	128.01	physical chemical	1P2 1C3
2	145.85	127.26	22.59	1.22	16.46	128.17	18.29 18.39 19.30 21.44 22.26	18.96	127.56 127.46 126.55 124.41 123.59	126.89	physical chemical chemical chemical physical	2P1 2C1 2C2 2C3 2P2
3	145.58	123.02	22.36	0.30	19.66	125.62	19.97 20.08 21.01 22.28 22.47	20.46	125.61 125.50 124.57 123.20 123.11	125.12	physical chemical chemical chemical physical	3P1 3C1 3C2 3C3 3P2
4	136.46	125.40	11.52	NA	NA	NA	1.70 8.49 11.72	2.03 8.76	134.76 127.97 124.74	134.43 127.70	physical physical chemical	4P1 4P2 4C1
5	131.62	127.04	5.18	NA	NA	NA	4.7		126.92		chemical	5C1
6	133.81	127.04	7.01	NA	NA	NA	0.91 1.35 2.27 4.40	1.46	132.90 132.46 131.54 129.41	132.35	physical chemical chemical chemical	6P1 6C1 6C2 6C3

(continued)

TABLE C-10. (continued)

Boring	Elevation of top of hole (m)	Elevation of water table (m)	Total depth (m)	Thickness of cover (m)	Thickness of refuse (m)	Elevation MW/soil interface (m)	Sampled depth interval (m)		Elevation of sampled intervals (m)		Type of sample	Sample number
							From	To	From	To		
139	7	125.27	121.71	4.12	NA	NA	4.57	5.11	129.24	128.70	physical	6P2
							5.93		127.88		chemical	6C4
							7.75		126.06		chemical	6C5
	8	132.38	130.50	3.20	NA	NA	0.91	1.58	124.36	123.69	physical	7P1
							3.47		121.80		chemical	7C1
	9	145.55	132.0	14.02	NA	NA	2.24	7.88	130.14	137.67	chemical	8C1
							2.08		143.47		chemical	9C1
							2.98		142.57		chemical	9C2
							5.11		140.44		chemical	9C3
							7.32		138.23		physical	9P1
							9.38		136.17		chemical	9C4
							13.64		131.91		chemical	9C5

NA = not applicable

Note: All elevations are given with reference to mean sea level.

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-600/2-78-096		3. RECIPIENT'S ACCESSION NO.	
4. TITLE AND SUBTITLE Chemical and Physical Effects of Municipal Landfills on Underlying Soils and Groundwater		5. REPORT DATE May 1978 (Issuing Date)	
7. AUTHOR(S) U.S. Army Engineer Waterways Experiment Station		6. PERFORMING ORGANIZATION CODE	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Environmental Effects Laboratory U.S. Army Engineer Waterways Experiment Station Vicksburg, Mississippi 39180		8. PERFORMING ORGANIZATION REPORT NO.	
12. SPONSORING AGENCY NAME AND ADDRESS Municipal Environmental Research Laboratory--Cin., OH Office of Research and Development U.S. Environmental Protection Agency Cincinnati, Ohio 45268		10. PROGRAM ELEMENT NO. 1DC618	
		11. CONTRACT/GRANT NO. IAG-D4-0569	
15. SUPPLEMENTARY NOTES Robert E. Landreth, Project Officer, 684-7871		13. TYPE OF REPORT AND PERIOD COVERED Final, June 1975-December 1975	
		14. SPONSORING AGENCY CODE EPA/600/14	
16. ABSTRACT Three municipal landfill sites in the eastern and central United States were studied to determine the effects of the disposal facilities on surrounding soils and groundwater. Borings were made up the groundwater gradient, down the groundwater gradient and through the landfill. Soil and groundwater samples from the test borings were examined. Groundwater samples were analyzed chemically. Soil samples were tested physically and distilled water extracts and nitric acid digests of the soils were analyzed chemically. Groundwater samples from under and downgradient from the landfill showed elevated levels of sulfate in every case. At some sites increased levels of nitrate, total organic carbon and cyanide could be related to the presence of the landfill. No changes in physical characteristics could be related to the presence of the landfill at any site. No evidence was found in this study to indicate that sub-landfill soils seal themselves. Distilled water extracts prepared from soil samples showed consistently low levels for all soluble constituents. Generally, there was more sulfate, chloride, organic carbon, nitrate and high levels of trace metals in extracts of soils from under the landfill than from soils collected at similar depths outside the landfill. Nitric acid digests of soil samples showed great variability in chemical composition. At two of the three sites; iron, manganese, boron, beryllium and zinc were found in higher concentrations in nitric acid digests immediately under the landfill. The results of this investigation indicate that chemical characteristics but, not physical characteristics were altered in sub-landfill soils. Removal of pollutants from leachate through the action of soil was observed for only a very limited number of pollutants.			
17. KEY WORDS AND DOCUMENT ANALYSIS			
a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Chemical Analysis Leaching Soil Chemistry		Solid Waste Pollutant Migration Groundwater Pollution Municipal Landfill	13B
18. DISTRIBUTION STATEMENT RELEASE TO PUBLIC		19. SECURITY CLASS (This Report) UNCLASSIFIED	21. NO. OF PAGES 154
		20. SECURITY CLASS (This page) UNCLASSIFIED	22. PRICE

EXHIBIT 10

Chapter 1 | Solid Waste Management



A brief history of waste and landfills

When the majority of people lived in rural areas, their waste, which consisted almost entirely of organic materials derived from plants, humans, and animals, was burned for fuel, used as crop fertilizers, or fed to livestock. These types of waste management strategies are still practiced in some areas of the world.

As civilization developed and populations concentrated in towns and cities, throwing waste out the door to animals or into the garden posed public health problems.

Some cities, notably in parts of Asia, solved their waste problem by hauling organic waste out to farms and composting it to revitalize crop lands. Another method was to take waste out to the countryside and dump it in piles. Around 500 B.C., Athens issued the first-known law against throwing waste in the streets, requiring it to be dumped no less than one mile outside the city walls. The open dump was born.

Included in this chapter

- Minnesota's waste management hierarchy
 - What do we throw away?
 - Collection
 - Transfer
 - Disposal
 - Solid waste planning and policy
-

Minnesota's waste management history

Prior to the 1960s, most waste was disposed of in open or burning dumps located throughout Minnesota. All waste types were allowed at these sites. The Minnesota Department of Health was given legislative authority over dumps located in tourist camps, summer hotels, and resorts. Cities, villages, or townships maintained regulatory control and responsibility over all other dumpsites.

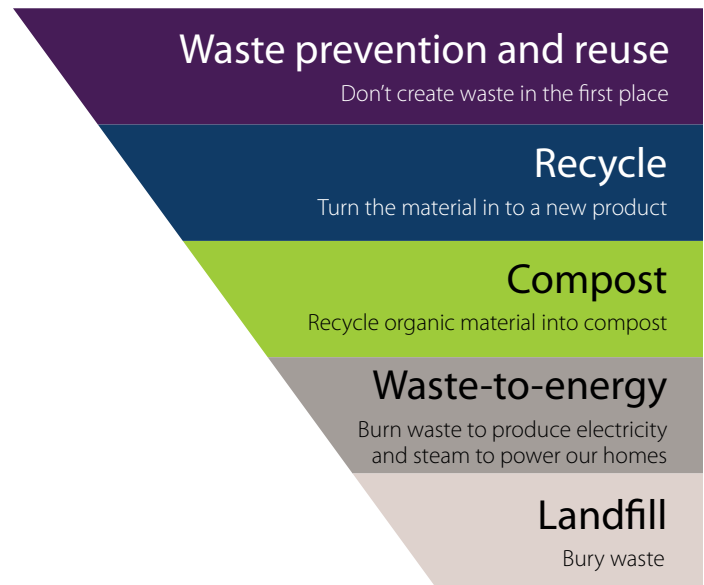
At the time, waste composition was vastly different, and the volume of household wastes was much smaller. Reuse was the norm; containers were made of glass or tin, and food was bought fresh or grown and processed at home. Junk mail and plastic packaging didn't exist. People were, in general, much more frugal. Two world wars and the Great Depression made people more conscious about saving and reusing items as much as they could. Many people went to dumps to scavenge for reusable materials and goods. In northern Minnesota, dumps even served as a social gathering place for activities such as shooting rats and watching bears.

Land use concerns grew as urban areas started to expand. New dumps became harder to site because fewer people were willing to have dumps near their properties. The Legislature passed the Federal Solid Waste Disposal Act in 1965. Two years later, the State of Minnesota created the Minnesota Pollution Control Agency (MPCA) to monitor and regulate air, water, and land pollution. In 1969, the Minnesota Solid Waste Act, which granted oversight of solid waste management to the MPCA, was passed. The act prohibited open burning, established a solid waste permitting process, and emphasized upgrading dumps to sanitary landfills.

During the 1970s, concerns over pollution from landfill sites led to the emergence of regulations for hazardous waste disposal and groundwater protection at landfill sites. These regulations would evolve over the next several decades.

Counties, with oversight from the MPCA, were given responsibility for local solid waste management and were required to submit solid waste management plans to the state. The composition of waste was changing rapidly and now included processed food, plastic packaging, and disposable diapers.

Passed in 1980, the Minnesota Waste Management Act established a waste management hierarchy. The hierarchy prioritizes waste reduction and reuse, recycling, composting, and resource recovery over land disposal. The act also created a landfill siting process and required solid waste abatement planning for metropolitan counties.



The Minnesota Waste Management Act mandates a two-fold strategy:

- Pursue the highest methods of solid waste abatement through source reduction, recycling, organics recovery and resource recovery.
- Minimize the use of landfills and ensure landfills are environmentally sound.

This strategy has helped Hennepin County achieve a recycling rate of approximately 45 percent, supported resource recovery facilities that use solid waste to generate energy, encouraged the implementation of organics recycling programs and the development of composting sites, and introduced source reduction, toxicity reduction, and public awareness activities.

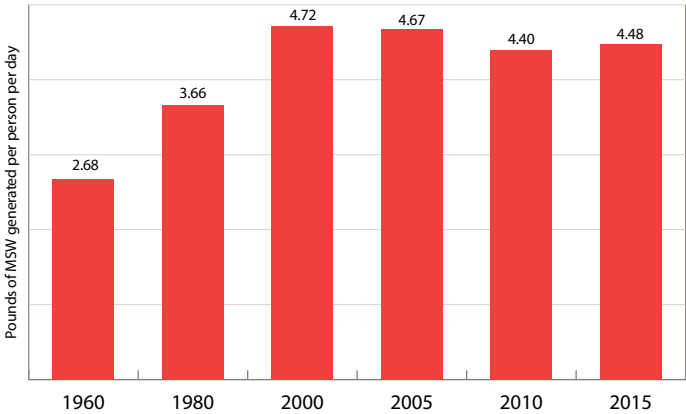
Yet the work is far from over. There is ample opportunity to shift more materials to top of the state's waste management hierarchy by emphasizing waste prevention, recycling and composting.

What do we throw away?

Municipal solid waste (MSW) includes everything we dispose of, including everything we recycle, put in the trash, bring to a household hazardous waste facility, etc. MSW consists of everyday items we use and then throw away. This includes appliances, batteries, bottles, cans, clothing, food scraps, furniture, newspapers, paint, product packaging and much more. MSW is waste that comes from homes, schools, businesses, and public spaces.

In 1960, total MSW generation in the U.S. was 88 million tons. This amount has steadily increased since. In 2018, Americans generated about 294 million tons of MSW, or about 4.9 pounds of waste per person per day.

U.S. MSW generation rate per person

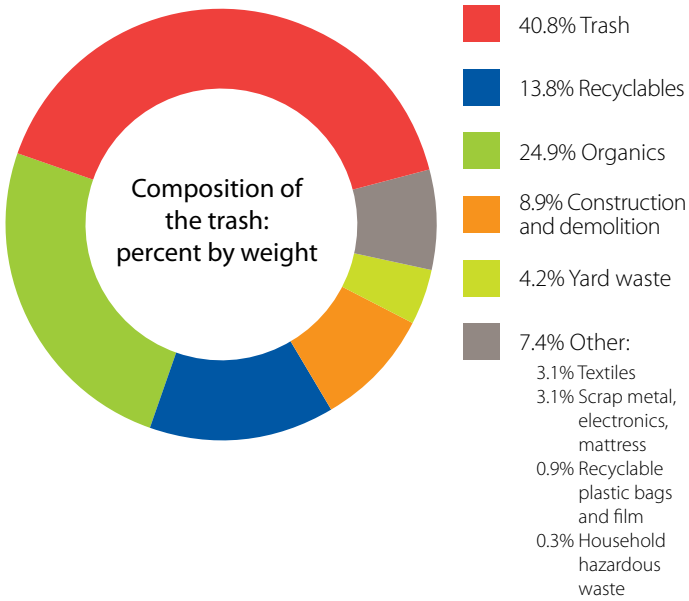


Of those 294 million tons of MSW, more than 94 million tons were recycled or composted. The national recovery rate for recycling, which includes composting, was 32.17 percent.

Hennepin County has a recycling rate that is higher than the national average. In 2024, 42 percent of waste generated in the county was either recycled or composted. Of the trash left, 28 percent was sent to resource recovery/ waste-to-energy facilities, and 29 percent was sent to landfills.

A 2016 waste composition study examined the composition of trash in Hennepin County. This reflects only what has been thrown in the trash; not what has already been diverted for recycling or composting.

Hennepin County MSW Composition in 2016



As shown, there are opportunities to increase both recycling and composting. Especially of food waste and other organic waste, which is the most prevalent material in the trash that could be diverted – representing about 25 percent of the trash by weight.

Collection

The Twin Cities solid waste infrastructure is made up of private and public entities that collect, transport, recycle, recover, and land-dispose of the materials generated at homes, businesses, and institutions. Hennepin County licenses nearly 200 waste-hauling businesses to collect and transport MSW. Waste haulers that collect and transport non-MSW, recycling, or organic waste are not licensed. State law requires waste haulers to provide volume-based service, meaning rates are set based on the amount of waste set out for collection.

Most Twin Cities communities allow residents and businesses to choose their waste hauler. This is referred to as open collection. Some cities, such as Minneapolis, arrange for the service by contract or provide their own service. This is referred to as organized collection. Communities with organized collection represent 48 percent of the households in Hennepin County (although most multifamily residences in these cities are not included in these services). There are no organized collection arrangements for commercial waste, although some communities give small businesses access to organized collection services.

Transfer and disposal

In Hennepin County, waste is either hauled directly to the Hennepin Energy Recovery Center (HERC) or a land disposal facility. Waste may also be taken to a transfer station where waste is loaded into trailer trucks and transported to landfills farther away. In the Twin Cities, there are 19 transfer stations; 14 are licensed to accept MSW and five to accept only construction and demolition (C&D) waste.



The Hennepin Energy Recovery Center (HERC) in downtown Minneapolis.

Only one transfer station is publicly owned – the Hennepin County Transfer Station in Brooklyn Park. The remaining are privately owned. Transfer stations allow waste haulers to spend more time picking up waste rather than traveling long distances to dump their loads at the landfill. Four to five waste truckloads can fit into one transfer trailer, reducing traffic to and from the landfill, saving energy, time, and money.



A transfer trailer at the Hennepin County Transfer Station in Brooklyn Park can haul four to five waste truckloads.

The Hennepin County Transfer Station in Brooklyn Park also accepts household hazardous waste and provides free drop-off facilities for recyclables and residential organics.

Disposal

Resource recovery

The Hennepin Energy Recovery Center (HERC) is a waste-to-energy facility in Minneapolis that uses mass-burn technology to generate energy. At HERC, waste is burned to produce high-pressure steam that turns a turbine to generate electricity. A portion of the steam is diverted to provide steam for heating and hot water to the downtown Minneapolis district energy system and Target Field.

Each year more than 16,000 tons of ferrous metal are recovered from the waste stream at HERC and recycled. This is almost double the 6,500 tons of ferrous metal collected annually in curbside and drop-off recycling programs in Hennepin County.

The state permits HERC to process up to 365,000 tons of waste per year. HERC generates enough electricity to power 25,000 homes each year.

Landfills

In 2024, 29 percent of MSW generated in Hennepin County was land disposed in the eight landfills shown below. Most of the waste was landfilled in the metro area.

Landfill	Tons	Location	Owner
Pine Bend	131,690	Inver Grove Heights, MN	Republic
Spruce Ridge	8,901	Glencoe, MN	Waste Management
Burnsville	84,920	Burnsville, MN	Waste Management
Elk River	146,440	Elk River, MN	Waste Management
Nobles County	406	Rushmore, MN	Nobles County
Superior 7-mile	16,245	Eau Claire, WI	Advanced Disposal
Timberline	476	Weyerhaeuser, WI	Waste Management
Lake Area Landfill	19,545	Sarona, WI	Republic
Total	323,281		

Solid waste planning and policy

Solid waste management policy plan

In 2024, the Minnesota Pollution Control Agency (MPCA) approved its new state solid waste management policy plan to set objectives for 2028 and establish a framework for meeting the statutory goal to recycle 75 percent by 2030. State statute requires metropolitan counties to prepare master plans every six years that identify strategies to meet the recycling goals and objectives in the state’s Metropolitan Solid Waste Management Policy Plan. The county’s plan was adopted by the Hennepin County Board of Commissioners and submitted to the MPCA on October 29, 2024.

Hennepin County developed its 2024 Solid Waste Management Master Plan to reach the goal of recycling 75 percent of waste by 2030. View the Hennepin County Solid Waste Management Plan at hennepin.us/solidwasteplanning.

Municipal responsibility

Hennepin County Ordinance 13 requires municipalities to adopt local laws relating to the separation of recyclables from waste. Hennepin County’s Residential Recycling Funding Policy facilitates the transfer of Select Committee on Recycling and the Environment (SCORE) funds, which the county receives from the state, to municipalities. These funds support curbside recycling and organics recycling programs.

Private sector responsibility

Individuals and businesses are expected to follow the state, county, and municipal laws and regulations and participate in waste management programs. Generally, the public sector relies on the private waste management industry to provide waste management services, including waste and recycling collection, disposal of ash and residues, and handling of problem materials and hazardous wastes.

Hennepin County solid waste management programs and initiatives

Hennepin County has a growing number of programs and initiatives that help cities, residents, organizations, and businesses reduce waste and increase waste diversion. An overview of these programs and initiatives can be found in the county’s annual Recycling Progress Report, available at hennepin.us/solidwasteplanning.

Resources

The following resources provide more information about solid waste management in Hennepin County and throughout Minnesota.

- **hennepin.us/solidwasteplanning**: Information about how waste is managed in the county and the solid waste planning process.
- **hennepin.us/HERC**: Information about the Hennepin Energy Recovery Center, the county-owned waste-to-energy facility.
- **revisor.mn.gov/rules/7035/**: The Minnesota Waste Management Act on the Minnesota Office of the Revisor of Statutes website.