Sage Creek Hutterite Colony

PWSID # MT0001779

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Report Date: June 9, 2000

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GLOSSARY*

Acute Health Effect An adverse health effect in which symptoms develop rapidly.

Alkalinity The capacity of water to neutralize acids.

Aquifer A water-bearing layer of rock or sediment that will yield water in usable quantity to a well or spring.

Best Management Practices (BMPs) Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from nonpoint sources.

Coliform Bacteria Bacteria found in the intestinal tracts of animals. Their presence in water is an indicator of pollution and possible contamination by pathogens.

Confined Aquifer A fully saturated aquifer overlain by a confining unit such as a clay layer. The static water level in a well in a confined aquifer is at an elevation that is equal to or higher than the base of the overlying confining unit.

Confining Unit A geologic formation that inhibits the flow of water.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Enacted in 1980. CERCLA provides a Federal "Superfund" to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. Through the Act, EPA was given power to seek out those parties responsible for any release and assure their cooperation in the cleanup.

Delineation A process of mapping source water management areas.

Hardness Characteristic of water caused by presence of various chemical compounds. Hard water may interfere with some industrial processes and prevent soap from lathering.

Hazard A measure of the potential of a contaminant leaked from a facility to reach a public water supply source. Proximity or density of significant potential contaminant sources determines hazard.

Hydraulic Conductivity A coefficient of proportionality describing the rate at which water can move through an aquifer.

Inventory Region A source water management area that encompasses the area expected to contribute water to a public water supply within a fixed distance or a specified groundwater travel time.

Maximum Contaminant Level (MCL) Maximum concentration of a substance in water that is permitted to be delivered to the users of a public water supply. Set by EPA under authority of the Safe Drinking Water Act.

Nitrate An important plant nutrient and type of inorganic fertilizer. In water, the major sources of nitrate pollution are septic tanks, sanitary sewers, feed lots and fertilizers.

Nonpoint-Source Pollution Pollution sources such as stormwater runoff that are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet.

Pathogens Bacterial organisms typically found in the intestinal tracts of mammals, capable of producing disease.

Point-Source A stationary location or fixed facility from which pollutants are discharged.

Public Water System A system that provides piped water for human consumption to at least 15 service connections or regularly serves 25 individuals.

Pumping Water Level Water level elevation in a well when the pump is operating.

Recharge Region Source water management region that is generally the entire area that could contribute water to an aquifer used by a public water system. Includes areas that could contribute water over long time-periods or under different water usage patterns.

Resource Conservation and Recovery Act (RCRA) Enacted by Congress in 1976. RCRA's primary goals are to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner.

Source Water Protection Area For surface water sources, the land and surface drainage network that contributes water to a stream or reservoir used by a public water supply.

Static Water Level (SWL) Water level elevation in a well when the pump is not operating.

Susceptibility (of a PWS) The potential for a public water system to draw water with contamination at concentrations that would pose concern. Susceptibility is evaluated at the point immediately preceding treatment or, if no treatment is provided, at the entry point to the distribution system.

Synthetic Organic Compounds (SOC) Manmade organic chemical compounds such as herbicides and pesticides.

Total Dissolved Solids (TDS) The dissolved solids collected after a sample of a known volume of water is passed through a very fine mesh filter.

Transmissivity The ability of an aquifer to transmit water.

Unconfined Aquifer An aquifer containing water that is not under pressure. The water table is the top surface of an unconfined aquifer.

Volatile Organic Compounds (VOC) Any organic compound which evaporates readily to the atmosphere.

> * Definitions taken from EPA's Glossary of Selected Terms and Abbreviations (http://www.epa.gov/ceisweb1/ceishome/ceisdocs/glossary/glossary.html)

INTRODUCTION

The Source Water Delineation and Assessment Report for Sage Creek Colony was completed by Russell L. Levens, Montana Department of Environmental Quality. John D. Wurtz assisted extensively with the contaminant source inventory. Paul P. Wurtz, the certified wastewater operator, also assisted with the inventory.

Purpose

This delineation and assessment report is intended to meet the technical requirements of the Montana Source Water Protection Program (DEQ, 1999) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (P.L. 104-182).

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protect public drinking water supplies from contamination. A major component of the Montana Source Water Protection Program is delineation and assessment. Delineation is a process of mapping areas that contribute water used for drinking, called source water protection areas. Assessment involves identifying locations or regions in source water protection areas where contaminants may be generated, stored, or transported, and then determining the relative potential for contamination of drinking water by these sources. The primary purpose of this source water delineation and assessment report is to provide information that helps Sage Creek Hutterite Colony complete a source water protection plan to protect its drinking water source.

Limitations

This report was prepared to assess threats to Sage Creek Hutterite Colony public water supply, and is based on published information and information obtained from local residents familiar with the community. The terms "drinking water supply" or "drinking water source" refer specifically to the source of the colony’s public water supply and not any other public or private water supply. In addition, not all potential or existing sources of groundwater or surface water contamination in the area of Sage Creek Hutterite Colony are identified. Only sources of contamination in areas that contribute water to its drinking water source are considered potential contaminant sources.

The terms "contaminant" and "toxin" are used in this report to refer to substances for which maximum concentration levels (MCLs) have been specified under the national primary drinking water standards plus certain substances that do not have MCLs but that are considered to be significant health threats. In this report we only consider those constituents that are threats to human health.

CHAPTER 1

BACKGROUND

The Community

Sage Creek Hutterite Colony is located in north central Montana near the U.S.-Canadian border. The nearest town with commercial services is Chester (pop. 950), 31 miles to the south. Approximately 120 people reside at the colony and produce a variety of agricultural products including hogs, chickens, dairy products, and grain. The colony complex consists of barns, shops, and homes covering approximately 20 acres.

Human and animal wastes are piped to separate two-cell treatment lagoons both lined with bentonite. Runoff from the dairy stockyards flows to a retention pond from which it is taken to irrigate cropland.

Geographic setting

Sage Creek Colony is northeast of the Sweet Grass Hills, a small collection of distinct peaks that rise nearly 3,000 feet above the surrounding plains (see vicinity map in Figure 1). The Sweet Grass Hills dominate the weather as well as the horizon. The orographic effect of the hills creates relatively wet islands in the otherwise semi-arid plains surrounding them. Precipitation in the Sweet Grass Hills approaches 20 inches per year compared to 10.7 inches per year in Chester. Most precipitation falls as rain during the months of May through August. Average low and high temperatures in Chester are 0.9° F and 26.7° F in January and 49.9° F and 83.5° F in July.

Sage Creek Colony lies between Chicken Coulee and Sage Creek, an intermittent stream that drains the northeast slope of East Butte. Sage Creek as other streams that drain the Sweet Grass Hills only flow in response to snowmelt or intense summer storms.

General Description of the Source Water

Sage Creek Colony gets its potable water from a confined sandstone aquifer approximately 700 feet beneath the colony complex. Recharge to the aquifer is primarily from percolation of precipitation and losses from streams that cross outcrops along the flanks of East Butte (Tuck, 1993). Groundwater flows from outcrops northeast toward the colony following the regional dip of the aquifer. The capacity of the colony's well is low.

Table 1 List of geologic or hydrogeologic maps available for the vicinity of Sage Creek Colony

Title or Description	Date	Area Covered	Reference
Reconnaissance Geologic Map of the Sweet Grass Hills 30 x 60-Minute Quadrangle, North-Central Montana	1995	Sweet Grass Hills	Lopez, David A., 1995, Geology of the Sweet Grass Hills, North-Central Montana: Montana Bureau of Mines and Geology Memoir 68, 35 p.
Potentiometric Surface Map of the Virgelle Sandstone Member of the Eagle Sandstone around the Sweet Grass Hills	1990	Helena Valley	Tuck, L. K., 1993, Reconnaissance of Geology and Water Resources along the North Flank of the Sweet Grass Hills, North-Central Montana: U.S. Geological Survey Water-Resources Investigations Report 93-4026, 68 p.

The Public Water Supply

The 120 residents of Sage Creek Colony receive water through four service connections. The well is in a below ground concrete pit at the southwest corner of the colony. The well was drilled in 1961 to a depth of 785 ft but was plugged back to 745 ft at completion. The colony purchases additional water from the Sage Creek Water Users (PWS#03150) exclusively for waste disposal. Two distribution systems keep the water systems separate. Water storage consists of two 7,000-gallon capacity concrete tanks.

Water Quality

Water at Sage Creek Colony is routinely monitored for compliance with drinking water standards. Bacteriological monitoring occurs monthly. Compliance with other drinking water standards is based on additional sampling on a variety of schedules. Nitrate was the only regulated contaminants detected in the last five years. Nitrate can come from human or animal wastes but also occurs naturally. The highest level detected in Sage Creek Colony's well was 0.57 mg/l, considerably below the maximum concentration level of 10 mg/l set by the U.S. Environmental Protection Agency (EPA). The only enforcement actions for non-compliance with public drinking water regulations taken against Sage Creek Colony in the last five years were for failure to monitor the distribution system.

Wells on the north flank of the Sweet Grass Hills were sampled by the USGS to characterize the chemical quality of the water (Tuck, 1993). Water from the sandstone aquifer used at Sage Creek Colony is good relative to alternative sources. A water sample from a well drilled at the colony in 1994 indicates the water in the sandstone aquifer is slightly alkaline and that sodium (Na), bicarbonate (HCO_3), and sulfate (SO_4) are the major dissolved constituents (Table 2). The U.S. Geological Survey sampled wells completed in the sandstone aquifer near the colony (Tuck, 1993). Dissolved solids in these samples ranged from 213 to 1,360 mg/L with a median of 620 mg/L.

Table 2 Concentration of common constituents in the Sage Creek Colony monitor well and in other wells near the Sweet Grass Hills (Tuck, 1993)

-	pH	Sc S/cm	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Fe mg/L	Mn mg/L	SiO_2 mg/L	HCO_3 mg/L	CO_3 mg/L	Cl mg/L	SO_4 mg/L	NO_3 mg/L
Sage Creek Colony	8.82	1248	1.3	0.5	303	1.5	0.006	0.002	10.2	544	34.2	4.5	175	0.42
Nearby Wells (range)	7.2 – 8.6	392 – 2,070	9.9 – 110	11 - 63	6.7 - 420	0.6 – 3	<4 – 2,800	<2 – 1,000	7.7 - 22	190 - 840	0 –52	0.9 - 65	3.6 - 550	0.01 - 0.24

CHAPTER 2

DELINEATION

The area that contributes water to the aquifer tapped by Sage Creek Colony's well is identified in this chapter. This "source water protection area" is divided into regions according to the likelihood that contaminants will reach the well. The sub-regions are, in order of increasing size, the control zone, inventory region, and recharge region. These regions are assigned different management objectives depending on their proximity to the well. The control zone is an area adjacent to the well where direct contaminants can be introduced directly into the well or immediate area. The inventory region encompasses an area in which contaminants could flow with shallow groundwater to the colony's well intake along unsealed well casing. The recharge region is the entire area contributing recharge to the colony's well. Water or contaminants in the recharge region may flow to the well over long periods of time or under increased pumping.

Geologic Conditions and Aquifer Characteristics

Most of the following description of geologic conditions near the Sage Creek Colony is summarized from two reports, one published by the U.S. Geological Survey (Tuck, 1993) and one published by the Montana Bureau of Mines and Geology (Lopez, 1995).

Table 3 List of geologic or hydrogeologic research activities in the area of the Sage Creek Colony

Title of Project	Period of Project	Area Covered	Project Objectives
Reconnaissance of Geology and Water Resources Along the North Flank of the Sweet Grass Hills, North-Central Montana (Tuck, 1993)	1988 - 1990	North Flank of the Sweet Grass Hills	Describe the geology and water resources in the study area
Geology of the Sweet Grass Hills, North-Central Montana (Lopez, 1995)	1992 - 1993	Sweet Grass Hills 30 x 60 minute Quadrangle	Describe and map the geology of the Sweet Grass Hills

Groundwater conditions at the Sage Creek Colony are influenced by the depositional history of layered sedimentary rocks and geologic processes that formed the Sweet Grass

Hills. The Sweet Grass Hills were formed when masses of liquid rock called magma rose thousands of feet along faults through layers of sedimentary rocks. These masses cooled and turned to solid rock below the surface and were exposed when the overlying sedimentary rock was removed by erosion. The layers of limestone, shale, and sandstone that now form the flanks of the Sweet Grass hills were faulted and tilted as the magma moved toward the surface. The Virgelle member of the Eagle Sandstone, the source of Sage Creek Colony's water, crops out along stream cuts on the northeast flank of East Butte and dips northeast at approximately 5° . At the colony the Claggett Shale, Judith River Formation, and glacial deposits of clay, sand, and gravel overlie the Eagle Sandstone (see geologic map in Figure 2).

The Virgelle member of the Eagle Sandstone near the Sweet Grass Hills consists of 60 to194 ft of very-fine to medium grained sandstone with thin interbeds of shale and siltstone (Lopez, 1995). The permeability of the Virgelle Member probably is controlled by fractures created when the magmas of the Sweet Grass Hills flowed toward the surface. The Claggett Shale is up to 430-ft thick near the colony and has very low-permeability making it an effective confining layer above the Eagle Sandstone. Wells drilled by Montana Salinity Control indicate there is 15 to 20 ft of silty clay and clay till overlying the Judith River Formation near the colony well (see Appendix D for well logs).

Conceptual Model and Assumptions

Groundwater in the Eagle Sandstone flows northeast toward the colony from the outcrop areas following the dip of the sedimentary layers. Recharge to the aquifer comes primarily from percolation of precipitation and losses from streams that cross its outcrops along the flanks of East Butte (Tuck, 1993). Leakage from adjacent bedrock formations and glacial sediments are less significant sources of recharge. The Claggett Shale limits recharge outside outcrop and subcrop areas, however, recharge could occur through leakage along the casing of the colony's well. Therefore, areas where the aquifer outcrops or subcrops beneath glacial sediments and the vicinity immediately around the well are the areas of greatest concern for protecting the colony's wells from contamination. See Figure 3 for a geologic cross-section depicting this conceptual model.

The main assumption that effects the accuracy of this analysis is that the Claggett Shale effectively limits water from percolating down to the Eagle Sandstone. In support of this assumption, specific storage of the Eagle is reported to be between 3.0×10^{-4} to 3.5×10^{-4}, a range indicative of a confined aquifer (Tuck, 1993). The further assumption that the groundwater flow direction near the colony can be approximated from water levels measured in widely spaced wells may not be strictly valid. To compensate for this uncertainty a range of groundwater flow directions is considered when delineating the recharge region for the colony's well.

Source-Well

Sage Creek Colony obtains potable water from a single well that was drilled in 1961 using a mud rotary drilling rig (see well location in Appendix A and well log in Appendix D). The well was originally drilled to 785 ft but was backfilled to 745 ft prior to completion. Casing was run from the surface to the top of the Virgille Sandstone at 703 ft. Water is produced from open hole between 703 ft and 745 ft. Light colored clean sand, sandy shale, and sand with bentonite are described for the Virgelle Sandstone on the log of the colony well. The main producing interval intercepted by the well is clean sand between 700 ft and 743 ft.

Table 4 Source well information for Sage Creek Colony

Well Information	Well #1	Source of Information
MBMG #	1779002	GWIC
Water Right #	W028413	DNRC
Latitude / Longitude	48.9279☜ / -110.9748☜	Topographic Map
Date Completed	February 1961	Well Log
Depth	745 ft	Well Log
Open Interval	703 ft – 745 ft	Well Log
SWL Depth	≅ 240 ft	Well Log from nearby well
PWL Depth	575 ft	Well Log
Drawdown	≅ 235 ft	Calculated using estimated SWL
Test Pumping Rate	6 gpm	Well Log
Specific Capacity	≅ 0.26	Calculated using estimated SWL
Intake Depth	660 ft	Well Log

Methods and Criteria

Methods and criteria used to delineate source water protection areas for the Sage Creek Colony are specified in the Montana Department of Environmental Quality's Source Water Protection Program (DEQ, 1999). Specifically, the methods and criteria are those for confined aquifers. Fixed distance criteria are used to delineate the control zone and inventory region. The recharge region is delineated by hydrogeologic mapping.

Time-of-Travel Calculation

Estimates of aquifer flow properties, well discharge rate, ambient ground water flow direction, and ground water gradient are used to calculate the time-of-travel between outcrops of the Eagle Sandstone and the Sage Creek Colony well (Table 5). Estimates of aquifer properties including hydraulic conductivity, transmissivity, and effective porosity were based on published values for the Eagle Sandstone (Tuck, 1993) or values measured in similar rocks.

The time-of-travel from outcrops of the Eagle Sandstone and the Sage Creek Colony was determined using the equations in Appendix B.

Table 5 Estimates of input parameters used to delineate the source water protection area

Input Parameter	Range	Value Used
Transmissivity	1 – 6,700 ft^2/day	13 ft^2/day
Thickness	43 ft	43 ft
Hydraulic Conductivity	0.3 ft/day	0.3 ft/day
Hydraulic Gradient	0.03	0.03
Flow Direction	N - E	N 45 E
Effective Porosity	5 – 20%	10%
Pumping Rate	1,000 ft^3/day	1,000 ft^3/day

Delineation Results

The control zone is a minimum 100-foot circle around the well; all sources of potential contaminants should be excluded in this region. The inventory region is a 1,000-foot radius circle around the well and is the focus of the contaminant source inventory. Outcrops of the Eagle Sandstone southwest of the colony limit the extent of the recharge region. The lateral extent of the recharge region was delineated by assuming groundwater flow direction is accurate within 45° . The time-of-travel from the nearest outcrop of the Eagle Sandstone to the colony well is approximately 300 years. See Figure 4 for the Base Map showing delineation results.

CHAPTER 3

INVENTORY

An inventory of potential sources of contamination was conducted to assess the susceptibility of Sage Creek Colony's drinking water source to contamination. Sources of all primary drinking water contaminants and cryptosporidium were identified; however, only potential sources of contaminants that are the greatest threat to health were selected for detailed inventory. The contaminants of greatest concern to Sage Creek Colony are nitrate, pathogenic organisms, fuels, solvents, and herbicides.

The inventory for Sage Creek Colony focuses on all activities in the control zone and point sources of all contaminants and certain land uses in the inventory region. General land uses and large point sources of contaminants are identified in the recharge region.

Inventory Method

All land within the inventory region is owned by Sage Creek Colony. Information on land use, agricultural chemical application, and waste disposal practices were provided by John D. Wurtz, backup water system operator. Russell Levens of Montana DEQ toured the colony in August 1999 to confirm the location of potential contaminant sources.

Inventory Results/Control Zone

The control zone includes the concrete well pit and surrounding buildings at the southwest corner of the colony ranch complex. Chemical use in the control region is limited to spot application of Roundup (glyphosate) for weed control.

Inventory Results/Inventory Region

The inventory region includes the farm complex and irrigated cropland to the southwest of the colony well. The farm complex includes colony housing and school, hog and chicken barns, a dairy stockyard with runoff retention pond, a slaughterhouse, equipment repair and maintenance shops, and various other shops and storage buildings (See Appendix A for PWS Site Plans). Two 5,000-gal above ground storage tanks, one for unleaded gas and one for diesel, and one 10,000 gal above ground storage tank for farm diesel are located at the northeast corner of the complex. Two additional tanks (500 gal and 300 gal) store diesel for two power plants. Herbicides for application on cropland are mixed on a concrete pad outside a small repair shop. Human waste is piped through sewer mains from each house, the dairy parlor, and the slaughterhouse to a two-cell treatment lagoon lined with bentonite. Floor drains in the truck maintenance garage also drain to the domestic waste lagoon. Animal waste from the barns is piped to a separate bentonite-lined lagoon. Runoff from the dairy stockyards flows to a retention pond and is disposed of by irrigation on cropland.

Potential contaminants at the colony include human and animal wastes, solvents and fuels, waste chemicals, and herbicides. The primary hazards are chemical or fuel spills, excess application of herbicides, spills at the chemical mixing station, runoff from the stockyard and slaughterhouse, and leakage from sewer mains. (Table 5).

Inventory Results/Recharge Region

The recharge region is solely used for agriculture; of the total, 58 percent is rangeland and 42 percent is cropland or hay (Figure 5). Land is owned in the recharge region by Gramer Farms and Harold Jenson in addition to the Sage Creek Colony. One farmstead is located approximately 1 ¾ miles southwest of the colony. The herbicide 2,4-D used for weed control and fuels for farm machinery are potential contaminants in the recharge region. Chemicals are used infrequently in the most sensitive areas where the Eagle Sandstone outcrops.

Table 6 Significant potential contaminant sources in the inventory region of Sage Creek Colony

Source	Hazard
Sanitary Sewer	Leaking Sewer Lines or Collection System for Housing and Barns
Confined Animal Feeding Operation	Leaching from Animal Wastes in Stockyard and Slaughterhouse
Stormwater Runoff	Spills And Runoff From Garage And Chemical Mixing Areas
Cultivated Cropland	Land Application of Animal Waste
Cultivated Cropland	Spills and Excess Application of Herbicides
Fuel Storage	Spills

Inventory Update

The certified operator should update the inventory every year. Changes in land uses or potential contaminant sources should be noted and additions made as needed. The complete inventory should be submitted to DEQ every five years.

Inventory Limitations

The potential sources of contaminants for Sage Creek Colony are taken from readily available data and reports. Consequently, unregulated activities or unreported contaminant releases may have been missed. The use of multiple sources of data, however, should ensure that the major contaminant threats to the source water for Sage Creek Colony are known.

CHAPTER 4

SUSCEPTIBILITY ASSESSMENT

Susceptibility is the potential for a well to be contaminated by one of the sources inventoried in the previous chapter. Susceptibility of Sage Creek Colony's well to contamination from each potential contaminant source is assessed separately in this chapter in order to prioritize management actions.

Susceptibility is determined by hazard ratings and the presence of barriers (Table 7). Hazard ratings are determined by the proximity of a potential contaminant source to the well. Barriers can be engineered structures, management actions, and/or natural conditions. Examples of engineered barriers are bentonite liners in animal waste lagoons and secondary containment in chemical storage areas. Chemical or manure management plans and procedures for safe mixing and application of agricultural chemicals are considered management barriers. Finally, thick clayey soils, a thick zone above the water table, and a deep well can be natural barriers. Dilution through mixing also may be a natural barrier.

Table 7 Susceptibility to specific contaminant sources as determined by hazard and the presence of barriers

-	High Hazard	Moderate Hazard	Low Hazard
No Barriers	Very High Susceptibility	High Susceptibility	Moderate Susceptibility
One Barrier	High Susceptibility	Moderate Susceptibility	Low Susceptibility
Multiple Barriers	Moderate Susceptibility	Low Susceptibility	Very Low Susceptibility

The results of the susceptibility assessment for Sage Creek Colony are summarized in Table 8. Hazard rating is based on density or proximity of a source to Sage Creek Colony's well. The susceptibility to potential sources of multiple contaminants is assessed separately for each contaminant. In addition, alternative management approaches that could be pursued by the Sage Creek Colony to reduce susceptibility are recommended in Table 6 for each significant potential source.

Hazard is rated as high for all significant potential contaminant sources listed in Table 7 because the Sage Creek Colony well was not grouted through the Clagett Shale as Montana well construction standards would require if it was drilled today. Contaminants released within the inventory region could reach the aquifer along the well bore, bypassing the confining layer. Susceptibility is rated as moderate for all sources because multiple barriers to contamination are afforded by thick clay rich glacial deposits and the depth of the colony well intake.

Table 8. Susceptibility assessment for significant potential sources of contamination in the inventory region**.**

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Sanitary Sewer	Pathogens and Nitrate	Leaks	High	Thick Clay Rich Soils, Depth to Intake	Moderate	Leak Monitoring and Prompt Repair
Confined Animal Feeding Operations	Pathogens and Nitrate	Leaching	High	Thick Clay Rich Soils, Depth to Intake	Moderate	Follow Animal Waste Management Plan
Cultivated Cropland	Pathogens and Nitrate	Spill	High	Thick Clay Rich Soils, Depth to Intake	Moderate	Animal Waste Application BMPs
Cultivated Cropland	Herbicides	Spill	High	Thick Clay Rich Soils, Depth to Intake	Moderate	Chemical Application BMPs
Fuel Storage	Gasoline and Diesel	Spills	High	Thick Clay Rich Soils, Depth to Intake	Moderate	Build Containment Around Storage Tanks

Sormwater Runoff	Fuels, Solvents, Waste Oil, and Pesticides	Spills	High	Thick Clay Rich Soils, Depth to Intake	Moderate	Chemical Management, Waste Chemical Recycling, and Spill Prevention

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