Sanders County Harvest Foods Public Water Supply

PWS ID # MT0003709

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

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by
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INTRODUCTION

Jeffrey Frank Herrick, a Hydrogeologist with the Montana Department of Environmental Quality (DEQ) and Joe Chiovaro, an intern with the Montana DEQ completed this Source Water Delineation and Assessment Report.

Purpose

This Source Water Delineation and Assessment Report (SWDAR) is intended to meet the technical requirements for completion of the delineation and assessment report for the public water supply (PWS) of Sanders County Harvest Foods, as required by 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 (PWSs) from contamination. A major component of the Montana Source Water Protection Program is termed “delineation and assessment.” Delineation is a process of mapping areas that contribute water used for drinking. Assessment involves identifying locations in the delineated areas where contaminants may be generated, stored, or transported, and then determining the relative potential for contamination of drinking water by these sources. This source water delineation and assessment is typically combined in the form of a source water delineation and assessment report (SWDAR). The primary purpose of a SWDAR is to provide information that helps the PWS owners and operators, and the owners of Sanders County Harvest Foods protect their drinking water sources and provide the information needed to develop a Source Water Protection Plan (SWPP).

Limitations

This report was prepared to assess threats to the public water supply in Sanders County Harvest Foods and is based on published and public information and input obtained from persons familiar with the community. The terms “drinking water supply” or “drinking water source” refer specifically to the source of the Sanders County Harvest Foods PWS and not any other public or private water supply. In addition, not all of the potential or existing sources of groundwater or surface water contamination in the area are identified. Only documented or known potential sources of contamination in areas that contribute water to public water supply sources are considered.

The term “contaminant” is used in this report to refer to constituents for which Maximum Contaminant Levels (MCLs) have been specified under the national primary drinking water standards and to certain constituents that do not have MCLs but are considered to be significant health threats.

CHAPTER 1
BACKGROUND

The Community
Sanders County Harvest Foods is large grocery store located southeast of Thompson Falls on Highway 200. The store is about 1.5 miles away from town in section 9 of Township 21 N, Range 29 West. There are approximately 25 full time employees, 15 part time employees, and the store serves 1,000 – 1,200 customers each day throughout the year. This public water supply is classified as a Non-Transient, Non-Community Water System because there are less than 25 year round residents (living onsite), but the employees are there on a daily basis. Harvest Foods is one of the main suppliers of grocery goods to Thompson Falls and surrounding communities. The main industries in the area have historically been lumber/wood products and some mining, but has shifted toward tourism. A hydroelectric plant is located north of the subdivision on the dam of the Clark Fork River. See Figure 1 and Figure 2.

Sanders County Harvest Foods is located just outside the city limits of Thompson Falls south of town. Thus a private onsite septic system treats the sewage for the business. The water used in the store comes from their nearby PWS well. The store lies on the south side of Highway 200 and the land surrounding it consists mainly of light residential areas, commercial areas, agricultural land, and grasslands.

Geographic setting
Sanders County Harvest Foods is about 2,400 to 2,500 feet above sea level at 47.58° north latitude and -115.31° west longitude (T 21N, R 29W, Section 09). Thompson Falls is located in the Clark Fork River valley, which is a north to northwest trending intermountain valley in northwestern Montana. The valley is surrounded by the Coeur d'Alene Mountains on the south and west, and the Cabinet Mountains on the north. The Clark Fork River runs less than half a mile to the south of the store. The valley ranges from around 2,395 feet in elevation near the river to about 2,800 feet along the base of the Cabinet Mountains. The higher terrain around Thompson Falls consists of forested mountains with rocky peaks that rise above 7,000 to 8,000 feet in elevation. The climate of the Clark Fork River valley is consistent with that of other lower elevation basins in the northern Rocky Mountains west of the Continental Divide. The average daily high and low temperatures at the nearest weather station in the Thompson Falls area are 87.1°F and 49.6°F in July and 31.5°F and 20.6°F in January. Precipitation falls throughout the year, but mostly as snow in late fall and winter. Precipitation (in the form of snowfall) ranges from 36 inches in Thompson Falls to about 70 inches in the Cabinet Mountains.

Table 1. Climatic Data
Collected at Thompson Falls Power HO, Montana (248211)
Period of Record: 2/ 1/1956 to 12/31/2000 - Period of Record Monthly Climate Summary

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Annual
Avg. Max. Temperature (°F)	34.5	42.4	51.5	61.8	71.0	78.0	87.1	86.7	75.8	60.5	43.1	35.0	60.6
Avg. Min. Temperature (°F)	20.6	24.0	27.6	33.2	39.7	46.2	49.6	48.8	41.7	34.3	28.3	22.9	34.7
Avg. Total Precipitation (in.)	2.72	2.02	1.83	1.65	2.07	2.12	1.08	1.25	1.30	1.80	2.69	2.75	23.28
Avg. Total Snowfall (in.)	13.7	4.5	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	12.1	36.9
Avg. Snow Depth (in.)	7	5	2	0	0	0	0	0	0	0	0	3	1

Percent of possible observations for period of record: x. Temp.: 99.8% Min. Temp.: 99.8% Precipitation: 99.8% Snowfall: 78.5% Snow Depth: 85.1%
Source: Western Regional Climate Center, wrcc@dri.edu

General description of the Source Water

Sanders County Harvest Foods has 2 wells located in the southeast corner of Section 9, T21N, R29W. The wells tap into what is believed to be a confined alluvial aquifer. The stratigraphy taken from the driller's log shows 43 feet of sand and coarse gravel, followed by 208 feet of clay matrices and 7 feet of coarse sand and gravel. Only one of these wells is currently being used by the PWS.

The store sits on what appears to be alluvial (river deposited) sediments that are resting above a series of lake bed sediments probably deposited by Glacial Lake Missoula over 15,000 years ago. The Ashley Creek drainage is located to the north, and Ashley Creek itself flows to the east of the store. The nearby Clark Fork River (west and south of the store) is the largest river in the Northern Rockies. It flows in a northwestern direction through the Thompson Falls area and eventually empties into Lake Pend Oreille in Idaho. Again, refer to Figures 1 & 2.

Public Water Supply

The entire Harvest Foods Public Water Supply comes from a single well located to the east of the store. There are actually 2 wells on site, however the older well (Well #1) is no longer in use. This original well did not provide adequate flow for the water system, so a newer well (Well #2) was drilled in 1992. Well #2 has since completely replaced Well #1, and with a yield of 50 gallons per minute, provides sufficient water for the store's needs. Well #1 has been physically disconnected from the system. At the time this report was completed, this well has not been abandoned (with a sealed borehole), but it is scheduled to be abandoned (personal communication with Fred Boon, 09/2002).

The new well (Well #2) is sealed with bentonite (high expansive clay) slurry to 21 feet. No completion information was available on the type or length of screen used for this well. The total depth of the well is approximately 258 feet, and the static water level is 32.9 feet. No well log was found for the original well (Well #1). The Sanders County Harvest Foods PWS is summarized in Table 2. The facilities associated with the PWS are listed on Table 3. Refer to Figure 3.

Table 2. PWS Relevant Information
Sanders County Harvest Foods PWS

PWS Name & Address	PWS ID	Class	Service Connections	Employees	Non-Residents	Contact Persons
Sanders County Harvest Foods Attn: Fred Boon, Operator P.O. Box 880 Thompson Falls, MT 59873	03709	Non-Transient Non-Community	1 (active)	40-42	1,000-1,200 (people served each day)	Bill Mathews, Asst. Mgr. (406) 827-4321 Fred Boon, Operator (406) 827-4321

A remodeling project in 2000 included an upgrade of the water system. This is a single source groundwater system with 1 service connection. The submersible well pump is actuated by line pressure. The system's pressure tank is located in the northeast corner of the building in the storeroom area, where a pressure gauge and pressure switch are also located. The visible plumbing is all copper and there are several treatment systems installed. The production apparatus consists of a Culligan water softener, 2 Culligan filters (one for sediment and one for finer materials), and a UV disinfection system. Extra treatment is provided for the water supplied to the ice machine by a reverse osmosis filtration system and a scale eliminator cartridge. Water supplied to all areas passes through the main pressure tank, UV treatment, and filtration.

Table 3. List of Facilities
Town of Pinesdale PWS

DEQ's PWS Section ID #	Status*	Facility Name
CH001	Inactive	Common Header for Well 1(inactive) and Well 2
DS001	Active	Distribution System - SP001
PC001	Inactive	Pressure Control Assembly 1 (for Well 1)
PC002	Active	Pressure Control Assembly 2 (for Well 2)
WL002	Inactive	Well 1 (inactive, not abandoned)
WL003	Active	Well 2 (active, installed in 1992
TP001	Active	Treatment Plant for Well 2

Table 3. List of Facilities
Town of Pinesdale PWS

DEQ's PWS Section ID #	Status*	Facility Name
		EP502 Entry Point for TP001 from WL003

Water Quality

Below are tables of data taken from both Sanders County Harvest Foods and the nearby Thompson Falls municipal public water supply. Not all water quality data are available for both systems. For values not reported for the store, refer to the Thompson Falls municipal public water supply data. Given the close proximity of the City of Thompson Falls PWS wells to the Sanders County Harvest Foods PWS, this data is a reasonable approximation of the water quality for the area. A more complete set of analytical results for the Sanders County Harvest Foods PWS is found in Appendix B. A more complete set of analytical results for the City of Thompson Falls PWS is found in the City of Thompson Falls PWS Source Water Protection Plan.

Table 4. Water Quality Data

	Units	Thompson Falls Well #1 Inactive	Thompson Falls Well #2 Active	Thompson Falls Well #3
pH		8.13	8.09	7.91
Specific Conductance	umhos/cm	163	387	293
Hardness	Grains /gallon	4.2	10.9	
Hardness as $CaCO_3$	mg/l	73.1	186.7	
Calcium	mg/l	21.2	55.1	42.1
Iron	mg/l	<0.01	0.04	<0.05
Manganese	mg/l	<0.005	0.454	<0.01
Magnesium	mg/l	4.9	11.9	13.3
Sodium	mg/l	0.3	3	2.25
Alkalinity	mg/l	171	199	168
Sulfate	mg/l	<6	7	3.65

Note: The 1993 values above are taken from the 1995 Wellhead Protection Plan for the City of Thompson Falls.

Table 5. Water Quality Data for Sanders County Harvest Foods

	units	Harvest Foods PWS Wells	MCL*
Cadmium	mg/l	0	0.005
Beryllium	mg/l	0	0.004
Barium	mg/l	0.3	2
Arsenic	mg/l	0.011	0.05
Antimony	mg/l	0	0.006
Nitrate plus Nitrite as N	mg/l	0.02	10
Chromium	mg/l	0	0.1
Fluoride	mg/l	0.7	4
Mercury	mg/l	0	0.002
Selenium	mg/l	0	0.05
Thallium	mg/l	0	0.002

*MCL values come from the DEQ Source Water Protection Program Guide (1999)

Of special note to Sanders County Harvest Foods is the presence of the nearby, the Clark Fork River, which is a TMDL (Total Maximum Daily Load) stream. TMDL is the total amount of a pollutant, per day, (including a margin of safety) that a waterbody may receive from any source (point, nonpoint, or natural background) without exceeding the state water quality standards. A stream that is identified for TMDL development exceeds these standards in at least 1 category. The Clark Fork River is classified as such because the cold-water fishery in this stream is impaired and the drinking water supply is not supported. This is most likely due to cadmium levels, other metals, or habitat alterations from resource extraction, abandoned mining, hydromodification, and dam construction. For more information, please see the following website provided by the Natural Resources Information System (Montana State Library): http://nris.mt.gov/wis/environet/.

Water Distribution and Treatment

The following table (Table 6) describes treatment of the Sanders County Harvest Foods PWS. See the most recent Sanitary Surveys in Appendix B for details about system operation.

Table 6. Water Distribution and Treatment of the Sanders County Harvest Foods PWS

Public Water Supply Location	Water Distribution	Treatment
Well #1 (not in use)	Not connected to system	N/A
Well #2 (Harvest Foods Well)	Piping near the well	Water softener 2 sand traps UV light disinfection Additional treatment for ice machine (all treatment is done within the store)

Note: This information was derived from the most recent Sanitary Survey conducted on 8/1/2000.

Monitoring and Enforcement Actions

The Sanders County Harvest Foods PWS sources are routinely monitored for compliance with drinking water standards. Bacteriological monitoring occurs monthly, as does sampling for lead, copper and nitrites/nitrates. Compliance with other drinking water standards is based on additional sampling, which is conducted on a variety of schedules or as required. A Culligan service representative does maintenance monthly, and records are on file with Culligan and the PWS operator or owners.

No organic or inorganic chemical waivers have been issued to the Sanders County Harvest Foods PWS. The new well has not been in service long enough to be eligible to apply for these waivers, as they require at least 3 compliance periods. The Harvest Foods new well completed its first period in 2001. These compliance periods typically last 2 years each.

Sanders County Harvest Foods has had no acute MCL or non-acute MCL violations of the Total Coliform Rule during the last 2 years. In addition, the results of the most recent analytical report of the drinking water from the store detected no inorganics, synthetic organic compounds (SOCs), or volatile organic compounds (VOCs) above the regulatory limit. Previous analytical reports have yielded similar results. The contaminant that is of the most concern for this PWS is arsenic. In a water sample taken on October 31, 2000 arsenic was detected at the level of 0.011 mg/L. The maximum contaminant level (MCL) for arsenic is currently 0.05 mg/L, however in 2006 the MCL will be reduced to 0.01 mg/L. The demonstrated value would then have been above the new MCL. A copy of several analytical reports may be found in Appendix B.

Influencing Factors

The causes of potential contamination to any PWS vary due to such factors as the hydrogeology and land uses of the surrounding area. In general, the cause of coliform bacterial contamination is often the result of a combination of factors. Contributing factors include: the proximity of septic tanks to the wells, aquifer sensitivity, the existence of hydraulic connections between surface water and production wells, potentially poor sanitary conditions of some wells, and potentially poor construction of the wells (i.e., poor seals or surface completions), or poor construction of the distribution system. Metal contamination is often the result of active or abandoned mining operations in the Recharge Region. Organic contaminants come from a variety of sources, including transportation routes (roads or railroads), underground storage tanks, or as the result of specific land uses (such as pesticides, herbicides, and commercial waste). Additionally, inconsistent sampling procedures or sample handling could result in the detection of some constituents. The area contributing water to the production well and to the Recharge Region is discussed in Chapter 2.

CHAPTER 2
DELINEATION

The source water protection areas for the Sanders County Harvest Foods PWS source is delineated in this chapter. The purpose of delineation is to map the source of drinking water and to define areas within which to prioritize source water protection efforts. Three types of management regions are mapped for the Sanders County Harvest Foods PWS. These are the Control Zone, Inventory Region, and Recharge Region. The goal of management in the Control Zone (an area within a 100-foot radius circle around the well) is to protect against direct introduction of contaminants into PWS wells from immediate surrounding areas. The Inventory Region represents the effective zone of contribution to the well, which usually approximates a 3-year groundwater time-of-travel distance. The goal of management in the Inventory Region is to protect water quality for the present and near future. The Recharge Region represents the entire portion of the aquifer that contributes water to the Sanders County Harvest Foods area (this is essentially a portion of the watershed or the whole watershed). The goal of management in the Recharge Region is to maintain and improve water quality over long periods.

Hydrogeologic Conditions

The geology of the Clark Fork River valley is a description of the sediments and bedrock of the valley and surrounding area. This information is relevant because these rock units and sediments comprise the aquifer (the water bearing formation) into which the Sanders County Harvest Foods PWS well is installed and are materials that supply groundwater to the alluvial aquifer and the surrounding bedrock. The hydrogeology is a description of the presence and movement of groundwater in this bedrock and within the Clark Fork River valley. This discussion is pertinent because it helps the reader to understand where the PWS well is obtaining its groundwater and the vulnerability of that source of water to contamination. Most of the following information was drawn from Alt and Hyndman (1990) and the Source Water Protection Plan for the City of Thompson Falls (2002).

Geology

The bedrock of the Cabinet and Coeur d'Alene Mountains is primarily Belt SuperGroup sedimentary rock of Precambrian age. The Belt SuperGroup rock is comprised of formations of metasediments, primarily quartzite, argillite, with some carbonate (limestone) units (Kendy and Tresch, 1996). They are not highly deformed. The region is extensively faulted with 2 main sets of fault zones in the area of Thompson Falls. Ancient and modern streams have exploited these fault zones and created the river channels seen today. The first set is a series of northwest trending strike-slip faults running at about 45° Northwest. The displacement along these faults is right-lateral with the eastern side of the fault moving southeast relative to the western side of the fault. The amount of displacement is not known. The northwest trending zone that is currently occupied by the Clark Fork River channel is called the Hope Fault Zone. A second set of faults are thrust faults (reverse faults) that trend north to south through the region. Thrust faults are a result of foreshortening of the continental crust in this region due to compressive tectonic forces (collisions between continental plates). Near the end of the Mesozoic Age the younger sediments that covered this area were somehow removed and displaced to the east along the north-south trending faults. This material ended up located to the east and is collectively called the overthrust belt. The uncovered older sediments (mostly Precambrian age) were allowed to float upward (there was less mass above them) and some steeper angled faults cut through the reverse faults. These steep, near vertical faults are attributed to the process of unloading with the older rocks floating upward unevenly with breakage between areas of unequal buoyancy. The Clark Fork River valley was not glaciated at any point in the recent geologic past. However, it was occupied by and was the avenue that glacial Lake Missoula used to drain catastrophically to the west. Alt and Hyndman (1990) suggest that during the draining of the lake through this valley, the flow volume reached 8 to 10 cubic miles of water per hour. This repeated flooding and draining has scoured the valley down to the bedrock in places and left a considerable volume of coarse sediment in localized bars along the river channels. Geologic maps are presented on Figure 4 and Figure 5. An idealized schematic cross section is seen on Figure 6.

Stratigraphy in the area of Thompson Falls has never been carefully worked out. An idealized schematic cross section is represented on Figure 6. Bedrock is exposed on both flanks of the valley as rock outcrops on the Cabinet and Coeur d'Alene Mountains. Bedrock is shallow (~40 to 100 feet below ground surface) on the south side of the river and in places, it is less than 25 feet below the base of the river. The deepest part of the valley (and the part containing the thickest sediments) is located north of the present-day river channel. The depth to bedrock in the center of the valley is thought to be more than 200 feet below the ground surface. Bedrock is also shallow just east of where the Thompson River drains into the Clark Fork River. The evidence for this is that the Clark Fork River valley narrows considerably at that location, suggesting that bedrock is constraining surface and subsurface water flow. The valley between the falls south of Thompson Falls and where the Thompson River enters the Clark Fork River, and the area between the Cabinet Mountains and the Coeur d'Alene Mountains forms a large bedrock trough filled with sediments. At various times in the history of the basin, fine sediments accumulated in its bottom. The lithologic logs suggest that on the north side of the river, there are laterally discontinuous silt and clay layers deposited primarily between 120 and 180 feet below ground surface. The lateral extent of these silt and clay rich layers is not known, but it is reasonable to suppose that they collectively extend from the bedrock on one side of the deepest part of the valley to the other side. These confining beds have never been mapped to confirm their lateral extent. Coarse sand, gravel, and silt were then deposited by stream action above these zones and make up the present valley floor and riverbed. These recent river sediments were deposited across the entire valley between the 2 ranges of mountains.

<u>Hydrogeology</u>

Groundwater is a widely used source of water for the residents in and around the Clark Fork River Valley. Two aquifers are present in the area of Thompson Falls, an unconfined aquifer within the unconsolidated alluvial and colluvial deposits, and a deeper aquifer that is believed to be confined. The aquifer used by the Sanders County Harvest Foods PWS wells is the confined aquifer located on the north side of the river. The aquifers in the area are bounded by the lower conductivity Precambrian bedrock that underlies and surrounds the valley, as well as the surface water bodies present in the drainage. Groundwater is abundantly available in the alluvial aquifers in the area, and from the springs discharging from the nearby mountains. Inter-aquifer movement by water has not been studied near Thompson Falls and is not understood. However, the confined alluvial aquifer is clearly recharged by seepage from the bedrock.

The deep aquifer (into which the PWS wells tap) appears to be confined. It is recharged by groundwater entering it directly from the surrounding bedrock. The materials that comprise this aquifer are coarse to very coarse sand, gravel, cobbles, and boulders. The Thompson Falls Production Well Construction report (2000) suggests that the gradient is shallow (0.006 feet/foot), and the water flows at a high velocity parallel to the river (flowing to the west and northwest). It is not clear if there is much interconnection between the confined aquifer and the unconfined aquifer above it. Many wells penetrate through the finer grained confining units and are poorly sealed across these units. For instance, the Harvest Foods production well, which was installed into the confined aquifer, is not sealed across the confining layers. When the well is pumped, boreholes such as this one can act as a conduit for upward and downward movement of groundwater between these aquifers. It can also allow contaminant movement between the aquifers. The lithologic logs indicate that if the upper (unconfined) and lower (confined) aquifers are interconnected, there will be a strong downward vertical gradient between them (water will flow downward). The lower confined aquifer is approximately 45 to 55 feet thick (location dependant). The confining layers above it appear to be approximately 15 to 20 feet thick each, but act in concert with other layers to restrict vertical movement of water between the unconfined and confined aquifers. It should be noted that the confining layers are comprised of numerous laterally discontinuous lenses of fine sand, silt, and clay. The lateral limits of these confining layers are not known, but their extent is limited by the geometry of the bedrock trough in which they were deposited. At their greatest lateral extent, these low flow layers may extend as far east as the outfall of the Thompson River; as far west as the falls of Thompson Falls; as far south as the north shore of the Clark Fork River; and as far north as the range front of the Cabinet Mountains.

The upper alluvial aquifer is approximately 50 to 100 feet thick, depending on where it is measured and is considered unconfined and in places, possibly semi-confined. It is limited in lateral extent by the same constraints as is the deeper confined aquifer. The unconfined aquifer overlies the confining unit in the deepest part of the valley bedrock trough but drapes against the bedrock on all other sides. Note that the unconfined alluvial aquifer covers a bedrock bench on the south side of the Clark Fork River with a saturated thickness that appears to be between 30 to 60 feet (possibly up to a 100 feet total). Although there are certain areas of the aquifer that may be locally confined, no confining layers appear to be present on the south side of the river. This aquifer is comprised of unconsolidated coarse sand, gravel, and cobbles laid down more recently than the catastrophic draining of glacial Lake Missoula. The fluvial materials were deposited in meandering stream channels that interwove and successively crosscut each other in complex patterns as the river channel migrated back and forth across the river valley. Water levels in the unconfined aquifer range from 10 to 100 feet below ground surface in most places. This wide range of water levels suggests that there may be some sort of complex movement of water through this aquifer. All groundwater and surface water in the valley must eventually discharge to the west. It was mentioned in several of the documents (referenced in this report) that the level of water in the pool above the falls of Thompson Falls was seasonally higher than the water level in the surrounding wells. This indicates that water is leaving the river and recharging the surrounding aquifer above the falls. Therefore, groundwater flow direction near the pool and for some distance upstream is away from the river to the north and northwest. The flow in the Clark Fork River is maintained at a reasonably consistent level by upstream dams. The result of this is that the pool at Thompson Falls maintains a relatively steady elevation throughout the year (it is lowest during the Fall) and from year to year.

The groundwater in the confined and unconfined aquifers in the vicinity of the Sanders County Harvest Foods PWS flows in a strongly north/northwest direction, paralleling the Clark Fork River to the south of the store. Refer to the model of groundwater movement on the schematic cross section on Figure 6. A plan-view model of groundwater flow patterns in the confined and unconfined aquifers is presented on Figure 7. This model is useful to visualize the recharge and discharge areas of the river and aquifer. Based upon the hydrogeologic setting (discussed in Table 7), the deep confined aquifer is classified as having a low source water sensitivity to contamination.

Table 7. Source Water Sensitivity, Determination of

Source Water Sensitivity **(based upon the aquifer from which the PWS draws its water)**
High Source Water Sensitivity Surface Water and Groundwater Under the Direct Influence of Surface Water (GWUDISW) Unconsolidated Alluvium (unconfined aquifer conditions) Fluvial-Glacial Gravel Terrace and Pediment Gravel Shallow Fractured or Carbonate Bedrock
Moderate Source Water Sensitivity Semi-consolidated Valley Fill sediments Unconsolidated Alluvium (semi-confined aquifer conditions)
Low Source Water Sensitivity Consolidated Sandstone Bedrock Deep Fractured or Carbonate Bedrock Semi-consolidated Valley Fill Sediments (or confined aquifer conditions)

Conceptual Model and Assumptions

A conceptual hydrogeologic model is a simplified representation of the hydrogeologic system. For the Sanders County Harvest Foods PWS, 1 source of water is utilized. The confined alluvial aquifer receives recharge from the surrounding bedrock. The effective boundaries of the confined aquifer are the bedrock range front of the Cabinet Mountains on the north, the Clark Fork River to the south, and the bedrock high of the falls at Thompson Falls. The confined aquifer has a considerable amount of water moving through it and has groundwater moving from southeast to northwest, which is roughly parallel to the Cabinet Mountains range front and the Clark Fork River.

Well Information

The PWS wells listed and summarized on Tables 2, 3, and 6 are located on the east side of the Sanders County Harvest Foods store (refer to Figure 2). The information on each well has been compiled from all available sources, which include: the DEQ's PWS database, Montana Bureau of Mines and Geology (MBMG) GWIC database, the Montana State Library Natural Resource Information System (NRIS), and information taken from the DEQ PWS Section Sanitary Survey. The most recent Sanitary Survey of the PWS was conducted in 2000 and a copy is found in Appendix B. The well logs for the PWS wells are found in Appendix A. Representative well logs for the other wells in the area of the Sanders County Harvest Foods PWS are also found in Appendix A.

Table 8. PWS Well Information Sanders County Harvest Foods PWS		
	Inactive Well Well #1	**Sanders County Harvest Foods Well Well #2**
PWS ID #	03709	03709
PWS Source ID #	002	003
Well Location (T, R, S)	T21N R29W S09 DDD	T21N R29W S09 DDD
Latitude Longitude	47.5853 -115.3111	47.5853 -115.3111
MBMG GWIC #	none	137574
DNRC Water Right #	Not reported	81487
Date Well was Completed	Unknown	February 14th, 1997
Total Depth (feet bgs)	Unknown	258.0
Screen Interval (feet bgs)	Unknown	Not reported
Static Water Level (feet bgs)	Unknown	32.9
Pumping Water Level (feet bgs)	Unknown	Not reported
Drawdown (feet)	Unknown	N/A
Yield = Q (gal/min)	Unknown	50.0
Yield = Q (ft^3/day)	Unknown	9,625

This PWS is considered a Non-Transient Non-Community Public Water Supply.

Delineation Results

In all instances, a 100-foot radius Control Zone is delineated around the wellhead. This is to ensure that the area immediately surrounding the wells remains free of contamination. Since this system draws its groundwater from what is thought to be a confined aquifer, a 1000 foot fixed radius was used as the Inventory Region for the Sanders County Harvest Foods PWS production well. The Inventory Region is depicted on Figure 8.

The Recharge Region is considered to be the entire watershed for stream drainage and the alluvial aquifers that supply water to the PWS wells. For the Sanders County Harvest Foods PWS, the Recharge Region would be both the entire Clark Fork and Little Thompson River watersheds. Together, these 2 watersheds are too large to be easily manageable, so a smaller area was delineated. The Recharge Region for this report extends approximately 20 miles upstream on the Clark Fork River, north through the main fork of the Thompson River, south to the Coeur d'Alene Mountain range front, and west to the pool below the Thompson Falls dam. The Recharge Region is depicted in Figure 11.

Limiting Factors

The reader should keep in mind that these delineations make some basic assumptions about the ground water movement in the area. Two major assumptions are used in the application of many groundwater flow models; that the flow of water in the aquifer is uniform, and that the flow of water in the aquifer is horizontal. The groundwater flow model should be considered within these limitations, as groundwater flow is generally not entirely uniform or strictly horizontal. Additionally, very little is known about the possible interconnection between the unconfined and confined aquifers, and groundwater flow within each (as well as within the fractured bedrock under and around the valley). Conclusions based on the author’s interpretation of the hydrogeology are uncertain because the extent and properties of the aquifer, along with the direction and rate of groundwater flow are not precisely known. This is especially true when addressing groundwater behavior beneath specific locations in the Clark Fork River valley.

CHAPTER 3
INVENTORY

An inventory of potential contaminant sources was conducted to assess the susceptibility of the Sanders County Harvest Foods PWS wells to contamination and to provide a basis for source water protection planning. The inventory focuses on areas of known contamination; facilities that use, generate, transport, or store potential contaminants; as well as certain land uses within the Inventory Region and Recharge Region delineated in the previous section. Sources of all primary drinking water contaminants and pathogens are identified, although only potential sources of contaminants that are the greatest threat to human health were selected for detailed inventory.

Inventory Method

Databases were searched to identify businesses, and land uses that are significant potential sources of regulated contaminants. The following steps were followed:

> Step 1: Land use was identified from the National Land Cover Dataset compiled by the U.S. Geological Survey and the U.S. Environmental Protection Agency (USGS, 2000). Land cover types in this dataset were mapped from satellite imagery at 30-meter resolution using a variety of supporting information.
>
> Step 2: EPA's Envirofacts System was queried to identify EPA regulated facilities. This system accesses the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory (TRI), Permit Compliance System (PCS), and Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS). The available reports were browsed for facility information including the Handler/Facility Classification to be used in assessing whether a facility is a significant potential contaminant source.
>
> Step 3: DEQ databases were queried to identify underground storage tanks (UST/LUST sites), hazardous waste contaminated sites, landfills (State Superfund Sites), and abandoned mines. These include, but are not limited to, the DEQ Hazardous Waste Site Cleanup Bureau - Petroleum Release Section and State Superfund Sections databases. The DEQ SWPP/NRIS Mapper was also used to identify and locate these sites.
>
> Step 4: A business telephone directory/database was consulted to identify businesses that generate, use, or store chemicals in the Inventory Region. Equipment manufacturing and/or repair facilities, printing or photographic shops, dry cleaners, farm chemical suppliers, and wholesale fuel suppliers were targeted by SIC code (Standard Industrial Classification Code).
>
> Step 5: Major road and rail transportation routes were identified.
>
> Step 6: All significant potential contaminant sources were identified within the Inventory Region. This includes sources of nitrate and microbial contaminants, land uses and facilities that generate, store, or use large quantities of hazardous materials identified within the Recharge Region.

Potential contaminant sources are designated as significant under the Montana Source Water Protection Program if they fall into 1 of the following categories:

- Large quantity hazardous waste generators
- Landfills
- Hazardous waste contaminated sites
- Underground storage tanks
- Major roads or rail transportation routes
- Cultivated cropland
- Animal feeding operations
- Wastewater treatment or spray irrigation lagoons
- Septic systems
- Sewered residential areas

- Storm runoff (e.g. from logging operations)
- Floor drains, sumps, or dry wells (essentially Class V Injection Wells)
- Abandoned or active mines

In support of this inventory, an evaluation of land use was made for the area within the Inventory Region and the Recharge Region/Watershed. Maps were developed that depict land use within these areas using the USGS 30-meter Landcover data (2000). An analysis was performed on these data that allowed for a quantified determination of primary land uses. The land use maps and the supporting analyses for these areas are found on the following pages.

Inventory Results/Control Zone

The Control Zone is the area located within 100 feet of a PWS well. Both wells are located to the east of the store, in close proximity to each other. Nitrate from over application of lawn chemicals such as fertilizers to lawns and landscape is a potential contaminant source for the active well, as it is located near an area described as urban/recreational grasses. Also, the old well that is no longer in use needs to be abandoned in accordance with DEQ standards. Old wells can provide conduit for pollution of ground water if not abandoned properly. Few other potential contamination sources are thought exist within the Control Zone for the store, although some concerns were addressed in the Sanitary Survey (conducted in 2000). These included the lack of positive sanitary seal on the existing well cap and the potential of cross contamination of the water supply with chemicals. It was also noted in the Sanitary Survey that the monitoring history is good and that the water facilities appeared to be in excellent shape. A copy of the Sanitary Survey for 2000 is found in Appendix B. A complete inventory of potential contaminant sources in and around Sanders County Harvest Foods is provided in Appendix C.

Inventory Results/Inventory Region

Land uses located within the boundaries of the Inventory Region that handle, store, or generate hazardous materials are considered potential contaminant sources. Inventoried significant potential contaminant sources are addressed in the next chapter. The businesses and land uses within the Inventory Region that are considered potential sources are listed on Table 9. It is important to remember that these businesses or facilities are included on the list solely because of the type of business or operation and the chemicals typically used by that type of business. This list does not imply that these businesses are actual polluters or that they mishandle the chemicals used. The locations of these possible contamination sources within the Inventory Region are shown on Figure 8.

There is only 1 business within the Inventory Region that has underground storage tanks (USTs). These particular tanks are active, but have no history of leaking. Underground storage tanks can be potential sources of VOCs and other petroleum hydrocarbons, and continued monitoring of the PWS water is necessary to detect contamination.

Agricultural land constitutes about 23% of the area within the Inventory Region. For the most part, this land consists of pastureland used for hay, with some land used for growing small grains. The agricultural practices of greatest threat to a PWS are those involving significant chemical application and irrigation. Residential and commercial lands make up 13% and 8%, respectively. Businesses that generate, store or dispose of small quantities of potential contaminants are generally not significant contaminant threats, if they handle those materials properly. However, disposal of even small quantities of contaminants in sumps, floor drains, dry wells, or septic tanks that are connected directly to the aquifer via infiltration can be significant threats. In addition, chemicals spilled at small businesses may be flushed to storm drains or local streams and indirectly reach the aquifer. Volatile organic compounds are the most prevalent chemicals used or stored and therefore the most likely to reach the groundwater where stormwater is concentrated and directly recharges the unconfined aquifer (these are essentially Class V Injection Wells). The locations of these injection wells are not known. The Sanders County Harvest Foods wells are susceptible to this type of contamination, even though they draw their water from the deeper confined aquifer. The newer well was not sealed through the confining units, and thus there may be some interaction with the groundwater in the unconfined alluvial aquifer. The land use in the Inventory Region is depicted in Figure 9.

The threat of groundwater contamination from the residential septic systems is considered low due to the low density of these systems within the Inventory Region. Septic tanks can be significant sources of pathogens to a public water supply and there has been bacterial contamination detected in the water of this PWS in the past. Septic density in the area is depicted on Figure 10. A summary of the septic density is presented in Table 9. Large capacity septic systems are those that service 20 or more people per day. These large septic systems are considered significant potential contaminant sources if located near a wellhead. The Sanders County Harvest Foods business is itself a large capacity septic system.

Highway 200 runs throughout the valley and is located less than 500 feet from the wellheads, while the Northern Pacific railroad line is less than 1000 feet away. Transportation lines such as these are potential sources of contamination due to the large quantities of chemicals that are carried on them. In addition, spraying for weeds is often conducted along these routes and these chemicals can be concentrated by stormwater runoff in the vicinity of the PWS wells.

Inventory Results/Recharge Region

Various land uses may contribute contamination to a public water supply. The majority (81.3%) of the Recharge Region is forested land, while the remaining land consists primarily of shrubland, grassland, agricultural land, and open water. The agricultural land makes up only about 5 percent of the Recharge Region. A land use map for the Recharge Region is presented on Figure 12. Private septic systems are also of concern to a PWS, as they may be potential sources of both nitrate and microbial contamination. Septic density throughout the region is generally low, with 98.5% of the land classified as having low septic density. This rating is based on an estimate of private septic systems per square mile. Low septic density means less than 50 septic systems per square mile. Septic density in the area is depicted on Figure 10. A summary of the septic density is presented in Table 9. Large capacity septic systems are those that service 20 or more people per day. Few large capacity septic systems within the Recharge Region are believed to be a threat to this PWS.

Highway 200 and the Northern Pacific Railroad, mentioned above, run through the entire length of the Recharge Region and are a potential contaminant source for VOCs and SOCs. In addition, within the delineated Recharge Region, there is a petroleum pipeline. A majority of the line is currently inactive, but the level of abandonment and inactivation is not completely known. The petroleum transported through the region is done so by railroad tanker car. It is brought by rail to Thompson Falls and unloaded from the trains at the Thompson Falls unloading terminal. At this point it is put into the active section of the pipeline and pumped/shipped north and west across the Clark Fork River. Accidental spills in along the pipeline or during the unloading process could possibly present a serious threat to the Sanders County Harvest Foods public water supply.

Another potential source of SOCs and VOCs (and other contaminants) in the Recharge Region is the stormwater discharge site located to the west of the PWS wells. These sites are places of registered release to stormwater of compounds from pavement, industrial processes, etc. Certain businesses within the Recharge Region present a potential contamination source due to the type of chemicals present. These businesses, along with all potential contamination sources, are listed in Table 9.

There is a power transmission line that runs through the Recharge Region. The power line lies to the north of the store, and presents a potential source of contamination due to the weed control practices often used around the lines. Herbicides are generally organic chemicals, which are known pollutants of ground water.

In addition to the underground storage tanks located in the Inventory Region, there are 2 other locations of these tanks in the Recharge Region. One of these sites is active with no known leaks, while the other one is no longer active, but has had leaks in the past. There is also a Montana Department of Transportation maintenance facility in the area. These sites can be potential sources of contamination as road salts, nitrates, VOCs, SOCs, and other chemicals that are used and stored at these facilities.

One of the primary sources of potential contamination to the PWS within the Recharge Region comes from the extensive mining in the area. Mining operations are a major source of metals in a ground water supply. There about 16 historic and operating mines in the Recharge Region. Locations of the mines are presented in Figure 11. A complete list of mines in the area can be found in Appendix C. Finally, there is 1 hazardous spill site in the Recharge Region. This is the Weeksville site, which is a section of the Yellowstone petroleum pipeline, and has been classified as a hazardous spill site since 1994.

Table 9. Inventory of Businesses & Other Facilities

Potential Contaminant Sources	Inventory Region 1,000-Foot Fixed Radius From the PWS Wells	Watershed / Recharge Region	Map ID # w/in Recharge Region
% Septic Density	0% High Density 0% Medium Density 100% Low Density	0.34% High Density 1.18% Medium Density 98.48% Low Density	________
Large Capacity Septic Systems	Sanders County Harvest Foods Ron's Express Pay	Thompson Falls Unloading Terminal Ron's Express Pay Plum Creek Timber Company Riley Creek Lumber Company Hoyt's Shop MDT Maintenance Facility Hopkins Trucking and Excavating Thompson Falls Airport	#3 #4 #5 #7 #10 #11 #12 #13
Land Use	8% Shrubland 23% Agricultural 4% Forest 44% Grassland 13% Residential 8% Commercial	6.4% Shrubland 4.9% Agricultural 81.3% Forest 6.0% Grassland 1.3% Open Water	________
Mines	None	16 mines in watershed; complete list in Appendix D	________
Pipelines	Oil Pipeline crosses the river from the unloading terminal, the abandoned line goes southeast running parallel to highway, railway, and Clark Fork River.	Inclusive of pipeline listed in the Inventory Region.	#1
Power Transmission Line	None	Power transmission line runs to the north of the store.	#2
USTs/LUSTs	Ron's Express Pay – active with no known leaks.	Thompson Falls Unloading Terminal – active with no known leaks. Ron's Express Pay – active with no known leaks. Plum Creek Timber Company – not active with known leaks.	#3 #4 #5
Hazardous Spill Sites	None	Weeksville Site – Yellowstone petroleum pipeline.	#6
Stormwater Discharge	None	Riley Creek Lumber Company	#7
Railroad/Highway	Northern Pacific Railroad line Highway 200	Northern Pacific Railroad line Highway 200	#8 #9
Auto Shops/Trucking	None	Hoyt's Shop MDT Maintenance Facility Hopkins Trucking and Excavating	#10 #11 #12
Airport – general	None	Thompson Falls Airport (large capacity septic system)	#13
Construction and related businesses	None	Captain Carpet	#14

Note:
- See Figure 11 for numbers corresponding to items in Recharge Region.

- This listing of businesses and other facilities came from telephone directories / databases and other public sources. It does not indicate that these businesses are current polluters, but is simply listing them as potential contaminant sources based on experience with and the chemicals handled by similar types of operations.
- Septic Density is based upon population numbers of 2000 census with 1 septic system per 2.5 persons. No central or municipal sewer system is present in the Inventory Region described.
- The hazard associated with private septic systems is determined on the basis of density of these systems. The hazard is described as being: High with >300/mile^2, Moderate with 50-300/mile^2, and Low with <50/mile^2.
- Land Use is based upon the USGS Landcover data (2000).

Inventory Update
To make this SWDAR a useful document in the years to come, the owners or the certified water system operators for the Sanders County Harvest Foods public water supply should update the inventory for their records 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 at least every 5 years to ensure that this report/plan stays current in the public record.

Inventory Limitations
The information compiled for this inventory was drawn from a number of public sources. It is as complete as possible, but is limited by the accuracy and/or completeness of the original data sources. For example, the information that addresses inactive and active mines did not describe the volumes or acreage of their associated tailing piles. This inventory (as written) is not intended to be a substitute for the first-hand knowledge of the area that can be provided by the PWS operators and owners. As such, the initial edits and the subsequent updates provided by these persons are critical to ensuring the accuracy and usefulness of this SWDAR.

CHAPTER 4
SUSCEPTIBILITY ASSESSMENT

Hazard Determination
Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by local entities, in this case Sanders County Harvest Foods.

The goal of Source Water Management is to protect the source water by: 1) controlling activities in the Control Zone, 2) managing significant potential contaminant sources in the Inventory Region, and 3) ensuring that land use activities in the Recharge Region pose minimal threat to the source water. Management priorities in the Inventory Region are determined by ranking the significant potential contaminant sources identified in the previous chapter according to susceptibility. Alternative management approaches that could be pursued by the Sanders County Harvest Foods PWS to reduce susceptibility are recommended.

Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers that decrease the likelihood that contaminated water will flow to the wells. The susceptibility of Sanders County Harvest Foods PWS to contamination is assessed in this chapter. The proximity of a potential contaminant source to a spring or well, or the density of potential non-point contaminant sources determines the threat of contamination, referred to here as hazard. Table 10 below determines hazard within the Inventory Region as delineated in this SWDAR. Within the 1000 foot fixed radius is considered to be the equivalent of within a 1-year time of travel. The time of travel (TOT) refers to the groundwater time of travel (the distance that groundwater is estimated to travel in a given time). This table is included for comparison purposes and to help the reader understand the vulnerability of the different sources of water.

Table 10. Determination of Hazard For Confined Aquifers

Potential Contaminant Sources	PWS Well is not sealed through the confining layer (or records are unclear)	Other wells in the Inventory Region are not sealed through the confining layer (or records are unclear)	All wells in the Inventory Region are sealed through the confined layer (records are clear)
Point Sources of All Contaminants	High Hazard Rating	Moderate Hazard Rating	Low Hazard Rating
Septic Systems (density)	High >300 Moderate 50-300 Low <50	Moderate >300 Low <300	Low
Cropped Agricultural Land (percent land use)	High >300 Moderate 50-300 Low <50	Moderate >50 Low <50	Low

Susceptibility Determination
Barriers to contamination can be anything that decreases the likelihood that contaminants will reach a spring or well. Barriers can be engineered structures, management actions, or natural conditions. Examples of engineered barriers are spill catchment structures for industrial facilities and leak detection for underground storage tanks. Emergency planning and best management practices are considered management barriers. Thick clay-rich soils, a deep water table or a thick saturated zone above the well intake can be natural barriers. Taking into account the presence of barriers, susceptibility is determined as described on Table 11 below.

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Table 11. Susceptibility of Source Water based on Hazard & Barriers

	High Hazard Rating	Moderate Hazard Rating	Low Hazard Rating
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

A Community Non-Transient PWS monitors for a wide range of contaminants on a varied schedule, dependant upon their history of contamination and regulatory requirements. Additional factors that are becoming useful in the determination of monitoring requirements for contaminants are:

- the presence of potential contaminant sources in proximity to the source water,
- the hazard posed by potential contaminant sources,
- the presence of barriers to those contaminants, and
- the susceptibility of the source water to the contaminants.

The significant potential contaminant sources are identified (by type of business or chemicals used) and by type and density of land use within the Inventory Region and the Recharge Region. These significant potential contaminant sources are listed on Tables 12 and 13. These tables address:

- types of significant contaminant sources,
- how the contaminants may be released to the environment and/or reach a collection point,
- Hazard rating for those contaminants,
- any barriers that may be present, and
- provide an evaluation of the susceptibility of the source to those contaminants.

The tables also describe some management tools that can reduce the Hazard and Susceptibility to particular contaminant sources.

Inventory Region

The Sanders County Harvest Foods PWS wells have a very high susceptibility to contamination from releases along the transportation routes in the Inventory Region. Both Highway 200 and the Northern Pacific Railroad run throughout the inventoried area. Any accidental spills from either the roadway or railway can be catastrophic and can pose a significant threat to the groundwater of this public water supply. The primary known contaminants typically transported (and spilled) along main roads and railways are fertilizers, bulk fuels or other petroleum products, SOCs, and VOCs.

The Sanders County Harvest Foods store is considered to have a high susceptibility to the underground storage tanks (USTs) in the Inventory Region. This potential source of contamination is considered a threat because it is located close to the wells, but is separated by multiple barriers. It should be noted that the well is not sealed through the confining unit, which makes the hazard from each contaminant source extremely high. Groundwater in the unconfined aquifer is thought to move from the southeast to the northwest, placing this source in a downgradient location from the well. Thus the groundwater flow in the area may help to prevent contamination from reaching the well (see Figure 7).

The susceptibility of this PWS to contamination from agricultural land uses is low, because approximately 23% of the lands in the Inventory Region are used for agricultural production. There are no known barriers to contaminants derived from agricultural chemicals. The main types of contaminants that result from agricultural land uses are nitrate (from fertilizers) and SOCs.

Septic density is considered a hazard because nitrates and pathogens can be released by poorly maintained private septic tanks. However, the entire area within the Inventory Region is classified as low septic density. This means then that the septic density represents a low hazard, and with no barriers to contamination the susceptibility of the Sanders County Harvest Foods PWS to this source of contaminants is considered moderate. For instance, properly sealing the well through the confining zone during installation would have lowered the susceptibility of this PWS to contamination dramatically (see Table 10 above). Large capacity septic systems pose a high hazard to this PWS. Their presence and the lack of barriers make the PWS have a very high susceptibility to their contamination.

Recharge Region

The Sanders County Harvest Foods PWS wells have a very high susceptibility to contamination from releases along the transportation routes and along the petroleum pipeline within the Recharge Region. Highway 200, the Northern Pacific Railroad, and the petroleum pipeline run throughout the length of the region and along the Clark Fork River. The pipeline crosses the river just upgradient from the well. Any accidental spills can be catastrophic and can pose a significant threat to the groundwater of this public water supply. The primary known contaminants typically transported (and potentially spilled) along main roads and railways are fertilizers, bulk fuels or other petroleum products, SOCs, and VOCs. The pipeline caries petroleum products.

Underground storage tanks (USTs) can leak petroleum products directly into the groundwater. Any tank that is currently leaking, or has a history of leaking is a concern. There are 3 locations with USTs in the Recharge Region (including the 1 location mentioned within the Inventory Region) for Sanders County Harvest Foods PWS. The Plum Creek UST is no longer in service, but is known to have leaked in the past. The known release, the proximity of the other 2 locations to the well, the fact that all 3 sites are located nearby, and several are located upgradient from Sanders County Harvest Foods increase the susceptibility of the PWS well to these point sources of contamination. It is this authors interpretation that the PWS is moderately susceptible to these sources of contamination.

Mining operations can be a major source of metals in a groundwater supply. The erosion of tailings, transport by surface water, and the leaching of sediments all contribute to the potential contamination from mines. Most of the mines are located a considerable distance from the PWS and so the susceptibility of the well to these point sources of contamination is considered very low.

The stormwater discharge location is considered a hazard (albeit a low hazard) because of its proximity to the well. However, based on groundwater flow direction, this business is probably located down gradient from Sanders County Harvest Foods, which can be considered a barrier to prevent contamination from reaching the well. The typical contaminants from this type of source are nitrates, VOCs, and SOCs, and the susceptibility of the PWS well to this source is considered very low.

The power transmission line, the land use within the inventory region, the septic density of the area, the airport facilities, and the MDT maintenance facility each constitute a low hazard and the well has a low to very low susceptibility to these potential contamination sources. Some distance separates the businesses located up gradient from Sanders County Harvest Foods. It appears that the MDT maintenance facility lies in a down gradient location. The land within the Recharge Region is primarily forested with little agriculture and low septic density (which is a low septic hazard).

Little information was available about the details of the Weeksville hazardous spill site (along the Yellowstone Pipeline near Plains) at the time of this report. This portion of the pipeline is no longer active, and it is unclear what, if any, cleanup efforts are underway or have been completed. Although the spill site is remote from this public water supply, any such spill is a contaminant source of concern. However it is not possible to rate/estimate the hazard posed by this source or the susceptibility of the Sanders County Harvest Foods PWS without more information.

Any potential contaminant sources discussed and rated in the Inventory Region would also apply to the Recharge Region. The susceptibility assessment for the Recharge Region is found on Table 13. Cooperative and regional planning agreements for the management of these significant potential contaminant sources and the reduction of the susceptibility to these sources should be undertaken.

Table 12. Significant Potential Contaminant Sources – Susceptibility Analysis within the Inventory Region

Source	Contaminant	Hazard / Origin of Contaminant	Hazard Rating	Barriers	Susceptibility of Aquifer to this Source of Contamination	Management Needed to Reduce Potential Impacts
Transportation Routes	SOCs, VOCs, other organic contaminants, nitrates, nitrites, metals, petroleum contaminants	Vehicular accidents, roadside pesticide spraying, application of deicer compounds, concentration of storm water runoff	High Hazard – because of proximity to well	None	Very High Susceptibility	Prevention planning Transportation restrictions Spill response planning & training DOT regulatory compliance Storm water diversion & catchment
Large Capacity Septic Systems	Sewage, nitrate, nitrite, pathogens	Nitrates & Pathogens that are insufficiently treated in private septic systems	High – because of proximity to PWS	None	Very High Susceptibility	Growth management Maintenance and replacement of old septic systems Advanced treatment systems
Underground Storage Tanks	Petroleum hydrocarbons, VOCs, SOCs, and lead	Leaks & spills that have reached or may reach groundwater	High Hazard – because of proximity to well	Groundwater monitoring Spill catchment	High Susceptibility	Spill prevention Spill response planning Spill catchment Best management practices Regulatory compliance Groundwater monitoring
Agricultural Land	Fertilizers, pesticides (SOCs), and erosion	Over application or improper application of chemicals, poor cropping practices, and spills allow contaminants to reach groundwater	Low Hazard – because 23% of the region is agricultural land	None	Moderate Susceptibility	Best Management Practices Training & education Technical assistance Spill prevention
Septic Systems in terms of Septic Density	Sewage, nitrate, nitrite, pathogens	Nitrates & Pathogens that are insufficiently treated in private septic systems	Low Hazard – based upon small acreage of moderate and high septic density	None	Moderate Susceptibility	Growth management Maintenance and replacement of old septic systems Advanced treatment systems

Table 13. Significant Potential Contaminant Sources - Susceptibility Analysis within the Recharge Region

Source	Contaminant	Hazard / Origin of Contaminant	Hazard Rating	Barriers	Susceptibility of Aquifer to this Source of Contamination	Management Needed to Reduce Potential Impacts
Transportation Routes	SOCs, VOCs, other organic contaminants, nitrates, nitrites, metals, petroleum contaminants	Vehicular accidents, roadside pesticide spraying, application of deicer compounds, concentration of storm water runoff	High Hazard – because they run the length of the region	None	Very High Susceptibility	Prevention planning Transportation restrictions Spill response planning & training DOT regulatory compliance Storm water diversion & catchment
Petroleum Pipeline	Petroleum hydrocarbons and VOCs	Leaks & spills that may reach the river or groundwater	High Hazard – because of proximity to and location upgradient from the PWS well	None	Very High Susceptibility	Spill prevention Spill response planning Spill catchment Best management practices Regulatory compliance Groundwater monitoring
Underground Storage Tanks	Petroleum hydrocarbons, VOCs, and lead	Leaks & spills that have reached or may reach groundwater	High Hazard – because of proximity to and locations upgradient from the PWS well	Groundwater monitoring Spill catchment	Moderate Susceptibility	Spill prevention Spill response planning Spill catchment Best management practices Regulatory compliance Groundwater monitoring
Mining Operations & Mine Tailings	Metals	Erosion of tailings, transport by surface water, leaching of sediments allowing metals to mobilize into groundwater	Low Hazard	Distance to the mines Immobility of the metals in sediment Dilution & mixing during transport	Very Low Susceptibility	Regulatory compliance Erosion control Revegetation Repository maintenance Remedial activities and monitoring
Stormwater Discharge	VOCs, SOCs, other organic compounds, metal, petroleum, nitrates, nitrites	Release to stormwater of compounds from pavement, industrial processes, etc.	Low Hazard	Groundwater flow direction Monitoring of discharges	Very Low Susceptibility	Source and drainage control Prevention planning Best management practices Regulatory compliance
Other: Power Transmission Line, Septic Density, Land Use, and MDT Maintenance Facilities	Nitrates, Pathogens, VOCs, SOCs, and other organic compounds	Pesticide spraying, leaking septic systems, agricultural land, and storage of chemicals	Low Hazard	None	Low Susceptibility	

PWS Monitoring Waivers

Monitoring Waivers
The 1986 Amendments to the Safe Drinking Water Act require that community and non-community PWS wells sample drinking water sources for the presence of volatile organic chemicals (VOCs) and synthetic organic chemicals (SOCs). The US EPA has authorized states to issue monitoring waivers for the organic chemicals to systems that have completed an approved waiver application and review process. All PWS wells in the State of Montana are eligible for consideration of monitoring waivers for several organic chemicals. The chemicals diquat, endothall, glyphosate, dioxins, ethylene dibromide (EDB), dibromochloropropane (DBCP), and polychlorinated biphenyls are excluded from monitoring requirements by statewide waivers.

Use Waivers
A Use Waiver can be allowed if through a vulnerability assessment, it is determined that specific organic chemicals were not used, manufactured, or stored in the area of a water source (or source area). If certain organic chemicals have been used, or if the use is unknown, the system would be determined to be vulnerable to organic chemical contamination and ineligible for a Use Waiver for those particular contaminants.

Susceptibility Waivers
If a Use Waiver is not granted, a system may still be eligible for a Susceptibility Waiver, if through a vulnerability assessment it is demonstrated that the water source would not be susceptible to contamination. Susceptibility is based on prior analytical or vulnerability assessment results, environmental persistence, and transport of the contaminants, natural protection of the source, wellhead protection program efforts, and the level of susceptibility indicators (such as nitrate and coliform bacteria). The vulnerability assessment of a surface water source must consider the watershed area above the source, or a minimum fixed radius of 1.5 miles upgradient of the surface water intake. PWS wells developed in unconfined aquifers should use a minimum fixed radius of 1.0 miles as an area of investigation for the use of organic chemicals. Vulnerability assessment of spring water sources should use a minimum fixed radius of 1.0 miles as an area of investigation for the use of organic chemicals. Shallow groundwater sources under the direct influence of surface water (GWUDISW) should use the same area of investigation as surface water systems; that is, the watershed area above the source, or a minimum fixed radius of 1.5 miles upgradient of the point of diversion. The purpose of the vulnerability assessment procedures outlined in this section is to determine which of the organic chemical contaminants are in the area of investigation.

Given the wide range of landforms, land uses, and the diversity of groundwater and surface water sources across the state, additional information is often required during the review of a waiver application. Additional information may include well logs, pump test data, or water quality monitoring data from surrounding public water systems; delineation of zones of influence and contribution to a well; Time-of-travel or attenuation studies; vulnerability mapping; and the use of computerized groundwater flow and transport models. Review of an organic chemical monitoring waiver application will be conducted by DEQ’s PWS Section and DEQ’s Source Water Protection Program. Other state agencies may be asked for assistance.

Susceptibility Waiver for Confined Aquifers
Confined groundwater is isolated from overlying material by relatively impermeable geologic formations. A confined aquifer is subject to pressures higher than atmospheric pressure that would exist at the top of the aquifer if the aquifer were not geologically confined. A well that is drilled through the impervious layer(s) into a confined aquifer will enable the water to rise in the borehole to a level that is proportional to the water pressure (hydrostatic head) that exists at the top of a confined aquifer.

The susceptibility of a confined aquifer relates to the probability of an introduced contaminant to travel from the source of contamination to the aquifer. Susceptibility of an aquifer to contamination will be influenced by the hydrogeologic characteristics of the soil, vadose zone (the unsaturated geologic materials between the ground surface and the aquifer), and confining layers. Important hydrogeologic controls include the thickness of the soil, the depth of the aquifer, the permeability of the soil and vadose zones, the thickness and uniformity of low permeability and confining layers between the surface and the aquifer, and hydrostatic head of the aquifer. These factors will control how readily a contaminant will infiltrate and percolate toward the groundwater.

The Susceptibility Waiver has the objective of assessing the potential of contaminants reaching the groundwater used by the PWS. A groundwater source that appears to be confined from surface infiltration in the immediate area of the wellhead may eventually be affected by contaminated groundwater flow from elsewhere in the recharge area. Contaminants could also enter the confined aquifer through improper well construction or abandonment creating a hydraulic connection from the surface to the confined aquifer. The extent of confinement of an aquifer is critical to limiting susceptibility to organic chemical contamination. Regional conditions that define the confinement of a groundwater source must be demonstrated by the PWS in order to be considered for a confined aquifer Susceptibility Waiver. Confinement of an aquifer can be demonstrated by pump test data (storage coefficient), geologic mapping, and well logs. Site specific information is required to sufficiently represent the recharge area of the aquifer and the zone of contribution to the PWS well. The following information should be provided:

- Abandoned wells in the region (zone of contribution to the well),
- Other wells in the region (zone of contribution to the well),
- Nitrate/Coliform bacteria analytical history of the PWS well,
- Organic chemical analytical history of the PWS well,

<u>Susceptibility Waiver for Unconfined Aquifers</u>
Unconfined aquifers are the most common source of usable groundwater. Unconfined aquifers differ from confined aquifers in that the groundwater is not regionally overlain by relatively impervious geologic strata. As a result, the upper groundwater surface or water table in an unconfined aquifer is not under pressure that produces hydrostatic head common to confined aquifers.

Unconfined aquifers are often locally recharged from surface water or precipitation. In general, groundwater flow gradients in unconfined aquifers may reflect surface topography, and the residence time of water in the aquifer is typically comparatively shorter than for water in confined aquifers. Similar water chemistry may often exist between unconfined groundwater and area surface water, and physical parameters and dissolved constituents can be indicators of the hydraulic connection between groundwater and surface water. Consequently, unconfined aquifers can be susceptible to contamination by organic chemicals migrating from the ground surface or surface water to groundwater.

The objective of the Susceptibility Waiver application is to assess the potential of organic chemical migration from the surface to the unconfined aquifer. The general procedures make use of a combination of site specific information pertaining to the location and construction of the source, monitoring history of the source, geologic characteristics of the vadose zones, and mobility and persistence characteristics of the organic chemicals. The zone of contribution of the unconfined groundwater source must be defined and plotted. Groundwater flow directions, gradients, and a 3-year groundwater time-of-travel should be described. All surface bodies within 1,000 feet of the PWS well(s) must be plotted. Analytical monitoring history of the PWS well and nearby wells should also be provided.

<u>Monitoring Waiver Recommendation</u>
Sanders County Harvest Foods is not currently eligible for any monitoring waivers, as the PWS well has not been in use long enough. The system may apply for such waivers after the minimum testing period, and the authors encourage the business to do so. It appears that the PWS may be eligible for a Confined Aquifer Susceptibility Waiver when the time is appropriate.

General Summary
This report was prepared to assist the owner/operator of the Sanders County Harvest Foods PWS to better understand the water source for which they are responsible. The report provides information concerning the aquifer that supplies water to the well and identifies the Control Zone, Inventory Region, and Recharge Region. Within each of these protection areas, the significant potential contaminant sources that may impact the well water are identified. Also included in the report are recommendations regarding how the potential sources of contaminants could be better managed to prevent impacts to the Sanders County Harvest Foods well. The authors recommend that the business develop an Emergency Spill Response Plan that identifies the procedures that managers, employees, and operators should follow in the event that the well is in danger of contamination for any type of contaminant. It is also important for the owner/operator to continue to monitor the water quality. This will ensure that the public water supply at Harvest Foods maintains its water quality and minimizes health risks. Steps should also be taken to properly abandon the well identified as Well #1, if there is no intention to retain the well as a backup. The PWS owners and operator are encouraged to protect the PWS well(s), distribution, and water treatment facilities from

accidental or intentional tampering. This protection can take the form of collision posts or substantial fencing around wellheads, locked chemical storage and treatment rooms/equipment, and limiting of the distribution of keys to the PWS facilities to facility owners, managers, and the PWS operator.

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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.

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.

Delineation. A process of mapping source water management areas.

Effective Porosity. The percent of soil, sediment, or rock through which fluids, such as air or water, can pass. Effective porosity is always less than total porosity because fluids can not pass through all openings.

Hardness. Characteristic of water caused by presence of various salts. 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 an area expected to contribute water to a public water supply well within a fixed distance or a specified groundwater time-of-travel distance.

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 nitrates are septic tanks, feed lots and fertilizers.

Nonpoint-Source Pollution. Pollution sources 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. A bacterial organism or virus 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.

Porosity. The percent of soil, sediment, or rock filled by air, water, or other fluid.

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

SIC Code. The U.S. Standard Industrial Classification (SIC) Codes classify categories of businesses. SIC Codes cover the entire range of business categories that exist within the economy.

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.

Susceptibility (of a PWS). The potential for a PWS to draw water contaminated 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 (SOCs). Man made organic chemical compounds (e.g. 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.

Total Maximum Daily Load (TMDL). The total pollutant load to a surface water body from point, non-point, and natural sources. The TMDL program was established by section 303(d) of the Clean Water Act to help states implement water quality standards.

Turbidity. The cloudy appearance of water caused by the presence of suspended matter.

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 (VOCs). Any organic compound which evaporates readily to the atmosphere (e.g. fuels and solvents).

Recharge Region / Watershed. The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common delivery point.

Note: Definitions are taken from EPA's Glossary of Selected Terms and Abbreviations and other sources.