Johnson's Mobile Home Park – PWSID # MT0000529

Pinewood Village – PWSID # MT0000275

Carousel Roller Rink – PWSID # MT0001169

Heritage Museum – PWSID # MT0001163

LDS Church – PWSID # MT0001168

Aitkens Quick Stop – PWSID # MT0003306

Helen's Tap Room – PWSID # MT0003494

Pioneer Junction Motel and Bar – PWSID # MT0000560

McGrade Elementary School - PWSID # MT0001148

Pine Tree Mobile Park – PWSID # MT0001364

White Haven (Libby Creek Valley) Public Water Supplies

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Report Date: 02 February 2002

by
Source Water Protection Program
Montana Department of Environmental Quality

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INTRODUCTION

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

Purpose

This report is intended to meet the technical requirements for completion of the delineation and assessment report for several Public Water Supplies (PWSs) in the area of White Haven, 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. The primary purpose of this source water delineation and assessment report (SWDAR) is to provide information that helps the PWS owners and operators, and the residents of the White Haven area south of Libby protect their drinking water source. This report is also intended to provide the information needed to develop a source water protection plan for these PWSs.

Limitations

This report was prepared to assess threats to public water supplies in the White Haven area and is based on published information and input obtained from local residents familiar with the community. The terms “drinking water supply” or “drinking water source” refer specifically to the source of PWSs in White Haven and not any other public or private water supply. Also, not all potential or existing sources of groundwater or surface water contamination in the White Haven area are identified. Only documented or potential sources of contamination in areas that contribute water to public water supply sources are considered.

The terms “contaminant” and “toxin” are 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

White Haven is an unincorporated settlement within the Libby Creek Valley and is situated along U.S. Highway 2, extending approximately 4 miles south of Libby, the seat of Lincoln County (Figure 1). The population of Lincoln County was estimated in 1998 at 18,696, of which approximately 750 live in or around White Haven. The Libby area economy has historically relied on the lumber and wood products industry, but employment in lumber mills and the woods declined by approximately 20 percent between 1992 and 1998. During this time period, service businesses became the largest employers in Libby and Lincoln County. A list of the PWSs incorporated into this report and their descriptions is found in Table 1. These PWSs are also depicted on Figure 2.

There are 10 public water supplies (PWSs) in White Haven, however the majority of residents get water from private wells. Individual onsite septic systems treat sewage, as there is no community sanitary sewage system in place.

Geographic setting

White Haven is 2,255 feet above sea level at 48.34° north latitude and -115.52° west longitude. The community is located in the Libby Creek Valley, which is a north to northwest trending intermountain valley in northwestern Montana. The valley is surrounded by the Purcell Mountains on the north, and the Cabinet Mountains on the east, west, and south. The valley ranges from around 2,000 feet in elevation near Libby to 4,000 along the flanks of the mountains. The higher terrain around White Haven consists of forested mountains with rocky mountain peaks that rise above 8,000 feet elevation. White Haven lies between Libby Creek and one of its tributaries, Big Cherry Creek. Libby Creek flows into the Kootenai River at Libby approximately 3 miles north of White Haven. The Cabinet Mountains Wilderness covers 147 square miles west of White Haven, and Libby Dam and Lake Koocanusa are 11 miles to the east (Figure 1).

The climate of the Libby Creek 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 Libby are 87.8°F and 46.0°F in July and 31.4°F and 15.1°F in January. Average annual precipitation falls mostly as snow in late fall and winter and ranges from 17.9 inches in Libby to about 70 inches in the Cabinet Mountains (Morrison and Maierle, Inc., 1980).

Public Water Supplies

Ten public water supplies (PWSs) serve residents of and visitors to White Haven (Refer to Figure 2 and Table 1). Three of these PWSs are classified as Community PWSs because they serve over 25 year-round residents. The other 7 PWSs are classified as Non-Community PWSs because they serve 25 or more people but do not serve 25 or more year-round residents. The Non-Community supplies are divided into 2 sub-classes designated as Non-Transient and Transient by the nature and frequency of water use. McGrade Elementary School PWS is classified as a Non-Community Non-Transient public water supply because it serves over 25 of the same persons (i.e., students and teachers) for at least six months per year (but not for the entire year). Carousel Roller Rink, Heritage Museum, the LDS Church, Aitkens Quick Stop, Helen's Tap Room, and the Pioneer Junction Motel and Bar are classified as Transient Non-Community PWSs because they serve travelers or business patrons for brief periods. All of the above mentioned PWSs derive their water from groundwater wells located on their premises.

PWSs in White Haven get water predominately from 100 to 160 foot deep wells that are screened in sand and gravel layers. These sand and gravel layers were deposited by glacial meltwater streams (that were reworking glacial till materials). They were laid on top of finer grained glacial till deposits. Yields reported on logs for these wells range from 20 to 100 gallons per minute but are mostly less than 30 gallons per minute. Clay and silt within or derived from the glacial deposits probably account for the relatively low yields in some area wells (Boettcher and Wilke, 1978). Numerous private wells in the area draw water from this shallow sand and gravel aquifer along Libby and Big Cherry creeks. Wells in the shallow aquifer (which is unconfined) generally yield more water than deeper wells but are more vulnerable to contamination.

Table 1. **Public Water Supplies** serving the White Haven area, Montana.
(Listed from north to south)

Public Water Supply	PWS ID#	Contact Person	Class*	Service Connections	Residents	Non-Residents
Carousel Roller Rink Well #1	01169	August Hardgrove 406/293-3323	TNC	3	0	50
Heritage Museum Well #1	01163	None Listed	TNC	2	0	50
LDS Church Well #1**	01168	None Listed	TNC	1	0	25
Aitkens Quick Stop Well #1***	03306	Cheryl Aitken 406/847-2191	TNC	2	0	800
Helen's Tap Room Well #1	03494	Dale Moen 406/293-8288	TNC	1	0	50
Johnson's Mobile Park Well #1	00529	Mildred Johnson 406/293-5483	C	15	35	0
Pioneer Junction Motel and Bar Well #1	00560	Neil Bertelsen 406/293-3781	TNC	4	4	75
McGrade Elementary School Well #1 & #2	01148	Phil Spencer 406/293-8791	NCNT	2	0	240
Pine Tree Mobile Park Well #1	01364	Bill Heinlien 406/293-5485	C	26	50	0
Pinewood Village Well #1 & #2	00275	Leroy Nixon 406/293-4957	C	81	160	0

*TNC = Transient Non-Community PWS, C = Community PWS, NCNT = Non-Community Non-Transient PWS

* *3 wells are thought to be present on this property although DEQ's database lists only 1. The LDS Church is currently connected to the Libby Community Water System, but no records exist concerning the abandonment of wells on this property.

*** a.k.a. in public records as Broadway Auto Shop and H & J Truck Stop

Water Quality

The U.S. Geological Survey investigated water quality in the Libby area in response to an unusual number of cases of infectious hepatitis that occurred in 1964 (Boettcher and Wilke, 1978). The objectives of this study conducted between 1972 and 1974 were to characterize the properties and chemical quality of aquifers in the Libby area and to determine whether septic-tank effluent was impacting groundwater quality in the shallow aquifer. Wells in the White Haven area were sampled and chemical analyses were conducted as part of this study (refer to Table 2). Dissolved-solids concentrations ranged from 73 to 254 mg/L in samples collected in White Haven during the summer of 1973. Calcium, magnesium, sodium, sulfate, and bicarbonate were the dominant ions encountered. There was no definitive evidence that septic-tank effluent was responsible for the 1964 hepatitis outbreak. However, a correlation between areas of dense rural development and elevated nitrate was interpreted as evidence of the impact of septic effluent on ground water quality.

Boettcher and Wilke (1978) concluded from their study that ground water and surface water are closely connected in the Libby area. Consequently, contaminants in surface water can potentially impact wells used for drinking water. In the White Haven area, Libby Creek and Big Cherry Creek are both on the 303(d) list of water bodies whose beneficial uses are limited by water quality impairment (DEQ develops this list as required under section 303(d) of the Clean Water Act). Libby Creek and Big Cherry Creek are listed as partially supporting aquatic life and cold water fisheries. Libby Creek also is listed as not supporting drinking water use. The probable causes and sources of impairment to Big Cherry Creek are dissolved zinc from logging road construction and maintenance, bank erosion of mine tailings, and fish habitat degradation from abandoned mining and habitat modification. For Libby Creek, the probable causes and source of impairment are metals (primarily mercury) from resource extraction, habitat alterations from placer mining, and riparian degradation from abandoned mining operations.

Table 2. Selected water quality data from groundwater samples taken in summer 1973 (Boettcher and Wilke, 1978).

Location	Depth ft	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	Cl mg/L	SO_4 mg/L	NO_3 mg/L	TDS
30N31W23AAD	102	8.2	249	27	12	8.3	1.2	0	0	18	160	0.7	5.8	1.1	147
30N31W23BAD	55	8.7	398	55	12	14	1.6	0	10	20	230	2.4	8.8	0.7	239
30N31W23CAC	197	8.5	375	47	12	25	1.9	0	20	22	230	1.3	7.1	0.0	244
30N31W23DAB	14	6.6	165	14	4.6	10	1.6	0	0	12	40	9.7	11	29	109
30N31W23DAD	45	6.7	168	16	5.4	6.7	1.4	0	0	15	41	11	6.9	21	106
30N31W 23DDA	46	7.9	162	16	5.5	9.6	2.1	0	0	12	67	9.1	14	7.4	110
30N31W 23DDC	117	8.1	92	12	3.9	3.3	1.1	0	0	17	54	0.2	7.4	0.6	73
30N31W23DDD2	103	8.0	143	14	5.8	5.0	1.4	0	0	16	64	5.1	3.2	7.8	90
30N31W24CBB2	12	8.2	170	19	6.8	8.3	3.1	0	200	10	93	6.4	9.2	2.1	112
30N31W24CBC	46	7.1	152	15	5.5	5.9	1.6	0	0	14	65	6.3	5.6	9.4	95

Table 2. Selected water quality data from groundwater samples taken in summer 1973 (Boettcher and Wilke, 1978).

Location	Depth ft	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	Cl mg/L	SO_4 mg/L	NO_3 mg/L	TDS
30N31W24CDB	15	8.0	168	20	8.7	2.8	0.6	0	0	9.0	110	0.6	4.9	0.9	101
30N31W25BBA	93	8.5	323	42	16	8.3	1.7	0	0	12	180	4.0	15	3.2	205
30N31W25BCB	169	8.2	422	51	20	12	1.6	10	0	15	270	1.2	14	0.4	254
30N31W25BDB	198	8.3	249	23	16	8.6	1.3	0	0	14	140	0.9	8.5	1.0	150
30N31W26ADA	40	8.3	253	23	12	11	2.7	0	0	21	82	22	18	23	170
30N31W26ADC3	100	8.7	373	49	18	11	1.8	0	0	18	210	2.8	11	1.5	235
30N31W26BBD	110	7.8	237	27	11	5.7	1.6	0	10	14	140	0.6	8.7	0.3	140

Table 3. Nitrate Levels Compared in groundwater samples taken in summer 1973 and January 1974 (Boettcher and Wilke, 1978).

Location	Well Depth ft	1973 NO_3 (as Nitrate) mg/L	1974 NO_3 (as Nitrate & Nitrite) mg/L
30N31W 3CBA	33	Not Previously Sampled	4.0
30N31W 4ACB	43	1.5	3.4
30N31W4CCB	67	1.4, 1.2	1.9
30N31W9ADD3	7	0.2	0.62
30N31W10DBC	67	21, 19	31
30N31W23BAD	55	0.7	1.4
30N31W24CBB2	12	2.1, 2.9	22
30N31W24CBD	80	Not Previously Sampled	8.8
30N31W26ADA	40	26, 23	23
30N31W32DDA	45	1.8, 1.1	1.7
30N31W33DCC	30	2.0, 1.7	7.9

Note: Nitrite concentrations in groundwater are typically negligible, which allows the comparison between the 1973 and 1974 sample data.

The largest quantities of chemicals or other toxins (not listed above) used by individuals or businesses in the White Haven area will be found primarily at retail gasoline outlets and auto repair shops situated along Highway 2. Potential contaminant sources are discussed in Chapter 3 and 4 of this document.

Monitoring and Enforcement Actions

Each of the PWS wells in White Haven are routinely monitored for compliance with drinking water standards. Bacteriological monitoring occurs monthly. Compliance with other drinking water standards is based on additional sampling, which is conducted on a variety of schedules. Coliform bacteria and nitrate were the only regulated contaminants detected in PWS wells in the last 5-6 years (see Table 4 below). In all instances where coliform bacteria were detected, repeat samples were negative. Also, nitrate can come from human or animal wastes but also is naturally occurring. The nitrate levels shown in Table 4 are below the maximum contaminant level (MCL) of 10 mg/L set by the U.S. Environmental Protection Agency (EPA), however, levels detected at Aitkens Quick Stop and Helen's Tap Room are relatively high, suggesting impacts from septic effluent.

Table 4. **Monitoring results for PWSs** in White Haven in the past 5-6 years.

Public Water Supply	Total Coliform (dates detected)	Fecal Coliform (dates detected)	Nitrate (mg/L)
Pinewood Village	08/02/96; 06/01/98	No Detects	0.24 – 0.28
Johnson's Mobile Home Park	No Detects	No Detects	0.26 – 0.57
Pine Tree Mobile Home Park	06/15/98	No Detects	0.77 – 0.91
McGrade Elementary School	No Detects	No Detects	0.08 – 0.72
Aitkens Quick Stop	No Detects	No Detects	5.31 – 5.37
Pioneer Junction Motel and Bar	No Detects	No Detects	0.44 – 0.50
Helen's Tap Room	10/30/95; 08/28/97	No Detects	1.7 – 4.37

Influencing Factors

There is a history of bacterial contamination in private and some public wells in the White Haven area. The cause of contamination is probably a combination of the proximity of septic tanks to wells, aquifer sensitivity, potentially poor sanitary conditions of some wells, and potentially poor construction of the wells or the distribution system. Additionally, poor sampling and sample handling could contribute to the values on Table 4. The greatest concentration of residential development is co-located in the Libby Creek Valley with the highest concentration of private septic systems and several large capacity septic systems. The mixture of public and private water supplies in the area makes it difficult to address these water quality threats.

CHAPTER 2
DELINEATION

The source water protection areas for PWSs in White Haven are delineated in this chapter. The purpose of delineation is to map the source of White Haven's drinking water and to define areas within which to prioritize source water protection efforts. Four types of management regions are mapped for the PWSs in White Haven (the Control Zone, Inventory Region, Surface Water Buffer, 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 the immediate surrounding areas. The Inventory Region represents the effective zone of contribution to the well, which approximates a 3-year groundwater time-of-travel distance. The Surface Water Buffer is an area from which water or contaminants can flow to the area of the well by means of the major surface water channels. The Recharge Region represents the entire portion of the aquifer that contributes water to the Libby Creek Valley (essentially the whole watershed). The goal of management in the Recharge Region is to maintain and improve water quality over long periods of time.

Hydrogeologic Conditions

The geology of the Libby Creek Valley is a description of the sediments and bedrock of the valley and surrounding area. This information is relevant because these sediments comprise the aquifer (the water bearing formations) into which the White Haven PWS wells are installed. The hydrogeology is a description of the presence and movement of groundwater in the Libby Creek Valley. This discussion is relevant because it helps the reader to understand where the PWS wells are obtaining their groundwater from and the vulnerability of that source of water to contamination.

Geology

The Libby Creek Valley is structurally derived from Cenozoic extensional (normal) faulting along the east and west basin margins (Kendy and Tresch, 1996). A geologic map of the area around Libby is presented on Figures 3, 4, 5, and 6. Note that Figure 3 is a composite map where the northern 1/3, the central 1/3, and the southern 1/3 are enlarged and displayed on Figures 4, 5, and 6 respectively. Precambrian rocks of the Belt Subgroup underlie the entire area. These rock units are composed of argillite, shale, sandstone, and quartzite. Gibson and others (1941) estimated the thickness of these units to be 20,000 feet. Glacial deposits typically overlie the Precambrian bedrock in most of the larger valleys in the area. It should be noted that the region was extensively glaciated during the Pleistocene leaving all main valleys U-shaped in cross section. The smaller mountain valleys may have been subsequently incised by stream erosion. The glacial materials that fill the U-shaped valleys are all of Quaternary age and composed of reworked and transported Precambrian rock deposited in the form of till, meltwater outwash deposits, and localized kame fields. Glacial till deposits predominate and are typically thick, poorly sorted beds of boulders, gravel, sand, silt, and clay mixtures. The thickness of the glacial deposits in the center of Libby Creek Valley is thought to be greater than 500 feet, but little data exist (Boettcher and Wilke, 1978). Overlying the glacial deposits are lakebed deposits of clay, silt, and fine sand. These lakebeds were deposited during regional glacial episodes and glacial retreat. Although locally up to 350 feet thick, the lakebed deposits are present in the form of incised remnant terraces along the edge of the valley (Kendy and Tresch, 1996). Alluvium is present in all stream valleys and within the Kootenai River Valley. The alluvium consists of relatively well sorted silt, sand, gravel, and cobbles that are reworked from glacial deposits. Paleo-stream channels have traversed back and forth across the Libby Creek Valley depositing alluvium unevenly on the glacial deposits. Boettcher and Wilke (1978) estimate the thickness of the alluvium to be approximately 100 feet.

Hydrogeology
Groundwater is a widely used source of water for the residents in the Libby Creek Valley. A surface water reservoir located on Flower Creek supplies water to residents in the town of Libby, but most other residents in the area depend on wells or springs. These wells and springs draw predominantly from the extensive unconfined alluvial aquifer that fills the Libby Creek Valley. Boettcher and Wilke (1978) produced a water table map for the area around Libby (see Figures 7, 8, 9, and 10). Big Cherry Creek and Libby Creek are the main streams that flow into the Libby Creek Valley. They drain the region from the southwest and south and in turn drain the Libby Creek Valley into the Kootenai River at the north end of the valley. Natural recharge to the aquifers in the valley is from precipitation, stream flow, and from subsurface groundwater flow from lateral stream valleys or upgradient in the Libby Creek Valley itself. It appears that infiltration anywhere within the valley can potentially recharge the unconfined or semi-confined aquifers of the basin. Boettcher and Wilke (1978) estimated flow in the Libby Creek and Big Cherry Creek drainage basins and determined the stretches where the streams were gaining (stream is receiving discharge from groundwater) or losing (stream is discharging into the groundwater). The determination is based on a close examination of the water table contour map. Specifically, it is the configuration of a water table contour line where it crosses a stream channel (forming a "V" at the crossing). If a stream is gaining, the apex of the "V" points upstream. If the stream is losing, the "V" apex points downstream. This can be seen on Figures 7, 8, 9, and 10. Additionally, Boettcher and Wilke conducted stream measurements (simple differences in stream discharge) during a low flow period (September 1972) when loss to evaporation and withdrawals from the creeks for irrigation or input into the system by snowmelt was not occurring. The results of this stream flow study are presented on Figure 11. It is worth noting that the streams in the vicinity of White Haven were clearly losing (recharging groundwater) at the time of the study.

The Precambrian bedrock that surrounds and underlies the basin typically does not produce abundant water for wells, although in places can produce sufficient water for some domestic use. The glacial tills and other glacially derived deposits produce water to wells, but the water-bearing zones in these units are typically laterally discontinuous and often receive limited recharge. This is not the case for the glacial lakebed deposits (seen as erosional remnant terraces along valley walls). These deposits typically do not provide sufficient yield for wells. Wells completed in the Quaternary alluvial deposits that fill the center of the valley can produce up to 500 gallons/minute (Boettcher and Wilke, 1978). Clay lenses are present within the alluvium, but have proven to be laterally discontinuous and do not prevent infiltrating water from reaching the lower portions of the aquifer. Kendy and Tresch (1996) discuss contamination from surface sources in the area reaching the lower parts of the alluvial aquifer. Also discussed in their work was a 1963-64 epidemic of infectious hepatitis among residents in the valley south of Libby. That epidemic prompted the Boettcher and Wilke (1978) study and the proposal of a public water supply and sewage treatment system for the area. The centralized water supply and sewage treatment system were never constructed.

Table 5. List of hydrogeologic research activities in the Libby area.

Title of Project	Period of Project	Area Covered	Project Objectives
Ground-Water Resources in the Libby Area, Northwestern Montana, by MBMG Bulletin 106	1972-1978	Libby Valley and area around Libby	Evaluation of Groundwater around Libby
Geographic, Geologic, and Hydrologic Summaries, Intermountain Basins of the Northern Rocky Mountains, Montana, by USGS Water Resources Investigations Report 96-4025	1996	Libby Creek Valley	Geography, Geology, Hydrogeology, and Hydrology of Libby Creek Valley

Table 6. List of geologic or hydrogeologic maps available for the Libby area.

Title of Project	Period of Project	Area Covered	Project Objectives
Ground-Water Resources in the Libby Area, Northwestern Montana, by MBMG	1972-1978	Libby Valley and vicinity around Libby	Evaluation of Groundwater around Libby
Geographic, Geologic, and Hydrologic Summaries of Intermountain Basins of the Northern Rocky Mountains, Montana	1996	Libby Creek Valley	Geography, Geology, Hydrogeology, and Hydrology of Libby Creek Valley

The primary aquifer of the Libby Creek Valley is considered unconfined, with localized semi-confined and perched groundwater conditions probable. The aquifer is bounded by the low conductivity Precambrian bedrock that underlies and surrounds the valley. Water is predominately available within the uppermost alluvium and less so in the underlying glacial till. Local streams actively recharge the aquifer throughout the length of the Libby Creek Valley. Some domestic wells within the Libby Creek Valley have historically been impacted by bacteriological and/or nitrate contamination. These impacts can be considered indicative of a communication between surface water and groundwater in certain areas of the stream valley. Based upon the hydrogeologic setting (discussed in Table 7), the aquifer is classified as having a high source water sensitivity to contamination.

Table 7. Source Water Sensitivity, Determination of

Source Water Sensitivity (based upon the aquifer from which the PWSs draw their water)
High Source Water Sensitivity Surface Water and Groundwater Under the Direct Influence of Surface Water (GWUDISW) <u>Unconsolidated Alluvium (unconfined aquifer conditions)</u> <u>Fluvial-Glacial Gravel</u> 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 (confined aquifer conditions)

Conceptual Model and Assumptions

A conceptual hydrogeologic model is a simplified representation of the hydrogeologic system. For the White Haven area, the groundwater occurs in the shallow alluvial deposits and probably in the upper portion of the glacial till deposits. Both of these units are thought to be recharged by direct infiltration from the surface and from stream loss that may occur throughout the length of the Libby Creek Valley. Groundwater is present in predominately unconfined aquifer conditions. Groundwater flows generally parallel to tributary streams in a northerly direction and is hydraulically connected with the streams throughout the area. Groundwater flow is toward and parallel to the major streams within the Libby Creek Valley. The relatively coarse aquifer materials, the periodic detects of nitrate and pathogens in local private wells and PWSs, and the absence of protective clay layers (that are laterally extensive) contribute to the determination that the aquifer has a high source water sensitivity to contaminants throughout the Libby Creek Valley.

Well Information

The PWS wells listed and summarized on Tables 8 & 9 are all located near the center of the Libby Creek Valley along Highway 2, and are south of the town of Libby (refer again to Figure 2). The information on each well has been compiled from all available sources, to include: 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 PWS Sanitary Surveys. The available well logs are found in Appendix D.

Table 8. PWS Source Well Information for White Haven

	Carousel Roller Rink Well #1	Heritage Museum Well #1	LDS Church Well #1 *	Aitken's Quick Stop Well #1**	Helen's Tap Room Well #1	Johnson's Mobile Home Park Well #1
PWS ID #	01169	01163	01168	03306	03494	00529
PWS Source ID #	002	002	002	002	002	002
Class	TNC	TNC	TNC	TNC	TNC	C
Well Location (T, R, S)	30N 31W 15AAB	30N 31W 14BCC	30N 31W 15DAA	30N 31W 23DAA	30N 31W 23CDA	30N 31W 25BBC
Latitude Longitude	48.3662 -115.5416	48.3628 -115.5370	48.3628 -115.5370	48.3483 -115.5176	48.3227 -115.5183	48.3390 -115.5151
MBMG GWIC #	NA***	NA	M87133	NA	M87206	M87346 or M87360
DNRC Water Right #	CO64976	CO34938 (?)		CO50706 or W143748	CO24829	CO17063
Date Well was Completed	09 August 1976	25 May 1976	14 April 1983	~1972	26 March 1974	29 September 1967
Total Depth (feet bgs)	115	76	303	106	104	40
Screen Interval (feet bgs)	111-115	Open bottom	268-303	NA	NA	Open bottom
Static Water Level (feet bgs)	36	35	15	38	77	14
Pumping Water Level (feet bgs)	NA	70	~254	NA	82	30
Drawdown (feet)	~76	35	NA	NA	5	NA
Yield = Q (gal/min)	7	25	3	10	15	18
Yield = Q (ft^3/day)	1,347	4,813	578	1,925	2,887	3,465
Test Pumping Rate (gal/min)	NA	NA	NA	NA	15	NA
Specific Capacity = Q/drawdown	0.09	0.71	NA	NA	0.375	NA

* 3 wells are thought to be present on this property but they do not show up in the DEQ PWS database. DEQ PWS records indicate that the LDS Church is now connected to the Libby Community Water System, but no records exist concerning the actual use of or abandonment of these wells.
** a.k.a. in public records as Broadway Auto Shop and H & J Truck Stop
*** NA means that the information was Not Available
Class: TNC = Transient Non-Community PWS, C = Community PWS, NCNT = Non-Community Non-Transient PWS

Table 9. PWS Source Well Information for White Haven (continued)

	Pioneer Junction Motel & Bar Well #1	**McGrade Elementary School Well #1**	**McGrade Elementary School Well #2**	**Pine Tree Mobile Home Park DOT Well #1**	**Pinewood Village Well #1**	**Pinewood Village Well #2**
PWS Source Code	00560	01148	01148	01364	00275	00275
PWS Source ID #	002	002	003	002	002	003
Class	TNC	NTNC	NTNC	C	C	C
Well Location (T, R, S)	30N 31W 26ADAD	30N 31W 25BCC	30N 31W 25BCC	30N 31W 26ADC	30N 31W 25CBD	30N 31W 25CBD
Latitude Longitude	48.3360 -115.5172	48.3354 -115.5145	48.3354 -115.5145	48.3343 -115.5193	48.3313 -115.5128	48.3313 -115.5128
MBMG GWIC #	M87427	M87340	M87340	M87431	M87372	M87337
DNRC Water Right #	C108279	CO43263 or CO66584	NA	CO27032	POO5615	POO5615
Date Well was Completed	19 July 1974	29 April 1982	NA	1975	Late ~1960s	01 May 1975
Total Depth (feet bgs)	125	138	NA	101	160	162
Screen Interval (feet bgs)	120-125	Open bottom	Open bottom	75-85	NA	152-162
Static Water Level (feet bgs)	60	9	NA	42-46	~21	21
Pumping Water Level (feet bgs)	~95	17	NA	74	~24	33
Drawdown (feet)	~35	8	NA	29	NA	12
Yield = Q (gal/min)	~30	80	NA	20	50	100-120
Yield = Q (ft^3/day)	5,775	15,399	NA	3,850	9,624	19,249
Test Pumping Rate (gal/min)	NA***	NA	NA	60	NA	NA
Specific Capacity = Q/drawdown	~0.86	10	NA	2.1-2.8	NA	8.3-10

*** NA means that the information was Not Available
Class: TNC = Transient Non-Community PWS, C = Community PWS, NCNT = Non-Community Non-Transient PWS

Water Distribution and Treatment

All the PWSs in White Haven serve untreated water (Table 10). See the most recent sanitary surveys in Appendix E for details about system operation.

Table 10. Water distribution and treatment at PWSs in White Haven.

Public Water Supply	Water Distribution	Treatment
Carousel Roller Rink	One captive air pressure tank Service to roller rink, pet shop, and a mobile home	None
Heritage Museum	None Service to museum only	None
LDS Church	Unknown, possible 9,000 gallon below grade concrete reservoir Service to church and grounds	None
Aitkens Quick Stop	One captive air pressure tank Service to gas station and adjacent propane business	None
Helen's Tap Room	One captive air pressure tank Service to bar and one adjacent house	None
Johnson's Mobile Park	Three captive air pressure tanks Service to 15 mobile homes plus office/residence	None
Pioneer Junction Motel and Cafe	Two captive air pressure tanks Service to a duplex, 10 apartments, 14 motel units, and cafe	None
McGrade Elementary School	Three captive air pressure tanks Service to elementary school and grounds	None
Pine Tree Mobile Home Park	One captive air pressure tank Service to 26 mobile homes	None
Pinewood Village	25,000 gallon buried concrete reservoir Service to 80 mobile homes and office	None

Aquifer Properties

Estimates including aquifer properties, hydraulic gradient, well discharge rate, and ambient groundwater flow direction are used to determine the 3-year time-of-travel and to model potential "capture zones" for wells used for PWSs. Capture zones are the area of the aquifer surrounding a pumping well that actively contribute groundwater to that well. This area of contribution is evidenced by the measurable cone of depression in the aquifer's potentiometric surface. The aquifer properties typically estimated are transmissivity, hydraulic conductivity, the aquifer's thickness, and effective porosity of the media. Flow test (or well pumping) data from well logs and representative published values were used to estimate hydraulic conductivity. A value for transmissivity was published for the Libby Creek Valley aquifer in Boettcher and Wilke (1978). The groundwater potentiometric surface elevation maps found in Boettcher and Wilke (1978) were used to estimate groundwater gradients in the areas of each of the Inventory Regions. Time-of-travel calculations are displayed in Appendix B.

The input parameters that were used to calculate a 3-year time-of-travel distance for groundwater movement (and from that the Inventory Region boundary for the Southern Inventory Region) are summarized on Tables 11 and 12.

Table 11. Estimates of input parameters used to delineate the source water protection areas.

Input Parameter	Range of Values And Units	Values Used				
		Carousel Roller Rink #01169	Heritage Museum #01163	Aitken's Quick Stop #03306	LDS Church #01168	Helen's Tap Room #03494
PWS Source		002	002	002	002	002
Transmissivity T	4000 ft^2/day	4,000 ft^2/day	4,000 ft^2/day	4,000 ft^2/day	4,000 ft^2/day	4,000 ft^2/day
Screen Length L	Feet	5	5	NA	NA	NA
Thickness b	Feet	79	65	68	288	68
Hydraulic Conductivity K = T/b	Feet/day	50.6	61.5	58.8	13.9	58.8
Hydraulic Gradient	Feet/Feet	0.024	0.024	0.024	0.024	0.011
Flow Direction		Northeast	North to Northeast	North to Northeast	North to Northeast	Northwest
Effective Porosity N e	0.2-0.3	0.25	0.25	0.25	0.25	0.25
Pumping Rate Q	ft^3/day	1,347	4,813	8,661	578	2,887
1-Year TOT**	Feet - Calculated	1,771	2,200	2,063	487	945
3-Year TOT**	Feet - Calculated	5,335	6,520	6,270	1,461	2,833

Transmissivity T for the Libby Creek Valley was published in the MBMG Bulletin 106. The same value was used for all PWSs.

Screen Length L is found in the published well logs.

Thickness b is assumed in this situation to be the saturated thickness of the aquifer rather than the screen or sand pack length. This information is found in the lithologic logs.

Hydraulic Conductivity K is derived arithmetically from T/b.

Hydraulic Gradient was measured and calculated in the vicinity of each PWS well on the MBMG Water Table contour maps in Bulletin 106.

Flow direction was taken from the MBMG Water Table contour maps in Bulletin 106. Groundwater flows perpendicular to the lines of equal potential and from high potential to low potential (essentially it flows downhill). Local groundwater flow may vary considerably throughout the seasons and from year to year.

Effective porosity Ne was taken from published values found in Weight and Sonderegger 2000. The same value was used for all PWSs.

Pumping rate Q is found in the published well logs.

TOT is groundwater Time of Travel for the various wells, and was calculated using EPA's uniform flow equation. The spreadsheet used to do the calculation and equation are found in Appendix B.

Table 12. Estimates of input parameters used to delineate the source water protection areas.

Input Parameter	Values Used					
	Johnson's Mobile Park #00529	**Pioneer Junction Motel & Bar #00560**	**McGrade Elem. School #01168**	**Pine Tree Mobile Park # 01364**	**Pinewood Village #00275**	**Pinewood Village #00275**
PWS Source	002	002	002	002	002	003
Transmissivity T	4,000 ft^2/day	4,000 ft^2/day	4,000 ft^2/day	4,000 ft^2/day	4,000 ft^2/day	4,000 ft^2/day
Screen Length L	5	5	5	10	NA	10
Thickness* b	26	65	129	56	139	141
Hydraulic Conductivity K = T/b	153.9	61.5	31.0	71.4	28.8	28.4
Hydraulic Gradient	0.011	0.011	0.011	0.011	0.011	0.011
Flow Direction	North to Northwest	North	North to Northwest	North to Northeast	North to Northwest	North to Northwest
Effective Porosity Ne	0.25	0.25	0.25	0.25	0.25	0.25
Pumping Rate Q	5,775	5,775	15,399	15,399	11,549	19,249
1-Year TOT**	2,474	987	497	1,146	463	456
3-Year TOT**	7,417	2,964	1,493	3,441	1,387	1,368

Transmissivity T for the Libby Creek Valley was published in the MBMG Bulletin 106. The same value was used for all PWSs.
Screen Length L is found in the published well logs.
Thickness b is assumed in this situation to be the saturated thickness of the aquifer rather than the screen or sand pack length. This information is found in the lithologic logs.
Hydraulic Conductivity K is derived arithmetically from T/b.
Hydraulic Gradient was measured and calculated in the vicinity of each PWS well on the MBMG Water Table contour maps in Bulletin 106.
Flow direction was taken from the MBMG Water Table contour maps in Bulletin 106. Groundwater flows perpendicular to the lines of equal potential and from high potential to low potential (essentially it flows downhill). Local groundwater flow may vary considerably throughout the seasons and from year to year.
Effective porosity Ne was taken from published values found in Weight and Sonderegger 2000. The same value was used for all PWSs.
Pumping rate Q is found in the published well logs.
TOT is groundwater Time of Travel for the various wells, and was calculated using EPA's uniform flow equation. The spreadsheet used to do the calculation and equation are found in Appendix B.

Delineation Results

A 100 foot radius Control Zone was delineated around each public water supply well. Inventory Regions for the Northern Inventory Region and the Central Inventory Region are based upon an arbitrary 1-mile radius around the PWSs. The use of a 1-mile radius Inventory Region for Transient Non-Community PWSs (as present in the Northern and Central Inventory Regions) is discussed in DEQ's SWPP document (1999). The boundaries of these regions have been modified based upon local topography and what is known of the local hydrogeology. The boundary of the Southern Inventory Region is based upon projected groundwater flow direction, aquifer boundaries, the estimated 3-year time-of-travel for groundwater to reach the PWSs, and was modified to fit obvious topographical and map features seen on the ground. The above described Inventory Regions have been established conservatively to be protective of the PWS wells that they surround. The PWSs in the 3 Inventory Regions are grouped together for the sake of convenience into a Northern, Central, and Southern Inventory Region. See Table 13.

Table 13. **Delineation Grouping and Criteria** for White Haven PWSs

Delineated Inventory Region	Type of PWS	Boundary of Inventory Region Based Upon These Criteria
Northern Inventory Region		1-mile radius around the PWSs modified by local hydrogeology and topographic features
Carousel Roller Rink	Transient Non-Community	
Heritage Museum	Transient Non-Community	
LDS Church	Transient Non-Community	
Central Inventory Region		1-mile radius around the PWSs modified by local hydrogeology and topographic features
Helen's Tap Room	Transient Non-Community	
Aitken's Quick Stop	Transient Non-Community	
Southern Inventory Region		Groundwater 3-year time-of-travel to all PWSs modified by local topographic features (with groundwater moving from south to the north)
Johnson's Mobile Home Park	Community Non-Transient	
Pioneer Junction Motel & Bar	Transient Non-Community	
McGrade Elementary School	Non-Community Non-Transient	
Pine Tree Mobile Home Park	Community Non-Transient	
Pinewood Village	Community Non-Transient	
Surface Water Buffer Along main tributaries	Inclusive of all PWSs	Surface Water Buffer extends 10 miles upstream along main tributaries of Libby Creek and Big Cherry Creek drainages
Recharge Region The Watershed	Inclusive of all PWSs	Boundary based upon the USGS 11 digit Hydrologic Unit Code for the local watershed draining to the Libby Creek Valley

The above 3 Inventory Regions, the Surface Water Buffer, and the Recharge Region (essentially the watershed) are presented on Figures 12, 13, 14, 15, and 16. It should be noted that the 5 PWSs in the Southern Inventory Region fall just within the southern boundary of the Central Inventory Region. For the purposes of this assessment, the inventory, and the management of potential contaminant sources, these 5 PWSs are placed into their own Inventory Region (the Southern Inventory Region seen on Figure 15).

The Surface Water Buffer extends 10 miles upstream along both Libby Creek and Big Cherry Creek. Boundaries of the Surface Water Buffer are 0.5 miles on either side of the respective creek or river. The Recharge Region is considered the Watershed for the stream drainages and the alluvial aquifers that supply water to the PWSs listed above.

Limiting Factors

The reader should keep in mind that the Northern and Central Inventory Regions are delineated using SWPP's standard 1-mile radius circle and estimates of groundwater flow. The delineation of the Southern Inventory Region is based upon an estimated 3-year groundwater time-of-travel. Conclusions based on this interpretation are uncertain because the extent and properties of the aquifer, and the direction and rate of groundwater flow are not precisely known. This especially true when addressing groundwater behavior beneath specific locations in the Libby Creek Valley. Uncertainties in the delineation of the Southern Inventory Region are addressed in two ways. First, input parameters were selected in order to yield a conservative estimate of the groundwater time-of-travel distance. This distance was used to delineate the upgradient extend of the Southern Inventory

Region. Second, lateral boundaries of the Inventory Regions were expanded in some areas to take into account potential seasonal variations in groundwater flow direction and the potential contribution to the aquifer by the Big Cherry Creek drainage.

CHAPTER 3
INVENTORY

An inventory of potential contaminant sources was conducted to assess the susceptibility of PWS wells in White Haven to contamination and to provide a basis for source water protection planning. The inventory for White Haven focuses on areas of known contamination, facilities that use, generate, transport, or store potential contaminants, and certain land uses within the Inventory Regions and Surface Water Buffer 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. The contaminants of greatest concern to PWSs in the Libby Creek Valley and White Haven are nitrate, pathogens, fuels, solvents, and pesticides.

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 Regions. 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 Regions. This includes sources of nitrate and microbial contaminants identified in the Surface Water Buffer, and 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 one 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 (~Class V Injection Wells)

In support of this inventory, an evaluation of land use was made for areas within the 3 Inventory Regions, the Surface Water Buffer, 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 the data that allowed for a quantified determination of primary land uses. The land use maps and the supporting analyses for these areas are found in Appendix C.

Inventory Results/Control Zones

The Control Zone is the area located within 100 feet of a PWS well. Leaks from sewer or septic tank connecting lines and stormwater runoff are potential contaminant sources for all of the PWS sources/wells. Of specific concern is the location of the septic system for Helen's Tap Room which is located within 70 feet of their PWS well. This PWS is located within the Central Inventory Region. All of the Control Zones discussed in this report are owned and controlled by the respective PWS owners or their tenants.

Inventory Results/Inventory Regions

Businesses located within the boundaries of the Inventory Region that handle or generate hazardous wastes are considered potential contaminant sources. They would qualify as significant potential contaminant sources if they are described by one or more of the categories listed above. The businesses considered as potential sources are listed on Table 14. It is important to remember that these businesses are included on the list solely on the basis of the type of business or operation and the chemicals typically used at these businesses. This list does not imply that these businesses are actual polluters or that they mishandle the chemicals used. The locations of these businesses within the 3 Inventory Regions are shown on Figure 17. There appear to be a limited number of businesses (mostly retail gasoline stations) with underground storage tanks (USTs) currently in use, or for which records exist describing leaking underground storage tanks (LUSTs). These USTs/LUSTs are also listed on Table 14. The locations of these UST/LUST sites are plotted on Figure 18. A listing of large capacity septic systems and the density of septic systems within the Inventory Regions are also provided on Table 14. A large capacity septic system is one that serves 20 or more persons per day for more than 6 months per year. Additionally, land use within the 3 Inventory Regions is described on the same table. Of significance is the small amount of commercial property, which ranges from 7.7 to 11.6% of the areas and residential properties, which occupy between 3.5 to 8.2% of the areas. There are no Montana State Superfund sites present within any of the Inventory Regions. The northern edge of the Northern Inventory Region overlaps the boundary of the EPA's CERCLIS Site identified as the Libby Groundwater Contamination Site. This site encompasses areas of both soil and groundwater contamination, but the potential that this contamination would impact any of the PWSs discussed in this report is low (because it is located downgradient of the PWSs in the Northern Inventory Region). This groundwater contamination site is depicted on Figure 19.

Businesses that generate, store or dispose of relatively 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; discharge to local streams, and indirectly reach the aquifer. Volatile organic compounds are the most prevalent chemicals used or stored and therefore the most likely contaminants that would reach the aquifer from areas where storm water is concentrated and directly recharges the unconfined aquifer (these are called Class V injection wells). These injection wells have not been inventoried and the locations are not known.

Accidental spills on highways and railways, the routine activities on cultivated cropland, unregistered confined animal feeding operations (CAFOs), and the presence of unsewered residential developments are other significant potential contaminant sources. Spills of large quantities of chemicals transported along Highway 2 pose a threat to many of the wells in the Libby Creek Valley, but are of particular concern to the PWSs, because they are located close to the roadway. No railways are present within the 3 Inventory Regions described in this report. The acreage of cultivated crops in the Libby Creek Valley is small, so the potential threat that pesticides and fertilizer pose is low. The threat of groundwater contamination by wastes from residential septic systems is considered low due to the low density of these systems within each of the Inventory Regions. Unfortunately, the highest density of these systems is in close proximity to the PWSs, which greatly increases the threat of contamination from these sources. This is especially true if there is an increase in residential and commercial development along the Highway 2 corridor running through the Libby Creek Valley. Septic density within the 3 Inventory Regions is depicted on Figure 20.

Inventory Results/Surface Water Buffer

The inventory for the Surface Water Buffer is also included on Table 14. Septic drainfields at rural homes and agricultural land are the only significant potential sources of nitrate or pathogen contaminants identified in the Surface Water Buffer. A majority of these sources appear to be located along the Libby Creek/Highway 2 corridor and along the upper reaches of Big Cherry Creek. Population and septic density are greatest within the 3 Inventory Regions identified in this SWDAR, which is in the northernmost section of the Surface Water Buffer. Overall septic density is low for the entire Surface Water Buffer, but the highest septic densities are located in close proximity to the PWS wells. Refer to Figure 21 and Table 16. The percentage of agricultural land in the Surface Water Buffer is 5.3% and poses a Low Hazard of contamination. Unidentified (and thus unregulated) confined animal feeding operations and large scale logging operations may pose an undetermined hazard to surface water and indirectly to groundwater in the Libby Creek Valley. Mines and mine related wastes may produce contaminants that could impact PWSs in the Surface

Water Buffer, their number and the volumes of tailings are not significant. Additionally, the metal contaminants which are the contaminant of concern are not evaluated in the Surface Water Buffer. Local mines are presented on Figure 22.

Inventory Results/Recharge Region (the Watershed)

There are few potential sources of contamination within the Recharge Region that are outside of the 3 Inventory Regions and the Surface Water Buffer identified in this report. The population and septic density in the Recharge Region as a whole are lower than in the Surface Water Buffer and the hazard posed by septic systems is considered Low. Although mines and mine related wastes produce contaminants that are regulated for PWSs, the number of inactive and active mines is low and the hazard posed by their tailings is thought to be Low. Unfortunately, data on the volume or acreage of mine tailing piles was not available while writing this report. Locations of the mines within the watershed are presented on Figure 22.

Inventory Update

To make this SWDAR a useful document in the years to come, the owners or the certified water system operators for each public water supply in White Haven 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 every 5 years to ensure that this report 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

The susceptibility of PWS wells in White Haven to contamination is assessed in this chapter. The proximity of a potential contaminant source to a well or the density of potential non-point contaminant sources determines the threat of contamination, referred to here as Hazard (Table 17). Hazard and the existence of barriers to contamination determine Susceptibility (Table 18).

Table 17. Hazard of potential contaminant sources, Determination of.

	High Hazard Rating	Moderate Hazard Rating	Low Hazard Rating
Point Sources of All Contaminants	Within 1-year TOT	1 to 3-years TOT	Over 3-years TOT
Septic Systems	More than 300 per sq. mi.	50 – 300 per sq. mi.	Less than 50 per sq. mi.
Municipal Sanitary Sewer (percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region
Cropped Agricultural Land (percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region

Note: There are no municipal sewer systems present within the Inventory Regions described in this SWDAR. TOT refers to groundwater time-of-travel (the distance that groundwater is estimated to travel in a given time).

Barriers can be anything that decreases the likelihood that contaminants will reach a 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 can be considered management barriers. Thick clay-rich soils, a deep water table or a thick saturated zone above the well intake can be natural barriers.

Table 18. Aquifer Susceptibility to potential contaminant sources based on hazard rating and the presence of 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

The significant potential contaminant sources are identified (by type of business or chemicals used) for the 3 Inventory Regions, within the Surface Water Buffer, and within the Recharge Region/Watershed. These are listed on Tables 19, 20, 21, 22, and 23. These tables address types of contaminant sources, how the contaminants may be released to the environment, the hazard rating for those contaminants, any barriers that may be present, and the susceptibility of the aquifer to those contaminants. The tables also describe some management tools that can be used to reduce the hazard from particular contaminants.

It is relevant and important to note that the only regulated contaminants within the Inventory Region of Transient PWSs are nitrates and pathogens. This is the situation for the Northern and Central Inventory Regions, the single Transient PWS in the Southern Inventory Region, and within the Surface Water Buffer. The Non-Community Non-Transient PWS and the Community PWSs located in the Southern Inventory Region are obligated to monitor for a larger list of regulated contaminants. Regardless of the classification of the PWS, Tables 19, 20, 21, 22, and 23 attempt to list the significant potential contaminant sources within the Inventory Region.

Overall the 3 Transient PWS wells in the Northern Inventory Region have a moderate susceptibility to contamination from septic systems and accidental spills along Highway 2. These PWS wells have a low susceptibility to contamination from agriculture because of the low percentage of agricultural land within the region. The 2 Transient PWS wells in the Central Inventory Region and the 1 Transient PWS well in the Southern Inventory Region have a similar susceptibility to the same contaminants and sources of contamination as seen in the Northern Inventory Region. Increasing the number of barriers between the wells and any of the potential contaminant sources can reduce the susceptibility of these PWSs and the aquifer. Many of these barriers are listed as management practices, procedures, and prevention planning on Tables 19 and 20.

The 3 Community and 1 Non-Community Non-Transient PWSs in the Southern Inventory Region monitor for a wide range of contaminants on a varied schedule, dependant upon requirements. These PWS wells have a high susceptibility to contaminants that might originate from an auto recycler located upgradient from the wells. These PWS wells have a moderate susceptibility to contamination from USTs/LUSTs, septic systems, and a metal fabricator shop. These PWS wells have a low susceptibility to potential contamination from an auto repair shop. As mentioned above, increasing the number of barriers between the wells and any of the potential contaminant sources can reduce the susceptibility of these PWSs to the contaminant. Many of these barriers are listed as management practices, procedures, and prevention planning on Table 21.

The results of the susceptibility assessment indicate that septic systems, USTs/LUSTs, and an assortment of mechanical shops represent the most significant potential threats to the aquifer and the PWS wells in the White Haven area. The most common potential contaminant sources in the White Haven area are the numerous private septic systems, especially those that are in close proximity to the PWSs. This source can be eliminated by the installation of a centralized community sewer system.

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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 (SOC). 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 (VOC). 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.

* Definitions taken from EPA’s Glossary of Selected Terms and Abbreviations and other sources.