This report has been modified for publication.

Monarch School

For Girls, Public Water Supply – PWS ID # MT0004420
For Boys, Public Water Supply – PWS ID # MT0004573

SOURCE WATER DELINEATION AND ASSESSMENT REPORT

Final Report

Report Date: 22 July 2008

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EXECUTIVE SUMMARY

This Source Water Delineation and Assessment Report was prepared under the Federal Safe Drinking Water Act and the Montana Source Water Assessment Plan. The Department of Environmental Quality (DEQ) has been conducting these assessments for all public water systems (PWSs) in Montana. The purpose is to provide information so that the public water system staff/operators, consumers, and community citizens can begin developing strategies to protect your source of drinking water. The information that is provided includes the identification of the area most critical to maintaining safe drinking water (the Inventory Region), an inventory of potential sources of contamination within this area, and an assessment of the relative threat that these potential sources pose to the water system.

The drinking water for the Monarch School is supplied by two wells located on the school campus. Based on the sanitary survey, area well logs, and the depth of area wells, it appears that the deep confined aquifer underlying this portion of the Clark Fork River Valley might be providing water to the PWS wells. No well logs were found to confirm this assumption, but the operator indicated recent 2007) work on one of the wells indicated that the well is approximately 280 feet deep. In accordance with the Montana Source Water Protection Program criteria (1999), the aquifer (source water) is considered to have a low sensitivity to potential contaminant sources. Sensitivity is defined as the relative ease that contaminants can migrate to source water through the natural materials.

Three types of source water protection management regions for the 2 Monarch School public water systems (combined) were mapped as part of this assessment. They are the Control Zones, Inventory Region, and the Recharge Region. Potential sources of contamination were identified within each of these three regions and the results are as follows:

- The Control Zone is delineated as a 100-foot radius around each of the wells and all sources of potential contaminants should be excluded in this region. The goal of management in the Control Zone is to avoid introducing contaminants directly into the water supply's well or immediate surrounding areas. The significant potential contaminant source identified within the Control Zone was the animal cages and pens that drain into a nearby stormwater drainage ditch which in turn passes right next to Well 1 Girls Dorm. This ditch needs to be moved and isolated from the animal pens.
- The Inventory Region for the wells is based on an approximate 1,000-foot radius circle (see Figure 3). The Inventory Region should be managed to help prevent contaminants from reaching the wells before natural processes reduce their concentrations. The significant potential contaminant sources identified within the Inventory Region include: the stormwater ditch noted in the Control Zone; the sewage lines servicing the school; and the sewage treatment lagoon that is located south of the school. Within this mostly confined aquifer groundwater generally flows north to north-northeast, which is roughly downslope and toward the river.
- The Recharge Region was delineated based upon topographic mapping of the watershed around and upstream of the public water supply wells. The goal of management in the Recharge Region is to maintain and improve water quality over long periods of time or increased usage. The potential contaminant sources identified within the Recharge Region were a few underground fuel storage tank sites and leaking underground fuel storage tank sites. Some agricultural land and areas of increased private septic system density were identified, but the amount of this land was too small to be significant. Due to their distance and small areas, most of these are not considered immediate

threats to water quality at the Monarch School PWSs, but may influence long-term water quality.

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried contaminant sources at concentrations that would pose concern. 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 public water supply well intakes. The susceptibility analysis provides the community and the public water system with information on where the greatest risk occurs and where to focus resources for protection of this valuable drinking water resource. The Monarch School public water supplies' wells have a high susceptibility to a couple of potential contaminant sources within the Inventory Region. These are contamination associated with leakage from the septic lagoon and animal waste impacted surface water in the ditch that passes Well 1 Girls Dorm. The PWS has a moderate susceptibility to potential contamination from the septic sewer lines that drain sewage from the school and convey it south to the sewage treatment lagoon. These susceptibilities noted above are ranked as high and moderate mostly due to the absence of well logs for the Monarch School wells. This is discussed in more detail in Chapter 4.

The costs associated with contaminated drinking water are high. Developing an approach to protect that drinking water resource will reduce the risks of a contamination event occurring. In this report, we have summarized the local geology and well construction issues as they pertain to the quality of your drinking water source. We have identified the areas we believe to be most critical to preserving your water quality (the Control Zone and the Inventory Region) and have identified potential sources of contamination within that area. In addition, we provide you with recommendations (Management Recommendations) regarding the proper use and practices associated with some common potential contamination sources (see Table 8). We believe public awareness is a powerful tool for protecting drinking water. The information in this report will help you increase public awareness about the relationship between land use activities and drinking water quality. Refer to the figures within the document to better understand the spatial relationship of the area. The susceptibility of the PWS wells to the significant potential contaminant sources is discussed on Table 8. Overall, there appear to be few nearby threats to the production wells, but of greatest significance is the presence of the drainage ditch located near Well 1 Girls Dorm.

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INTRODUCTION

This report is intended to meet the technical requirements for the completion of the Source Water Delineation and Assessment for the Monarch School's 2 public water supplies (PWS) numbered as MT0004573 and MT0004420. This report is completed as required by the Montana Source Water Protection Program and the federal Safe Drinking Water Act. Jeffrey Frank Herrick, a hydrogeologist with the Source Water Protection Program, Montana Department of Environmental Quality (DEQ) completed this Delineation and Assessment Report (SWDAR). This SWDAR was completed on behalf of the Monarch School located in Heron, Montana.

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protecting public drinking water supplies from contamination. A major component of the Montana Source Water Protection Program is termed delineation and assessment. The emphasis of this delineation and assessment report is identifying significant potential contaminant threats to public drinking water sources and providing the information needed to develop source water protection planning.

Delineation is a process whereby areas that contribute water to aquifers or surface waters used for drinking water, called source water protection areas, are identified on a map. Geologic and hydrologic conditions are evaluated in order to delineate source water protection areas. Assessment involves identifying locations or regions in source water protection areas where contaminants may be generated, stored, or transported and then determining the potential for contamination of drinking water by these sources.

Delineation and assessment is the foundation of source water protection for the Monarch School's groundwater source. Although voluntary, source water protection planning is the ultimate focus of source water delineation and assessment. This delineation and assessment report is written to encourage and facilitate the Monarch School PWS managers and the operator to be involved in source water protection planning and protection activities.

This report has been written based on readily available public information and is as complete and accurate as possible within time and resource constraints. Unfortunately, accurate and reliable information may not be available on the hydrogeology beneath certain areas or on the nature or location of some potential contaminant sources in the area. The author has asked for comments and/or corrections from the managers and operator of this PWS prior to finalization of this report.

CHAPTER 1
BACKGROUND

The Community

The Monarch School, Inc. of Sandpoint, Idaho owns the Monarch School for Boys and Girls, which share a campus near Heron, Montana. The Monarch School campus is located a couple of miles west of Heron in the Cabinet Gorge valley. Heron is found in Sanders County of northwestern Montana (Figures 1 and 2). Heron and the Cabinet Gorge are situated within the northwest trending Clark Fork River Valley and along the south shore of the river (currently the Cabinet Gorge Reservoir). Highway 200 runs parallel to and along the north side of the Clark Fork River and the reservoir. The public water supplies (PWS) addressed in this SWDAR are the Monarch School for Girls (MT0004420) and the Monarch School for Boys (MT0004573). Both of these systems are classified by DEQ as a Community Non-Transient PWSs with each system serving up to 36 residents (students and staff) and 20 non-transients (day workers) through 6 service connections. The combined population numbers (for both systems) are 72 residents and 40 non-transients being served through 12 service connections. According to the 2000 US Census, the population of nearby Noxon consists of approximately 230 people and the Heron area consists of approximately 149 people. Sanders County has a population of approximately 10,227 people. The population of the county has increased approximately 18% since the 1990 Census, but there was little net change in the population of these couple of small towns. Thompson Falls is the Sanders County seat. The economic base of the Clark Fork River Valley and Sanders County is not very diverse. The county's leading industries are wood products manufacturing, some general manufacturing, petroleum conveyance, tourism, and some service industries in support of government facilities. Residents and businesses of the Heron area must use onsite domestic wells and have their sewage discharged to onsite septic drain-fields. The town of Heron does not appear to have sewer service.

Geographic Setting

The unincorporated town of Heron is located just south of the Clark Fork River (now occupied by the Cabinet Gorge Reservoir) within the Clark Fork River Valley (here called the Cabinet Gorge). The Clark Fork River Valley is a northwest trending intermountain valley on the western side of the continental divide in western Montana. The Coeur d'Alene and/or the Bitterroot Mountains flank the valley on the southwest and the Cabinet Mountains border the valley on the northeast side (Figure 1). There are alluvial aquifers distributed intermittently throughout the length of the Clark Fork River valley and present in the area of Heron. These aquifers are usually highly transmissive sand and gravel water table (unconfined) aquifers or deeper confined aquifers. The Monarch School PWSs' wells appear to draw water from what the author believes is a deep confined aquifer that is present within buried alluvial materials.

The climate of the Clark Fork River Valley is consistent with that of other middle elevation basins in the northern Rocky Mountains, west of the Continental Divide. The elevation at Heron is around 2,250 and the elevation of the school looks like it is around 1,414 feet above mean sea level. The ranges of average temperatures at the nearest weather station in Trout Creek (just southeast of Noxon) are 85.4 and 45.5 degrees F in July and 34.0 and 19.5 degrees F in January. Snowy winters are common, with winter months generating up to 19-21 inches of snow. Average annual precipitation is spread evenly throughout the year, but November, December, and January snows are noteworthy with an annual average total precipitation of 28.71 inches.

Table 1. Climatic Data

Trout Creek Ranger Station, Montana (248380)

Period of Record Monthly Climate Summary, Period of Record: 7/ 1/1960 to 12/31/2003

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	34.0	41.3	49.6	59.8	69.1	76.2	85.4	85.9	75.3	59.6	42.3	33.9	59.4
Average Min. Temperature (F)	19.5	22.4	26.2	31.1	36.8	42.9	45.5	45.0	39.1	32.4	27.8	21.5	32.5
Average Total Precipitation (in.)	3.87	2.71	2.32	1.84	2.27	2.32	1.14	1.29	1.38	2.02	3.77	3.78	28.71
Average Total Snowfall (in.)	21.6	9.7	5.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	6.7	19.3	63.1
Average Snow Depth (in.)	10	8	3	0	0	0	0	0	0	0	1	5	2

Note: Source is the Western Regional Climate Center, wrcc@dri.edu

General Description of the Source Water

The majority of drinking water in the Clark Fork River Valley comes from both the unconfined and confined valley fill aquifers that are present in the sediments lining the valley. The well logs for several wells in the area of the Monarch School suggest that there are laterally extensive confining clay layers within the valley fill sediments. Many of the local wells actually tap into this deeper confined aquifer and true for wells in the vicinity of the Monarch School. These wells are not only deep (275-375 feet deep) but the static water level recorded in the wells is between 250-330 feet below ground surface (bgs). This is mostly seen in the wells located on the terrace above the 2400 foot elevation (see the topographic map on Figure 3b). The author wasn't able to find any well logs for the Monarch School PWS. As such, it isn't clear if these PWS wells draw water from a deep confined aquifer or from a shallow unconfined aquifer. It is important for the Monarch School managers to determine the depths and other details of their wells' construction. Groundwater in the valley aquifers (both confined and unconfined) generally flows from the surrounding mountains within the fractured bedrock and toward the tributary stream valleys, eventually draining through these valleys toward the Clark Fork River valley. As the groundwater enters the river valley, the groundwater generally turns to flow downslope toward the river and as it approaches the river it will flow sub-parallel the river. It should be noted that it is very common for tributary streams in the area to exit the mountain valleys and drain into the valley sediments (and recharging localized shallow unconfined aquifers) prior to reaching the Clark Fork River. An examination of a topographic map (Figure 3b) suggests that the Monarch School is located on top of a laterally extensive terrace. The geologic map (Figure 4) suggests these terraces within the Cabinet Gorge are comprised of glacial material. This section of the river valley was both submerged by Glacial Lake Missoula (thus receiving layered lakebed sediments) and subject to the repeated catastrophic draining of that lake (which would cut down through the valley sediments). Glacial lakebed sediments are found in many locations along the Clark Fork River and these fine grained materials are usually flat lying, finely bedded, and will act as a confining unit lying on top of coarse water-bearing sand and gravel units. The terrace above the 2400 foot elevation as seen on Figure 3b contains abundant pothole lakes (kettles) and extensive swampy terrain. These suggest that there is poor local infiltration of water into the subsurface. The evidence of the presence of a confined aquifer would be the following: 1) mapped glacial material seen on the geologic map; 2) the fine grained bedding seen in local well logs; 3) the extremely deep static water levels in local wells, and 4) the presence of kettle/pothole lakes suggesting poor local drainage. Although I did not have a well log for either of the Monarch School wells, it's probably justifiable to assume that the wells are probably installed deep enough to be drawing water from a confined aquifer. I really didn't see any compelling evidence of a shallow unconfined aquifer in the vicinity of the school.

The Public Water Supply

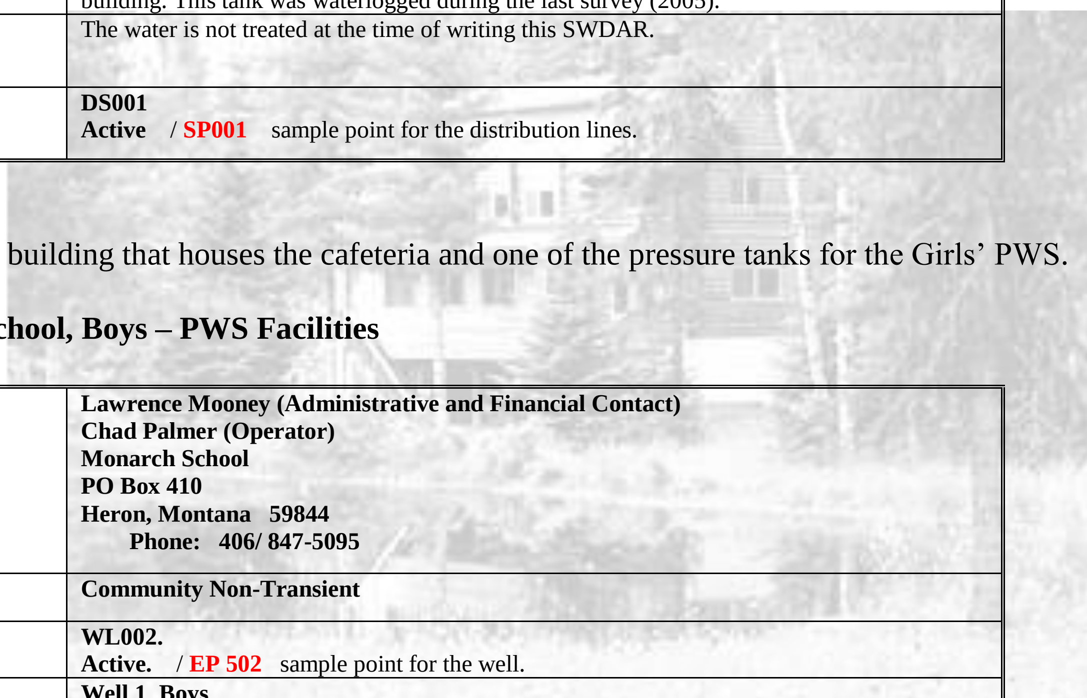
The Monarch School PWSs (Boys MT0004573 and Girls MT0004420) are both classified by DEQ as Community Non-Transient Public Water Supplies (PWSs). The PWSs are not interconnected and as dictated by regulations, they are treated by DEQ as 2 different water systems (although they serve the single school campus). Each PWS operates 1 production well (with 2 wells for the campus). The wells are located as depicted on Figure 3. Nothing is known of the drilling, construction, or performance of these wells and neither are listed in the Montana Bureau of Mines and Geology's database called the Ground Water Information Center (GWIC). The operator (Chad Palmer) indicated that work performed on Well 1 Girls Dorm performed during the summer of 2007 involved pulling and replacing the submersible pump. The well's depth was verified at that time as approximately 280 feet below ground surface (bgs) (personal communication with Jeffrey F. Herrick on 11 August 2008). The DEQ PWS database output and summary for the Boys' and Girls' PWSs are found in Appendix A. This printout information lists the known facilities, contacts, sampling schedule, and a brief regulatory history. This information also provides a summary of historical water quality data for the wells. According to the most recent Sanitary Survey (2005) and DEQ files the PWSs each have 6 active service connections that serve approximately 36 residents (faculty and students) and 20 non-transients (day workers). The population served is assumed to remain relatively stable throughout the year. The 2 wells are not connected to common header. For each system, water is sent from the well to the storage facility (water tank), then to the pressure control assembly and distribution system. Each PWS system is made up of one production well, a buried concrete storage tank, a pressure control assembly, and an independent distribution system. It does not appear that the water is treated prior to being sent to the distribution systems. The most recent DEQ Sanitary Survey (2005) for this system is found in Appendix B along with Relevant Correspondence and other supporting information. Tables 2a and 2b summarize the systems as best I can determine. It should be noted that the Public Water Supply System database printout for the Monarch School Girls (MT0004420) reflects the Boys' and Girls' PWSs incorrectly as a single PWS comprised of 2 wells, 2 storage tanks, 2 pressure control assemblies and 2 different distribution systems. The Girls' PWS is not properly reflected in that printout.

A note from the author is relevant at this point. The maintenance of these 2 separate water systems as 2 distinct Public Water Supplies (as regulated by DEQ) is warranted based on policy and rules. Keeping the 2 water systems separate and bearing the sampling costs for these 2 PWSs is probably unnecessary and seems inefficient. One reason is that the regulations governing PWSs in Montana dictate that all Community Non-Transient PWSs need to maintain 2 active water sources (wells). This would suggest that the Monarch School Girls' PWS and the Monarch School Boys' PWS will each need to drill and install a second well. Another reason is that the sampling/analytical costs are greater for 2 different PWSs (each with 1 or 2 wells) as compared to a single PWS with 2 wells. I suggest that it would be logical and feasible to connect the 2 different water systems together. Strategies to do this connection process (to ensure good water quality for students and staff) should be coordinated with the Montana DEQ Public Water Supply Section. They can be contacted in Kalispell at 406/ 755-8985.

Table 2a. Monarch School, Girls – PWS Facilities

PWS ID # MT0004420

Operator / Contact Person & Address	**Lawrence Mooney (Administrative and Financial Contact) Chad Palmer (Operator) Monarch School PO Box 410 Heron, Montana 59844 Phone: 406/ 847-5095**
Class	**Community Non-Transient**
Intake Source Code	**WL002.** **Active.** / **EP 502** sample point for the well.
Well/Intake Name	**Well 1 Girls**
Storage Facility	**ST001. Active 1,800 gallon buried concrete tank located under pressure control assembly**
Pressure Control Assemblies	**PC001**. Active. Above the water storage tank. Another active pressure tank is located in the cafeteria building. This tank was waterlogged during the last survey (2005).
Treatment Plants	The water is not treated at the time of writing this SWDAR.
Distribution System	**DS001** **Active** / **SP001** sample point for the distribution lines.



This appears to be the building that houses the cafeteria and one of the pressure tanks for the Girls' PWS.

Table 2b. Monarch School, Boys – PWS Facilities

PWS ID # MT0004573

Operator / Contact Person & Address	**Lawrence Mooney (Administrative and Financial Contact) Chad Palmer (Operator) Monarch School PO Box 410 Heron, Montana 59844 Phone: 406/ 847-5095**
Class	**Community Non-Transient**
Intake Source Code	**WL002.** **Active.** / **EP 502** sample point for the well.
Well/Intake Name	**Well 1 Boys**
Storage Facility	**ST001. Active 1,800 gallon buried concrete tank located under pressure control assembly**
Pressure Control Assemblies	**PC001**. Active. Above the water storage tank.
Treatment Plants	The water is not treated at the time of writing this SWDAR.
Distribution System	**DS001** **Active** / **SP001** sample point for the distribution lines.

Water Quality and Regulatory History

The Monarch School PWSs' wells and systems have been sampled as part of regular water quality monitoring for public water supplies. The up-to-date bacteriological and chemical analytical results are displayed on tables within Appendix A of this report. The chemical and bacteriological data found in these data tables begins in 2005. These data tables are presented along with output from the DEQ PWS Section database and relevant correspondence or reports drawn from DEQ files. Standards compliance with regulated contaminants occurs on a variety of sampling schedules. The BACT (bacteriological) and chemical analytical data contain no exceedences of any of the regulated contaminants. The most recent correspondence and other records found during the development of this SWDAR did not indicate that any form of treatment or disinfection is being used on the PWS.

Facilities and residences in and around the community of Heron are serviced by private onsite septic disposal systems as the community is too dispersed to have a central sewer system. Monarch School utilizes a central sewage collection system with disposal to a lagoon that is located south of the campus (see Figure 3).

Main Lodge.

CHAPTER 2
DELINEATION

Delineation Process

The source water protection regions are the delineated land areas that contribute water to wells used by the Monarch School PWS. These areas/regions are identified in this chapter. Three management regions, or source water protection regions, are usually identified for any given water source. These 3 regions are the Control Zone, Inventory Region, and Recharge Region. The Control Zone, also known as the exclusion zone, is an area at least 100-foot radius around the wellhead, spring collection box, or surface water intake. Human activity in this area can have an immediate impact on water quality by introducing contaminants to the area around an intake. As such, careful management of this Control Zone is critical to protect a PWS. The Inventory Region usually represents the zone of groundwater contribution to the well, which can approximate a three-year groundwater time-of-travel (TOT) distance or an approximate 1-mile radius around a wellhead. The Inventory Region comprising a 1-mile radius circle around a well is often a conservative value that is used either for convenience or when insufficient geologic or hydrogeologic information is available about an area or if details are lacking on the construction of a production well. In certain circumstances where a PWS well taps into an aquifer that has been characterized as being confined, the Inventory Region can be limited to a 1,000-foot radius around the wellhead, and the inventory of potential contaminant sources is only completed for those sources within 1,000 feet of the well. Activities or contaminant releases in the Inventory Region have the potential to allow contamination to reach a PWS well in a period of a few years. The Recharge Region is the largest of the regions and represents the entire aquifer or an area that contributes water to the local aquifer and over time supplies water to a well. This extended region of groundwater recharge is often, but not always inclusive of the limits of a watershed. At times an entire watershed is too large to be realistically manageable by a PWS or community, so a practical subsection of that watershed can be delineated as the Recharge Region. Long-term water quality at a PWS is affected by large contaminant sources, accidental chemical releases, or extensive land use activities in the Recharge Region. Table 3 summarizes how these source water protection regions are determined.

Table 3. Criteria for Delineating Source Water Protection Regions

If Your Source of Water Is:	Delineate These Water Protection Regions	Method For Each Region	Minimum Distance Values & Type of Inventory Required
Ground Water that is: • **Unconfined or Semi-confined*** • **Confined** *Ground Water that is hydraulically Connected to Surface Water also needs the following ……… →	Control Zone Inventory Region Recharge Region Control Zone Inventory Region Recharge Region Surface Water Buffer	Fixed radius Fixed radius Topography Fixed radius Fixed radius Topography Fixed Distance	Distance – 100 feet Distance – ~1 mile or 3 Year Groundwater TOT Limits of the watershed Distance – 100 feet Distance – 1000 feet Limits of the watershed In addition to the Inventory Region, a one-half mile surface water buffer will extend upstream a distance corresponding to a 4-hour TOT but not to exceed ten miles or the nearest intake. The buffer will not exceed the extent of the watershed. Inventory is limited to pathogens and nitrate sources.
Surface water	Spill Response Region Watershed Region	Fixed Distance Topography	One-half mile buffer extending upstream a distance corresponding to a 4-hour TOT but not to exceed 10. Buffer will not exceed the extent of the watershed. Limits of the watershed

Hydrogeologic Conditions

The following is a description of the sediments, bedrock, and groundwater in the Clark Fork River valley and surrounding area. This information is relevant because the rock units and sediments comprise the aquifer(s) (the water bearing formations) into which the Monarch School PWS wells are installed. The hydrogeology is a description of the presence and movement of groundwater in the bedrock and within the Clark Fork River valley. This discussion is intended to help the reader understand where the PWS wells are obtaining their groundwater and the vulnerability of that source of water to potential contamination. Most of the following information was drawn from Alt and Hyndman (1990) and other sources.

<u>Geology</u>

The bedrock of the Cabinet and Bitterroot / Coeur d'Alene Mountains is primarily Belt Supergroup sedimentary rock of Precambrian age (a.k.a. Mid-Proterozoic age). I should note that I am confused about whether the Bitterroot Range or the Coeur d'Alene Mountains (or both) are located directly to the south of the Cabinet Gorge near Heron. The Belt Supergroup rock is comprised of formations of metasediments primarily quartzite, argillite, with some carbonate (limestone) units (Kendy and Tresch, 1996). A set of older and newer geologic maps is provided on Figure 4. The Belt Supergroup rocks are not highly deformed, although the region is extensively faulted with two main sets of fault zones. 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 a little less than 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 along this fault zone 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 is categorized as 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 much of 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) 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 submerged by and the avenue through which Glacial Lake Missoula repeatedly drained catastrophically to the west. Alt and Hyndman (1990) suggest that during the repeated draining of the lake through this valley, the flow volume reached 8 to 10 cubic miles of water per hour. Because the glacial lake repeatedly submerged this area, fine-grained lake deposits are present throughout the Clark Fork Valley. The geologic maps of Figure 4 indicate laterally extensive deposits of glacial till, glacial outwash (Qg), and/or glacial lakebed sediments (Ql) throughout the area. The area around Heron was mapped as glacial material (type not differentiated). Glacial till and outwash tend to be chaotic mixtures of clast sizes suspended in a fine-grained (silt or clay) matrix. Glacial lake deposits are usually fine-grained (silt and clay) deposited in laterally extensive horizontal layers. I have assumed that the Monarch School production wells are drilled through a thick near surface deposit of some type of glacial outwash, till, or lake deposit. It is speculated that this fine-grained material acts as a blanket over deeper coarse grained alluvium buried in the bottom of the valley. The repeated flooding of the valley by Glacial Lake Missoula filled the valleys with fine sediments. This deposition was followed by repeated catastrophic draining of the lake that actually scoured the valley down to the bedrock in places and left a considerable volume of coarse sediment in localized bars along the river channels (this is usually mapped as modern alluvium (Qal) or glacial outwash (Qg). This scouring also left terraces along the flanks of many of the wider valleys along the river. The terraces are often glacial outwash or glacial lakebed deposits that survived the scouring that occurred during the draining of the glacial lake. Please refer to the topographic map on Figure 3b (to see the local terrace) and the geologic maps that are presented on Figure 4 (to see the distribution of glacial outwash and lakebed sediments).

A detailed stratigraphy of sediments in the area of Heron has never been worked out. Bedrock is exposed on both flanks of the valley as rock outcrops on the Cabinet and Coeur d'Alene Mountains. The deepest part of the valley (and the part containing the thickest sediments) is probably located directly beneath the present-day river channel and the Cabinet Gorge Reservoir. Lithologic logs for some area wells suggest the presence of laterally continuous silt and clay layers. The lateral extent of these silt and clay-rich layers is not known, but it is reasonable to suppose that they are not strictly localized and are somewhat laterally extensive. The most recent deposits of sand and gravel at the surface were deposited by modern stream action and make up the present valley floor beneath and surrounding the active river and stream channels. The most recent active channel deposits are usually mapped as Qal (see Figure 4).

Hydrogeology

Groundwater is a widely used source of water for the residents in the Clark Fork River valley. There are often laterally extensive and small isolated unconfined aquifers along the valley margins. Little detail is actually known about the valley hydrogeology surrounding Heron and Noxon. It is obvious that there is a shallow unconfined alluvial aquifer located directly adjacent to the current reservoir in many places, but the lateral extent of the aquifer hasn't been mapped. There appear to be other areas of unconfined alluvium that probably contain unconfined aquifers scattered throughout the region and centered around lateral stream drainages. There is a thick low permeable layer covering the surface of the wide upper terrace south, west, and northwest of Heron that is mapped as glacial undifferentiated or glacial lakebed deposits (Qg or Ql). Well logs suggest that it lies on top of sand and gravel deposits that are present at various depths. This thick low permeable layer appears to be a broad confining unit.

The scattered water table (unconfined) aquifers in the area are typically recharged by local streams draining the surrounding mountains, discharge from the Clark Fork River, discharge from the surrounding fractured bedrock, and by infiltration of precipitation at the ground surface. I actually didn't find a lot of evidence for a shallow unconfined aquifer in the vicinity of the Monarch School (which doesn't mean it isn't there). Any deeper confined aquifer(s) present are probably recharged predominately by water moving from the fractured rock of the valley margins into the coarser and higher conductivity alluvial materials in the bottom of the bedrock valley trough. Inter-aquifer movement by water has not been studied in this area and is not understood. Drinking water in the Clark Fork River Valley comes from both unconfined and confined valley fill aquifers that are present in the sediments lining the valley. The well logs for several wells in the area of the Monarch School suggest that there are thick laterally extensive confining clay & silt layers within the valley fill sediments that lay above deeply buried water-bearing sand and gravel units. These deeply buried water-bearing units comprise what looks like a confined aquifer. Many of the local wells actually tap into this deeper confined aquifer. Wells located on the terrace above the 2400 foot elevation (on top of the terrace) all seem to be deep and their logs describe the deep water-bearing units (a deep aquifer). The author wasn't able to find any well logs for the Monarch School PWS, but the operator suggested that he'd determined that Well 1 Girls Dorm was approximately 280 feet deep. As such, it appears that the Monarch School PWSs' wells draw water from a deep confined aquifer. It is important for the Monarch School managers to determine the actual details of their wells' construction.

Groundwater in the valley aquifers (both confined and unconfined) generally flows from the surrounding mountains within the fractured bedrock or within stream valley sediments. It generally flows downslope and down the stream valleys toward larger tributary stream valleys. These streams coalesce and enter the Clark Fork River valley. Then as the groundwater enters the river valley, it will approach the river and turn to flow sub-parallel to the river. It should be noted that it is very common for tributary streams in the area to exit the mountain valleys and drain into the valley sediments (thus recharging shallow unconfined aquifers) prior to reaching the Clark Fork River. An examination of a topographic map (Figure 3b) suggests that the Monarch School is located on top of a laterally extensive terrace. The geologic map (Figure 4) suggests these terraces within the Cabinet Gorge are comprised of glacial material. This area was both submerged by Glacial Lake Missoula and subject to the repeated catastrophic floods of that lake. Glacial lakebed sediments are found in many locations along the Clark Fork River and these fine grained materials often act as a confining unit lying on top of coarse water bearing sand and gravel units. The terrace above the 2400 foot elevation as seen on Figure 3b contains abundant pothole lakes (kettles) and extensive swampy terrain. The kettles are actually formed by blocks of ice that ran aground in the glacial lakebed and had fine lakebed sediment fill in around them until the lake drained away and the ice was completely melted. The swampy areas suggest that there is poor local infiltration of water into the subsurface in laterally extensive areas on the terrace. The poor infiltration is also suggestive of lakebed sediments. The evidence of the presence of a confined aquifer would be the following: 1) mapped glacial material seen on the geologic map; 2) the fine grained bedding seen in local well logs; 3) the extremely deep static water levels in local wells, and 4) the presence of kettle/pothole lakes and swamps suggesting poor local drainage. Although I did not have a well log for either of the Monarch School wells, at least one of them appears to be ~280 feet deep. I'm going to assume that both of the wells are probably installed deep enough to be drawing water from a confined aquifer. I really didn't see any compelling evidence of a shallow unconfined aquifer in the vicinity of the school. Little is known about the groundwater flow directions within any shallow unconfined or deep confined aquifers beneath the Monarch School. The author estimates that groundwater beneath the school probably will flow north to north-northeast (roughly downslope and toward the river).

PWS Source Information and Aquifer Properties

Other than their location and an approximate depth of 280 feet for Well 1 Girls Dorm, little or no information is available about the Monarch School PWS wells. A Preliminary Assessment GWUDISW Worksheet was completed for each of the PWS wells. GWUDISW is the acronym for Ground Water Under the Direct Influence of Surface Water and is one measure of the vulnerability of a well to surface contamination events. Based on the lack of available information and the presence of a wastewater/drainage ditch next to one well and a bacteriological history for the other well, both wells failed the determination. These determination sheets are attached with the Sanitary Surveys in Appendix B. The confined alluvial aquifer used by the Monarch School PWSs (if the school is indeed using the confined aquifer) is best characterized as having Low Source Water Sensitivity to contamination. This is based on criteria used by the DEQ Source Water Protection Program as outlined on Table 4. The interpretation of the author is that that the wells are located in an area where the water-bearing formations are topped or locally confined by low conductivity materials of clay and silt and the aquifer may be under pressure that is greater than atmospheric pressure.

Table 4. Source Water (Aquifer) Sensitivity

High Source Water Sensitivity	Moderate Source Water Sensitivity	Low Source Water Sensitivity
• Surface water and GWUDISW • Unconsolidated Alluvium (unconfined) • Fluvial-Glacial Gravel • Terrace and Pediment Gravel • Shallow Fractured or Carbonate Bedrock	• Semi-consolidated Valley Fill sediments (semi-confined) • Unconsolidated Alluvium (semi-confined)	• Consolidated Sandstone Bedrock • Deep Fractured or Carbonate Bedrock • Semi-consolidated • Confined Aquifers

Delineation Results

Control Zone

The delineations for the source water protection regions were done based on the fact that the Monarch School PWSs' wells are withdrawing water from the same water-bearing zones within what is probably a confined aquifer. So for the sake of the delineation in this report, the author will utilize the criteria for confined aquifers. The Control Zones are delineated to provide a minimum 100-foot radius buffer around the wellheads. It is critically important to keep contaminant sources outside of the Control Zone. The reason for this is that in all wells, even for wells that tap a confined aquifer, surface water will preferentially migrate downward along the outside of a well casing. The annulus (the gap) between the outside of the well casing and the inside of the hole into which the casing was installed is typically filled with cement or bentonite clay grout to reduce the potential that water will migrate along it (or water with contaminants). The placement of this annulus grout is called sealing of the well. No records exist that discuss how the Monarch School PWSs' wells were grouted or if they were grouted.

Inventory Region

An Inventory Region was delineated for the PWSs' production wells based roughly upon a 1,000-foot radius circle around both of the wellheads. Given the conditions at the site (the thick clay sedimentary units above the confined aquifer) it is felt that this Inventory Region is conservative and protective of public health. In situations where there is confinement of the aquifer, the hazard of potential contaminant sources is generally determined both on their presence near the wellhead and on the integrity of the seal between the well casing and the formation into which the casing is installed. As discussed above, when a well annulus is not properly sealed, then the outside of the well casing can act as an avenue of preferred migration of water and contamination. In this way contaminants can quickly travel downward along the outside of a well casing and impact an aquifer that would otherwise be relatively safe. If the aquifer was defined as an unconfined or semi-confined aquifer, the hazard of potential contaminant sources is determined based on their proximity to the wells, their concentration, and/or the amount of area within the Inventory Region occupied by that potential contaminant source. The determination of hazard is described in Chapter 4. Figure 3 depicts the Inventory Region for the Monarch School PWSs.

Recharge Region

The Recharge Region is depicted on Figure 5. It is best described as encompassing most of the valley around Heron south of the reservoir and upstream (east) of the Monarch School campus. This map also depicts the location of several of the area wells. Many of these wells have well logs that are attached to this report and found in Appendix B. A few noteworthy potential contaminant sources are present in Recharge Region, but these will be discussed in the next chapter.

Limiting Factors

Although groundwater behavior has been well studied in some locations along the Clark Fork River Valley, little work has actually be done around the town of Noxon and less beneath Heron. As such, some reasonable assumptions had to be made about groundwater movement. It should be noted that groundwater behavior beneath specific locations is very difficult to predict with any confidence. Groundwater flow directions fluctuate seasonally and from year to year, which adds a complication to any models of groundwater behavior beneath specific areas. Additionally, models of groundwater movement assume that the aquifer is homogenous, isotropic, and that groundwater flows almost exclusively in a horizontal direction. The reality is that none of these assumptions are precisely true. But assuming that those aquifer characteristics are generally true helps to develop a simple working model of groundwater movement. The author has made several conservative assumptions in the delineation of the source water protection areas and the development of this report. The author used his professional judgment and reliance on some basic hydrogeologic principals to define the aquifer boundaries and groundwater movement. This report can and should be revised if more data becomes available that significantly alters the assumed groundwater flow direction(s) or the assumptions about other hydrogeologic conditions (such as the confinement of the aquifer). In addition, if well logs are found or developed for these PWS wells, the situation described in this report could be very different. As the maps and figures were developed for this SWDAR, readily available published maps, reports, and databases were used to plot the various features and facilities depicted. Since the author did not have a personal knowledge of each of these facilities, input and corrections provided by the PWS operator or managers is critical to ensuring the information provided in this chapter is accurate and complete.

CHAPTER 3
INVENTORY

Inventory Method

An inventory of potential sources of contamination was conducted for the Monarch School PWS within the Control Zone, Inventory Region, and Recharge Region. Potential sources of all primary drinking water contaminants and Cryptosporidium were identified and noted, however, only significant potential contaminant sources were selected for detailed inventory and the susceptibility evaluation that occurs in Chapter 4 of this SWDAR (Source Water Delineation and Assessment Report). It should be noted that the inventory emphasizes potential contaminant sources. Inclusion of a facility or business in the inventory does not indicate that it is an actual polluter. The exception to this would be known hazardous waste sites where past releases have occurred, areas with known onsite contamination, locations with leaking underground storage tank sits (LUSTs), or wastewater dischargers.

The inventory for these 2 PWSs focuses on all activities in the Control Zones for the wells; certain types of municipal/public and private facilities or land uses in the Inventory Region; and general land uses and large facilities in the Recharge Region. The following databases have been searched in an effort to identify generators, storage facilities, and land uses that could be potential generators of contamination.

Step 1: Urban and agricultural land uses were identified from the U.S. Geological Survey's Geographic Information Retrieval and Analysis System (http://nris.state.mt.us/gis/datalist.html). County tax records were also examined to determine the predominant agricultural land usage for properties in the area. Sewered and unsewered residential land uses were identified from boundaries of sewer coverage obtained from municipal wastewater utilities. The density of private onsite septic systems is based upon the 2000 US Census data with the boundaries of areas of increased septic density based on Census Blocks.

Step 2: As appropriate, EPA's Envirofacts System (http://www.epa.gov/enviro/) was queried to identify EPA regulated facilities located in the Inventory Region. This system accesses facilities listed in the following databases: Resource Conservation and Recovery Information System (RCRIS), Biennial Reporting System (BRS), Toxic Release Inventory (TRI), 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 should be classified as a significant potential contaminant source.

Step 3: The Permit Compliance System (PCS) was queried using Envirofacts (http://www.epa.gov/enviro/) to identify Concentrated Animal Feeding Operations with MPDES permits. The PWS system operator and/or system managers are familiar with the area included in the Inventory Region will have identified animal feeding operations that are not required to obtain a permit.

Step 4: Databases were queried to identify the following in the Inventory Region: Underground Storage Tanks (UST) (http://webdev.deq.state.mt.us/UST/), hazardous waste contaminated sites (DEQ hazardous waste site cleanup bureau), landfills (http://nris.state.mt.us/gis/datalist.html), abandoned mines (http://nris.state.mt.us/gis/datalist.html) and active mines including gravel pits. Any information on past releases and present compliance status was noted.

Step 5: Major road and rail transportation routes were identified throughout the Inventory Region (http://nris.state.mt.us/gis/datalist.html).

Step 6. All land uses and facilities that generate, store, or use large quantities of hazardous materials were identified within the Inventory Region and the Recharge Region, and were identified on the base map.

Potential contaminant sources are designated as significant if they fall into one of the following categories:

1. Large quantity hazardous waste generators.
2. Landfills.
3. Underground storage tanks.
4. Known groundwater contamination (including open or closed hazardous waste sites, state or federal superfund sites, and UST leak sites).
5. Underground injection wells.
6. Major roads or rail transportation routes.
7. Cultivated cropland greater than 20 % of the Inventory Region.
8. Animal feeding operations.
9. Wastewater treatment facilities, sludge handling sites, or land application areas.
10. Septic systems.
11. Sewer mains.
12. Storm sewer outflows.
13. Abandoned or active mines.

Inventory Results

Control Zone

An examination of Figure 3 suggests that the designated garden area is located within the Control Zone for Well 1 Girls Dorm. In addition, the school's animal pens and coups may also be within 100 feet of the well. The most recent Sanitary Survey (2005) indicated that a drainage ditch (from the barnyard) passed right next to the well. This would be a significant threat to water quality and to the health of people that drink the water from this well. At the time this report was written, the drainage ditch has been moved and culverts installed as needed to divert surface water away from the well and out of the Control Zone. The alteration of local drainage is an effective strategy to protect water quality from this well. No activities or known potential contaminant sources were noted near Well 1 Boys Dorm. Sewer lines leading from the buildings to the sewage lagoon are known to be present, but their locations are unknown. It is hoped that none of these lines pass through the either of the PWS wells' Control Zones.

Inventory Region

The area within the Inventory Region for the Monarch Schools PWSs' wells (as depicted on Figure 3) includes most of the Monarch School properties, all of its buildings and facilities, and some of the adjoining lots. The school and all or most of its buildings are serviced by a central sewer collection system that uses multiple sewer lines which convey sewage to the treatment lagoon located directly south of the school. These sewer lines can be treated as a potential non-point source of contamination (septic effluent containing nitrate and pathogens). Sewage lines can fail and chronically or catastrophically leak considerable effluent to the subsurface and do so without evidence at the surface. All of the school's sewer lines are within the Inventory Region and are considered to be a significant potential contaminant source. The lagoon that these lines drain to collects, holds, and presumably treats the sewage from the school. A lagoon has the potential to fail, leaking sewage to the surface or subsurface. Lagoons are treated as significant potential point sources of contamination. It appears that the lagoon may be directly upgradient from the wells. Although it does look like a couple of hay fields are found on adjoining properties, these fields are not designated by county tax records as having a predominant agricultural land use (such as grazing, hay, continuous cropped, etc.). So they are not considered to be significant potential contaminant sources. As far as I could determine, there are no other significant potential contaminant sources within the Inventory Region for the Monarch School. Table 5 is a general listing of the potential contaminant sources known to be present within the Inventory Region of the Monarch School PWSs. This is a short list, because the Inventory Region is a small area and in relatively remote part of the state.

Table 5. Potential contaminant sources
Monarch School PWSs (Refer to Figure 3)

Contaminant Source	Contaminants	Description
Sewer lines draining from the school's facilities	Nitrate, pathogens, other chemicals that may have been dumped down school drains	Chronic or catastrophic leaks of untreated septic effluent that would reach the subsurface and may impact groundwater.
Sewage Lagoon	Nitrate, pathogens, other chemicals that may have been dumped down school drains	Similar to sewer lines, there can be chronic or catastrophic leaks of untreated septic effluent that would reach the subsurface and may impact groundwater.

Recharge Region
The Recharge Region as delineated for this SWDAR is depicted on Figure 5. It is a portion of the watershed that surrounds the Heron area. Based on county tax records, there were some grazing and hay production in the valley, but none of the agricultural land occupied sufficient an area to constitute a significant potential contaminant source. There are a couple of underground fuel storage tanks (UST sits) and leaking underground fuel storage tanks (LUST site) in Heron. These would be considered point sources of contamination. Right around Heron and just south of town there are areas of increased density of private onsite septic systems. The overall area occupied by these concentrations is not great. These potential contaminant sources are depicted on Figure 6 as are some of the local water wells.

Inventory Limitations & Update

The accuracy of this potential contaminant source inventory is limited in several respects. The inventory is based on data that is readily available through state documents, published maps and reports, GIS data, and discussions with people that are familiar with the area. Documentation may not be readily available on some potential sources. Additionally, some contaminant sources may show up on an inventory, but may not have accurate coordinates associated with them. Alternately, DEQ may have somewhat incomplete or outright erroneous information on the nature or the extent of certain facilities. As a result of the unknowns, all potential contaminant sources may not have been identified or recognized as being significant potential contaminant sources. The author of this SWDAR is depending on local PWS managers and the operator for site-specific knowledge. Their initial review of this document has been sought and their comments incorporated. To make this SWDAR a useful document in the years to come, the managers and certified operator for the PWS should update the inventory for their records every year. Changes in land uses or the presence of new potential contaminant sources should be noted and additions made as needed. This updated inventory should be submitted to DEQ at least every 5 years to ensure that this report/plan stays current in the public record.

CHAPTER 4
SUSCEPTIBILITY ASSESSMENT

General Discussion

The Susceptibility of the Monarch School PWSs' production wells to various types of contamination is assessed in the following paragraphs. The proximity of a potential contaminant source to a spring or well intake, potential contaminant migration pathways, and the density of potential non-point contaminant sources all determine the threat of contamination, referred to here as hazard (Table 6).

Hazard Determination

Table 6 below describes the criteria to determine hazard within the Inventory Region as it was delineated in this SWDAR. Hazard and the existence of barriers to contamination determine susceptibility, which is described in Table 7. Note that this table is specific to PWSs that draw their water from confined aquifers. The determination of hazard is somewhat different for other types of water sources. The lithology recorded for Monarch School PWSs' wells is unknown. Other wells in the area tap into sand and gravel materials that reside beneath thick and laterally continuous confining units. As such, the School PWSs' wells are considered to be drawing water from a confined aquifer. According to Table 6 below, any potential point source located within the Inventory Region is assigned a high hazard. This is because it can't be determined if the school's wells are adequately sealed to prevent contaminant migration down to the well intake. The sewage treatment lagoon is a potential point source found within the Inventory Region and is assigned a high hazard. The sewer lines that drain school facilities, conveying septic effluent south to the lagoon are collectively treated as a non-point source. As such, they occupy somewhere between 20-50% of the Inventory Region (probably just above 20%) and are assigned a moderate hazard. Note the highlighted items in Table 6 below.

Table 6. Hazard of potential contaminant sources
For wells drawing water from confined aquifers

Potential Contaminant Source	The PWS well is not sealed through the confining layer	Other wells in the Inventory Region are not sealed through the confining layer	All wells in the Inventory Region are sealed through the confining layer
Point Sources	**High**	Moderate	Low
Density of Private Septic Systems (# per square mile)	High: > 300/mi^2 Moderate: 50-300/mi^2 Low: < 50/mi^2	Moderate: >300/mi^2 Low: <300/mi^2	Low
Municipal or Community Sanitary Sewer (percent of area)	High: > 50% **Moderate: 20 – 50%** Low: < 20%	Moderate: >50% Low: <50%	Low
Cropped Agricultural Land (percent land use)	High: > 50% Moderate: 20 – 50% Low: < 20%	Moderate: >50% Low: <50%	Low

Notes:

- Highlighted areas are those probably relevant to the Monarch School PWSs' Inventory Region.
- Key to the highlighted choices above is the fact that no lithologic logs were found that indicate the PWS wells were sealed adequately. Note that it is an assumption that the PWS wells draw water from a confined aquifer. It would benefit the Monarch School to contact the drilling company to develop accurate well logs for their wells.

Susceptibility Determination

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 a PWS well intake. First, hazard is rated by the proximity of a potential contaminant source to the well(s) (it's within the region), the integrity of the well seal, and as appropriate it is based on the percentage of the Inventory Region occupied (for non-point sources or land uses (from Table 6). Then the presence of barriers is then used to come up with a susceptibility rating. Barriers are things that can stand between a potential contaminant source and a well intake. Barriers are typically of 3 main varieties. They can be:

- management barriers (things that are done or planned),
- engineered barriers (things that are built), or
- natural barriers (things that are in place that naturally protect the well).

Susceptibility ratings are then determined individually for each significant potential contaminant source and/or contaminant based on Table 7. These susceptibility ratings are the evaluation of the vulnerability of wells to the significant potential contaminant sources and are presented on Table 8.

Table 7. Susceptibility, based on Hazard and Barriers.

Presence Of Barriers	Hazard		
	High	Moderate	Low
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

Discussion of the Susceptibility Assessment

A summary of the susceptibility assessment for Monarch School PWSs' production wells is located in Table 8. Because a contaminant source has not been identified in the inventory or susceptibility assessment of this report, it doesn't mean that the potential for contamination does not exist or is not a threat. So, if potential contaminant sources were present near or upgradient of the PWS, it would be prudent to understand the threat from these sources.

Table 8. Susceptibility Assessment Results

Monarch School PWSs – Significant Potential Contaminant Sources within the Inventory Region

Contaminant Source	Contaminants	Description	Hazard Rating	Barriers	Susceptibility	Management Recommendations
Sewage Lagoon (located roughly upgradient from the school)	Nitrate, pathogens, other chemicals that may have been dumped down school drains	Similar to sewer lines, there can be chronic or catastrophic leaks of untreated septic effluent that would reach the subsurface and may impact groundwater.	**High Hazard**	The static water level of the aquifer being tapped is extraordinarily deep. So the thickness of the unsaturated sediment above the aquifer is considerable.	**High Susceptibility**	Ensure (by whatever means) that this lagoon is not discharging to groundwater. Consider the development of a second lagoon. This allows sewage to be diverted from one lagoon to another as needed to work on a lagoon. If the lagoons work in series, it may provide a more effective treatment of the septic effluent.
Sewer lines draining from the school's facilities	Nitrate, pathogens, other chemicals that may have been dumped down school drains	Chronic or catastrophic leaks of untreated septic effluent that would reach the subsurface and may impact groundwater.	**Moderate Hazard**	The static water level of the aquifer being tapped is extraordinarily deep. So the thickness of the unsaturated sediment above the aquifer is considerable.	**Moderate Susceptibility**	If detailed maps of line locations do not yet exist, develop them. This would enable you to find and repair leaks more readily. Consider developing a program to prevent the dumping of spent hazardous chemicals to sinks and floor drains at the school. These chemicals generally do not break down and are poorly treated at the lagoon. Warning notices at the drains are an effective mechanism. In addition, consider beginning a detailed recycle program that includes spent or unused chemicals.

Note: If some of the Management Recommendations listed above are instituted, they can be considered to be additional barriers that would stand between the PCSs (potential contaminant sources) and the well. Increasing the number of barriers will reduce the susceptibility rating. Of greater significance, if well logs can be found for the wells which indicate that the wells were sealed, all potential contaminant sources (no matter their size or nature) will be assigned a low hazard (right hand column in Table 6 above). If 2 or more barriers are present, the susceptibility will be changed to low to very low for each PCS. It is worth the effort to find a well log for both of these PWSs' wells. I would contact and visit with the driller.

Summary of Susceptibility Assessment Results

The Monarch School's 2 public water supplies use 2 wells (one for each PWS) that are located on the campus as depicted on Figure 3. The wells are assumed to be installed into deep valley fill alluvium. The wells withdraw water from what appears to be a confined aquifer. This is an assumption as no well logs are available. However, the operator indicates that Well 1 Girls Dorm was worked on in 2007 and found to be 280 feet deep. The groundwater beneath the area of the school wells is believed to flow approximately north to north-northeast, which is downslope and toward the Clark Fork River.

Only a few significant potential contaminant sources were identified within the Inventory Region (1,000 foot radius circle around the wells). These are the animal pens and stormwater drainage ditch that run by Well 1 Girls Dorm; the sewer lines that convey sewage to the treatment lagoon; and the sewage treatment lagoon that is located south of the school. Some barriers were in place, so the PWS wells are believed to have a high susceptibility to contamination associated with the animal pens and ditch. They also are believed to have a high sensitivity to the sewage treatment lagoon located south of the school. It appears that the school wells have a moderate susceptibility to contamination that may come from leakage from the sewer lines that convey sewage from school facilities to the lagoon. It is significant to note that the hazards assigned to all of the potential contaminant sources are significantly higher than they would otherwise be. The high hazards are based on the fact that there were no well logs that indicated that the wells were adequately sealed or that they were installed into the deep confined aquifer (as other area wells appear to be). With a high to moderate hazard and only one barrier in place between these potential contaminant sources and the wells, the PWSs' wells have a high to moderate susceptibility to contamination from the potential contaminant sources discussed.

If some research is done to verify the depth of the wells, or better yet, if well logs are found, then the hazard ratings assigned might be lowered (see the note associated with Table 8 above). If there is a low hazard and more barriers are discovered or created, the wells would have a low to very low susceptibility to contamination.

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FIGURES

Figure 1 Regional Map

Figure 2 Heron Area Map

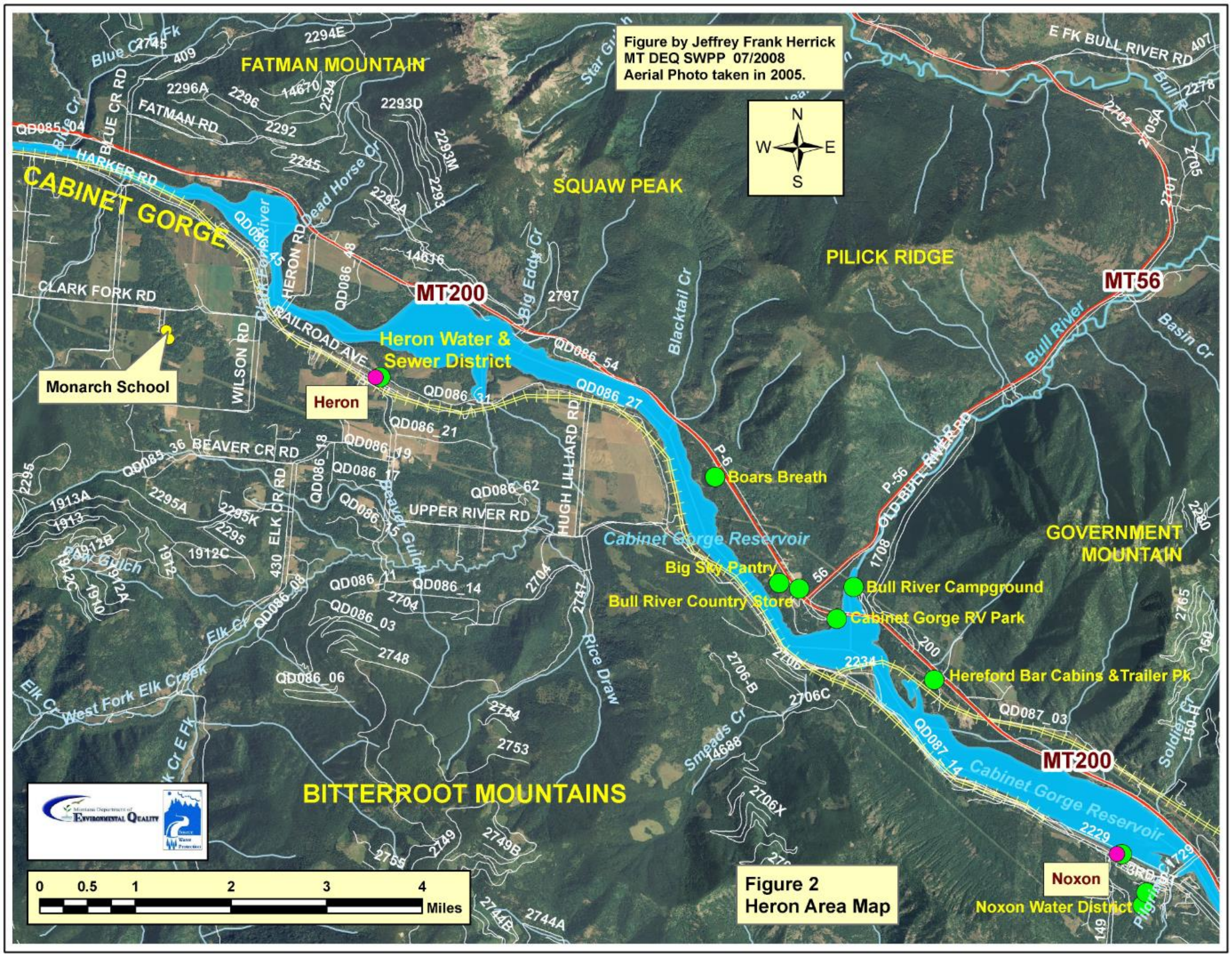


Figure 3 Monarch School, Facilities & Neighborhood

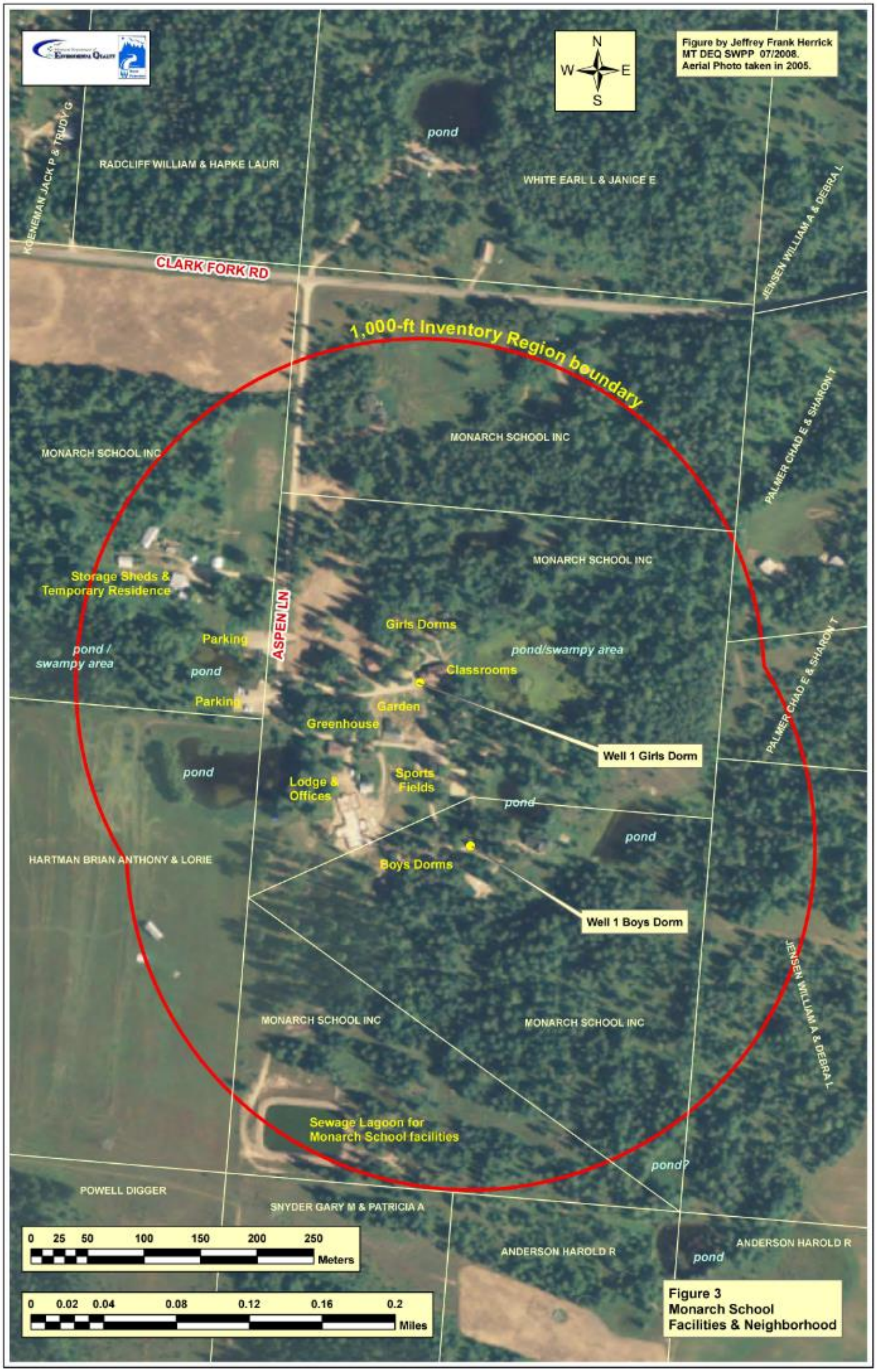


Figure 3b Local Topographic Map

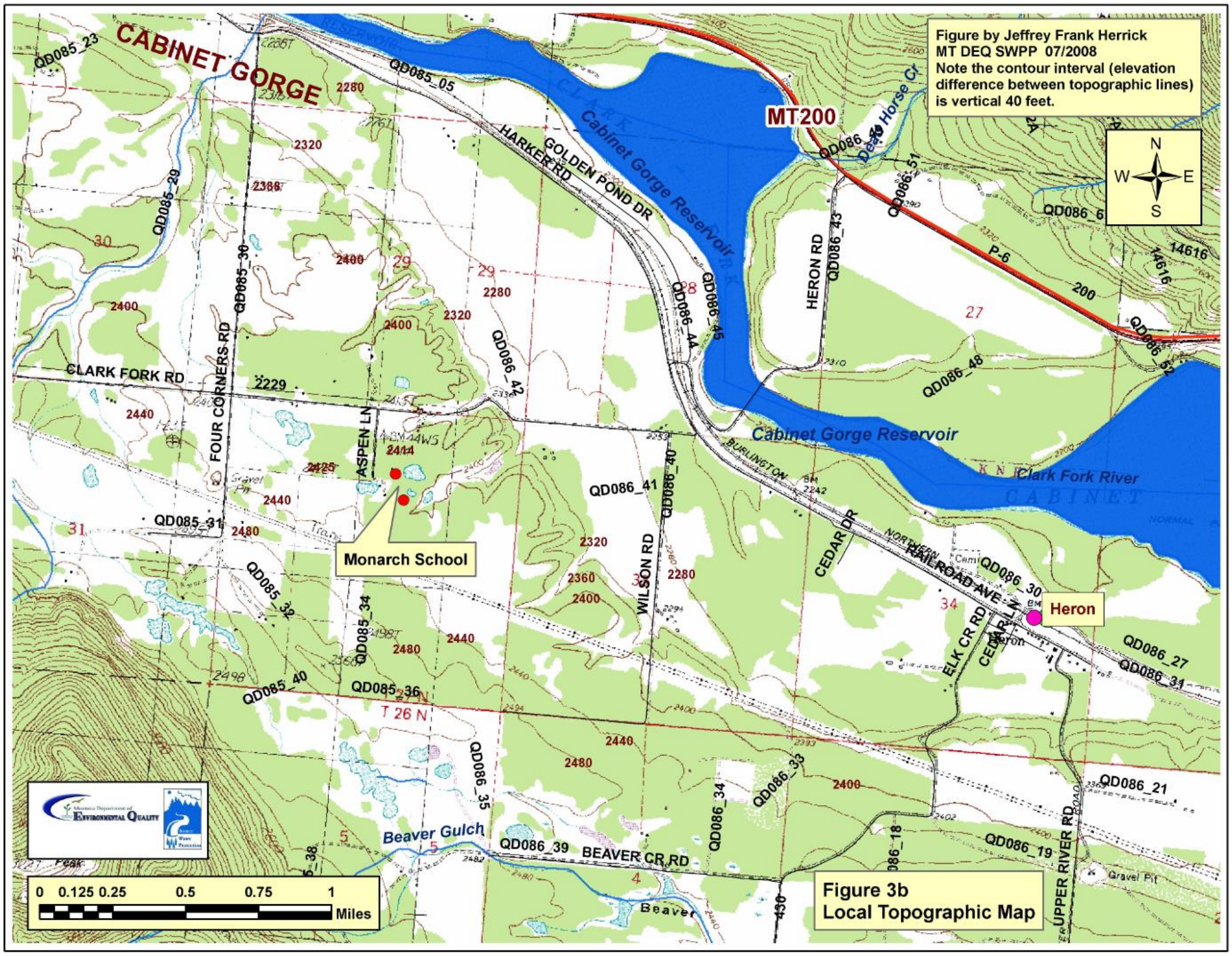


Figure 4 Geologic Maps for the Region

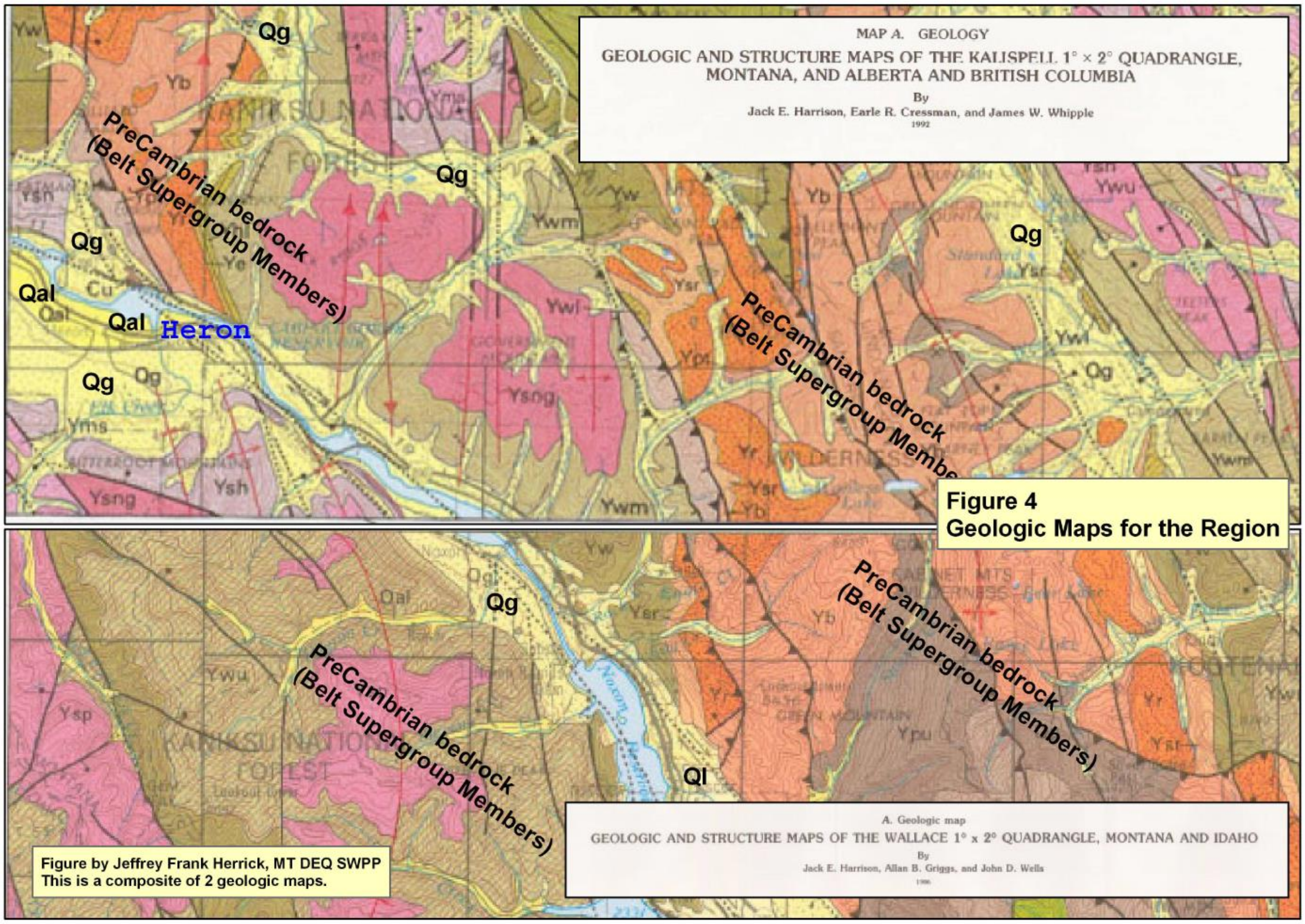
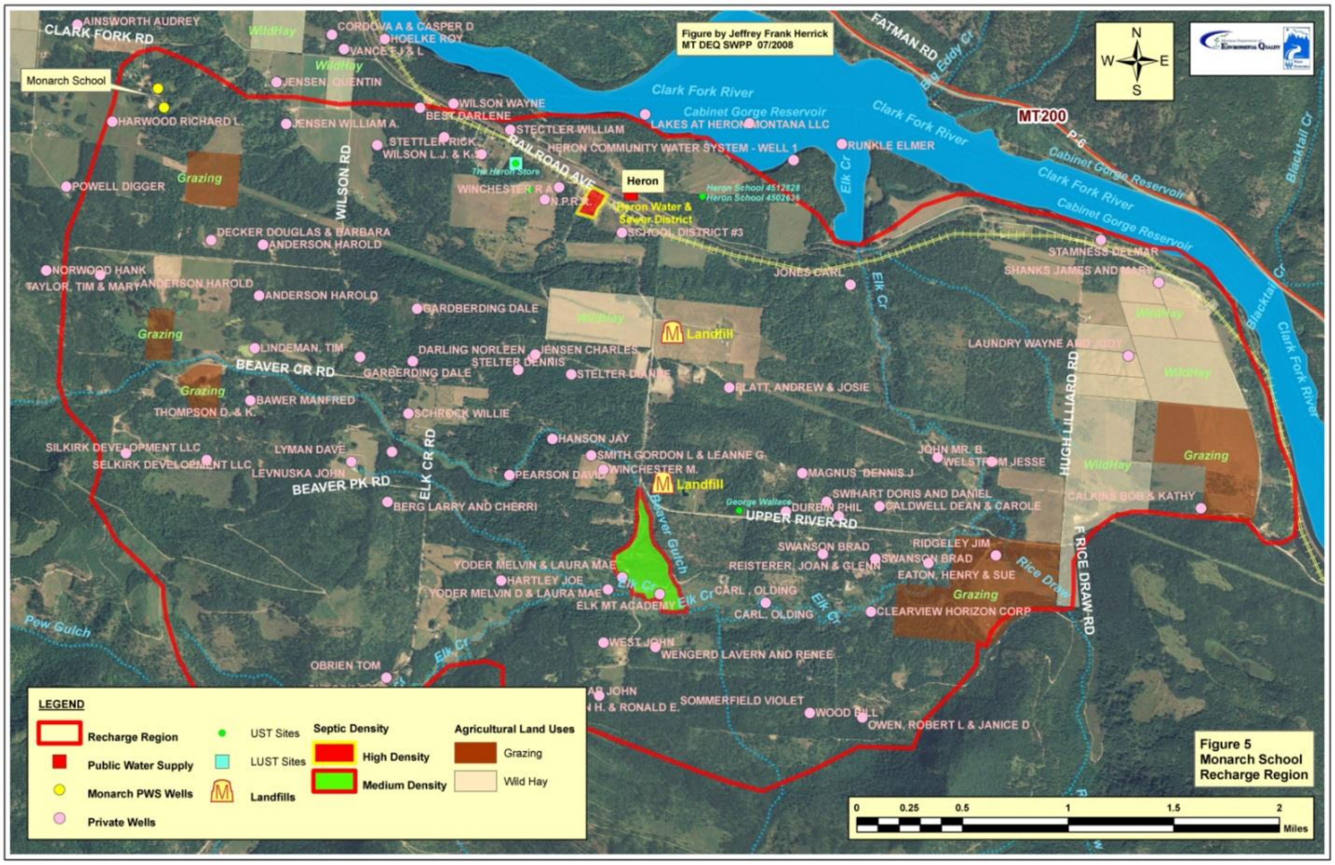


Figure 5 Recharge Region



APPENDICES

Available Upon Request

Appendix A

DEQ PWS Section's Database, System Summary
DEQ PWS Section's Database, Sample Schedule
DEQ PWS Section's Database, Water Quality Data

Appendix B

Sanitary Surveys
Preliminary Assessment Documents
Well Logs for Some Area Wells

Appendix C

LUST and UST Sites

Appendix D

Concurrence Letter