Cabinet Ranger Station

Source Water Delineation and Assessment Report (SWDAR)

Cabinet Ranger Station
United States Forest Service
Public Water Supply

State of Montana Public Water Supply ID#MT0062359

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October 2004

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INTRODUCTION

The Safe Drinking Water Act (SDWA) Amendments of 1996 requires states to develop and implement Source Water Assessment Programs (SWAP) to analyze existing and potential threats to the quality of the public drinking water supplies throughout the state. The Montana SWAP was formally approved by the US Environmental Protection Agency (EPA) in November 1999. The Montana SWAP was developed from the former Wellhead Protection Program, but includes surface water sources and requires a more rigorous inventory of potential contaminant sources. SWAP addresses only public water systems (PWS) regulated according to the Federal Safe Drinking Water Act. A public water supply system is defined, according to Federal and Montana regulations, as a system that supplies water for human consumption. A public water supply system has at least 15 service connections or regularly provides water to at least 25 persons daily for a minimum of 60 days in a calendar year. There are three types of public water supply systems:

- Community water systems provide water on a year-round basis, and have a minimum of 15 service connections or regularly serve at least 25 residents. In addition to incorporated towns, community systems may serve smaller areas such as housing subdivisions or trailer courts.
- Non-transient non-community systems do not serve communities, but provide water regularly to a minimum of 25 of the same people for at least 6 months of a year. These systems serve public buildings such as schools and hospitals, where people are employed but do not reside. The Cabinet Ranger Station is classified as a non-transient, non-community system.
- Transient non-community systems do not serve communities, and do not regularly serve a minimum of 25 of the same people for at least 6 months of the year. These systems are usually seasonal, and are located in areas such as campgrounds and parks.

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to help public drinking water supplies protect their water source from contamination. The United States Forest Service (USFS) works with the Montana DEQ to complete delineation and assessment reports for USFS managed public water supplies in Montana. The Source Water Delineation and Assessment Report (SWDAR) compiles the appropriate data and other technical information about an area to allow the USFS to develop source water protection plans for potable water supplies. 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 potential contaminant sources in delineated source water protection areas, and evaluating the potential for contamination of drinking water from these sources under "worst-case" conditions such as a flood, fire or human error.

Scope and Purpose

This report presents the source water delineation and assessments for the public water supply for the Cabinet Ranger Station public water supply. This report was prepared by James Swierc,

Hydrogeologist with the USFS. Additional information was provided by Frank Votapka, Forest Engineer on the Kootenai National Forest.

The Cabinet Ranger Station is located approximately 23 miles northwest of the town of Thompson Falls in Sanders County, Montana. This report is intended to meet the technical requirements for the completion of the delineation and assessment report for this PWS, 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).

Limitations

This report was prepared to assess threats to the Cabinet Ranger Station public water supply, and is based on published information and information obtained from USFS staff familiar with the system and area. The inventory of potential contaminant sources focuses on the management areas delineated for the public water supply in this report. As a result, other potential sources of contamination to surface and ground water in the area may not be identified.

The term "contaminant" is used in this report to refer to any chemical or biologic constituent in water that are listed as regulated under state and federal regulations. Water constituents are generally regulated based on health effects that may occur when ingested at certain levels. Water quality standards are based on maximum contaminant level goals (MCLGs) for a compound, which represents a concentration where adverse health effects are not considered likely to occur when ingested. However, as natural waters contain many dissolved constituents and MCLGs are frequently not attainable with economically viable water treatment alternative, maximum concentration levels (MCLs) are used. MCLs represent concentrations that may result in chronic or acute health problems when ingested. MCLs are based on the relative risk, or likelihood that health problems may occur, and economics associated with a treatment technology for a specific constituent of water. In some cases, sources for constituents with Secondary MCLs are also evaluated in this report. Secondary MCLs are non-regulatory guidelines regarding cosmetic effects (such as tooth or skin discoloration) or aesthetic effects (such as taste, odor, or color) of drinking water.

BACKGROUND

Study Area

The Cabinet Ranger Station (formerly known as the Trout Creek Ranger Station) is located on the northern part of the floodplain for the Clark Fork River, in Sanders County (Figure 1). The area is relatively isolated by the mountains in the area, and is predominantly undeveloped at this time. Thompson Falls is the largest town in the area, located approximately 23 miles southeast of the Cabinet Ranger Station. The Cabinet Ranger Station is located at an approximate elevation of 2400 feet above mean sea level in Section 6 of Township 24 North, Range 31 West at approximately 47.87°N latitude and 115.63°W longitude. Thompson Falls is the closest community with commercial services in the predominantly rural area. The economy of the area includes limited agriculture, timber, tourism, and various small businesses.

Geographic Setting

The Cabinet Ranger Station is located on the floodplain of the lower Clark Fork River, which flows northwest in the area in a narrow valley between the Bitterroot Mountains to the southwest and the Cabinet Mountains to the north. The Clark Fork River watershed (USGS Hydrologic Unit Code 17010213) is the primary drainage basin for Western Montana and is located within the Westslope, or Columbia River Watershed Management Region for Montana. The floodplain area near the Ranger Station is generally flat, while the mountains provide significant relief to the area. The Clark Fork River flows northwest in the area. The Noxon Dam on the Clark Fork River is located approximately 8 miles north of the Cabinet Ranger Station. The Noxon Reservoir behind the dam is located approximately 0.5 miles south of the Ranger Station. The topography of the region is mountainous, with a large amount of vertical relief. The area is primarily forested except for bare regions at high elevations. The majority of residents in the area live in the lower elevations in the Clark Fork River valley and tributaries. The geographic setting is shown in Figure 2.

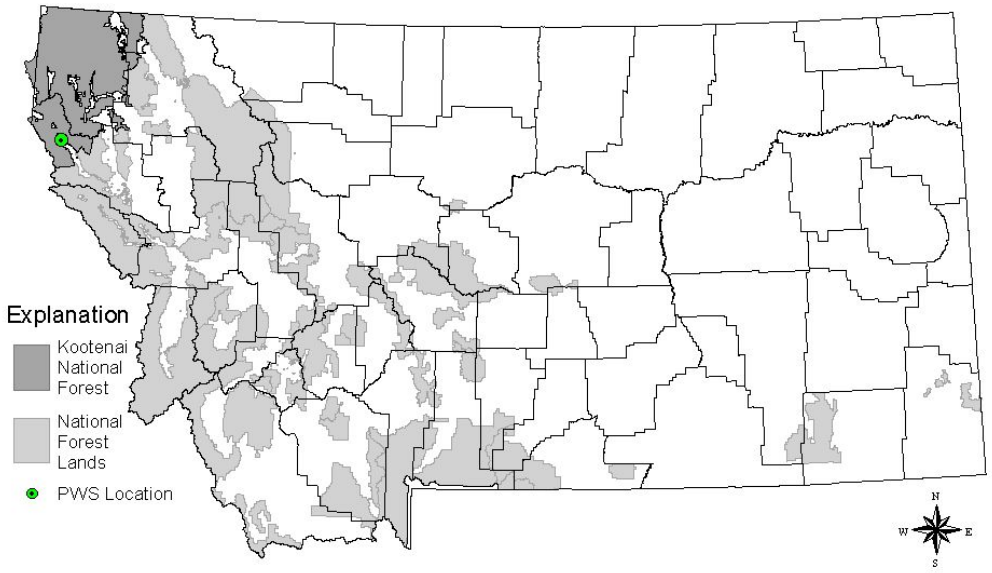

Figure 1 – Cabinet Ranger Station Location Map

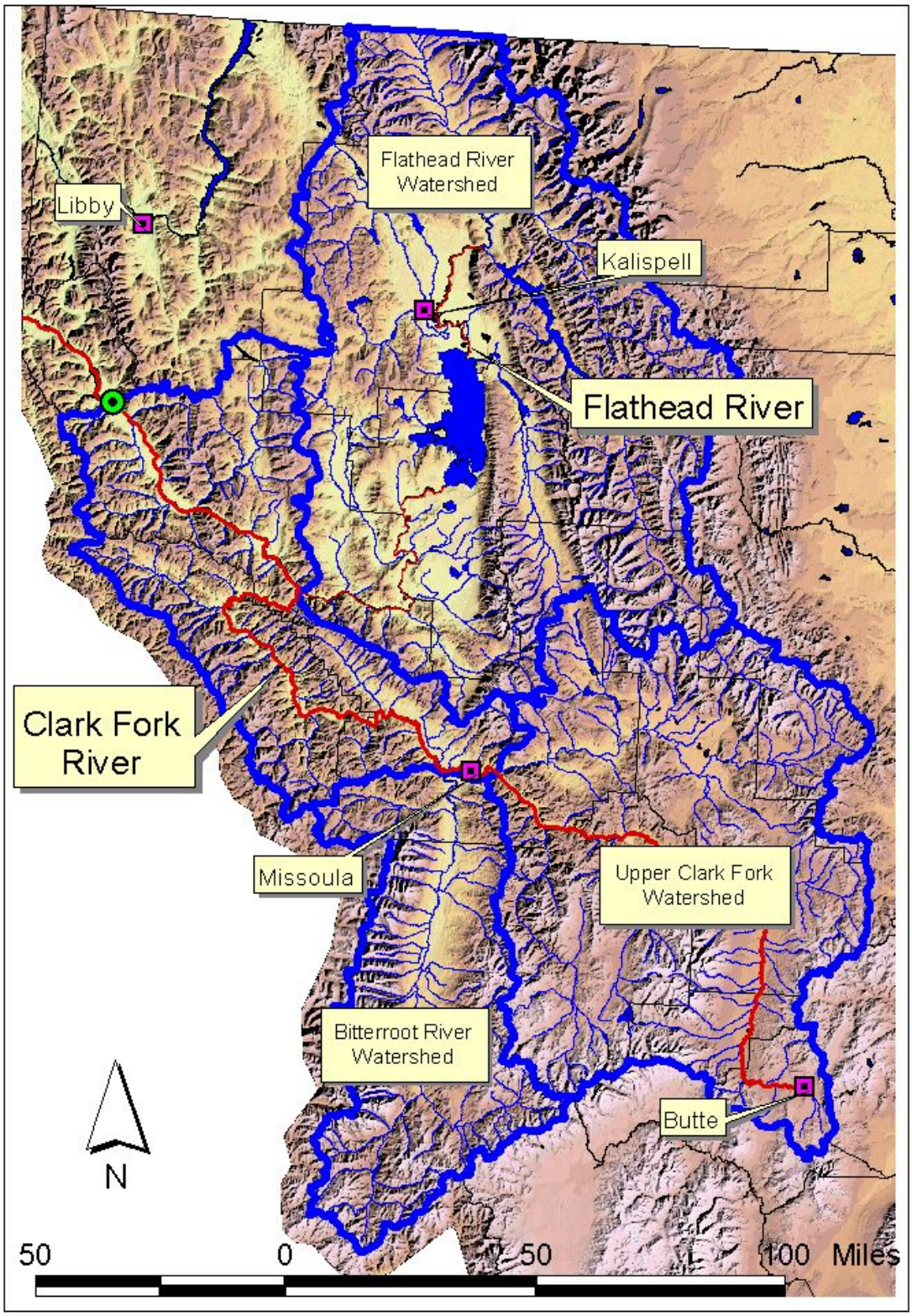

Figure 2 – Clark Fork River Watershed Area

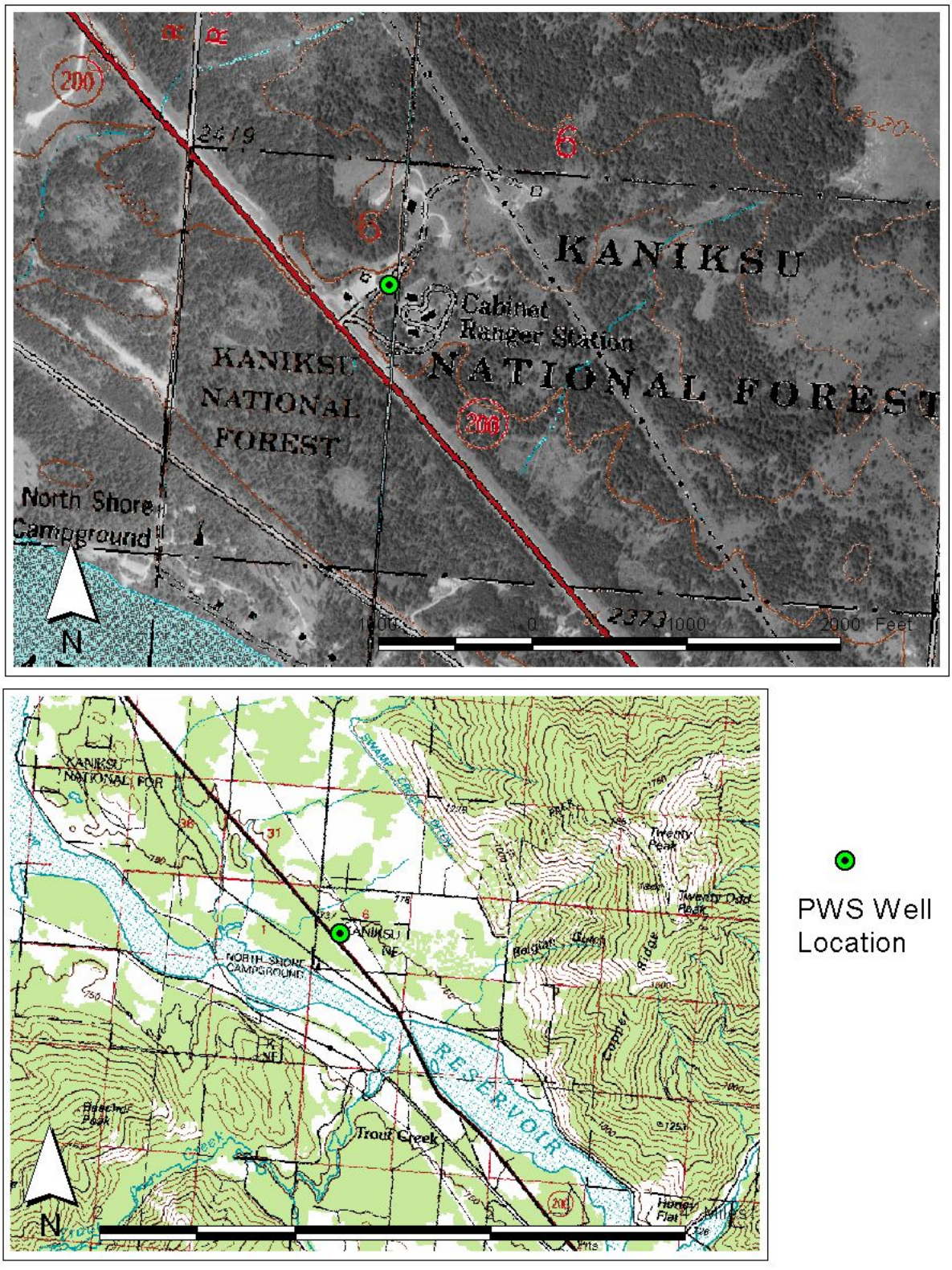

Figure 3 – Cabinet Ranger Station Vicinity and PWS Well Location

Climate

The climate is typical of western Montana. Precipitation averages 28.75 inches a year as measured at the Cabinet Ranger Station. The wettest months are December and January averaging 3.82 and 3.87 inches monthly, respectively. The driest months are July and August, averaging 1.14 and 1.31 inches per month. The temperature ranges from an average high of 85.8 °F in August (minimum August average of 44.8 °F) to an average of 33.9 °F in December (minimum January average of 21.4 °F).

General Description of the PWS Source Waters

The Cabinet Ranger Station public water supply well is located in the valley of the Clark Fork River, in the central part of the floodplain as depicted in Figure 3. The PWS obtains ground water from a well installed into deep glacial deposits filling the valley. The glacial deposits represent a confined aquifer in the area, separated from the alluvial system by a thick clay layer. The aquifer can be characterized as confined. Recharge to the well occurs in the mountains from upgradient areas within the Clark Fork River valley, where the confining clay lens thins along bedrock boundaries or is not present.

Public Water Supply

The Cabinet Ranger Station public water supply serves a population of approximately 24 residents and numerous non-residents in the summer; the winter population is less. The system has a total of 11 service connections. Information on the system was obtained primarily from a recent sanitary inspection of the system in November, 2002. A copy of this report is included in Appendix A. The system utilizes one well installed in 1958 to an estimated depth of 215 feet. The well location is shown in Figure 3. Water from the well is pumped into a 28,400 gallon concrete reservoir tank located in the hills east of the Ranger Station. Water is pumped into the storage tank, which provides gravity flow to the distribution system. The main distribution system for the compound was replaced in 2002 with polyethylene pipe because of excessive corrosion of the original galvanized piping installed in the mid 1960's. A map of the layout of the distribution system is included in Appendix A. There is currently no treatment or disinfection applied to the water before distribution to consumers.

Wastewater Treatment

Wastewater from the facility buildings is treated with septic systems and drainfields located south of Highway 200 approximately ¼ mile below the Ranger Station.

Water Quality

Every PWS is required to perform monitoring for contamination to their water supply. The monitoring constituents include coliforms and other signs of pathogenic organisms, nitrates, metals and for multiple chemicals. The monitoring schedule depends on many factors such as the size and source water for a PWS, the number of sources (e.g. wells), and the population served. Each PWS has a specific monitoring program tailored to their system that follows the general protocols for operation of a PWS defined by DEQ. A review of the DEQ PWS database indicates that monitoring results for the Cabinet Ranger Station PWS show no violations or exceedences of any drinking water quality standards based on detections in the past several years. Two coliform violations occurred in 2000 and 2001, but these were resolved. There have

been no other detects of regulated contaminants in the last five years, with the exception of nitrate with detected levels considerably below the Maximum Contaminant Level of 10 mg/l set by the U.S. Environmental Protection Agency (EPA).

Ground water quality in the area is generally good and meets the needs of local consumers who utilize the resource. Ground water quality data from the area from MBMG-GWIC is included in Appendix C. This data is considered representative of background water quality in the area.

All of the surface water in the study area, including this part of the Clark Fork River and tributaries, are classified as B-1 waters using the State of Montana stream classification system for beneficial uses. These types of waters are suitable for drinking, culinary and food processing purposes after conventional treatment. Additional uses include bathing, swimming and recreation, growth and propogation of salmonid fishes and associated aquatic life, waterfowl and furbearers, and agricultural and industrial water supply. The Total Maximum Daily Loading (TMDL) assessment for the surface waters in the area will identify threats to the listed potential uses for the surface waters in the area. The TMDL assessment will evaluate the ability of the surface waters to buffer various types of discharges to the waters, including both natural and human caused sources, and the impact to the overall health of the water bodies. These include wastewater treatment plant discharges, surface water runoff and non-point source pollution. After the TMDL assessment is complete, the results will be presented to area and community leaders to help identify and plan methods to meet the goals of the TMDL assessment in preserving and improving surface water quality in the area. Since the USFS manages much of the land in the upper reaches of the watershed, they will be involved in this process.

DELINEATION

The source water protection area, the land that contributes water to the Cabinet Ranger Station PWS source is identified in this chapter. Delineation of management areas for source water protection is based on the hydrogeologic setting of the water source, in accordance with the requirements outlined in the Montana Source Water Protection Program (DEQ, 1999). For ground water systems in general, there are three regions referred to as 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 well. The area within a 1,000-foot radius around the wellhead defines the inventory region for confined aquifers. The recharge region represents the area where the source aquifer for a water system is replenished.

Regional Geology

The hydrogeology of the PWS Source reflects both consolidated bedrock and overlying glacial strata. The bedrock geology of the Cabinet Ranger Station watershed area comprises PreCambrian metasedimentary rocks of the Missoula, Ravalli, and Wallace Groups and the Pritchard Formation as mapped by Ross et al (1955). These rocks have little primary porosity as a result of regional metamorphism, consistent with other rocks of the Belt Supergroup in the region (Crowley, 1963). Quaternary alluvium is present filling the base of stream valleys, with glacial deposits comprising predominantly tills with limited coarser grained outwash seams present along the margins of the valley mantling bedrock, and beneath the alluvium. Many geologic studies have been performed on region (Harrison et al, 1986); however, the focus of these was mineral exploration and none of these studies included any hydrogeologic assessment. A generalized geologic map of the area is shown in Figure 4. The interpretation of the geology and hydrogeology of the area is based on standard hydogeological principles, information presented in the regional references, and an evaluation of well logs for the area obtained from the Montana Bureau of Mines and Geology Ground Water Information Center (MBMG-GWIC). Summary tables of wells and well lithology and construction logs from MBMG-GWIC are included in Appendix B.

Hydrogeology

Ground water in the area near the Cabinet Ranger Station is present in a locally confined glacial aquifer present across the base of the valley. The aquifer is bounded by bedrock present near the surface along the margins of the valley. Recent alluvium fills the majority of the floodplain overlying the glacial strata which fills the valley base and continues to cover the bedrock on the margins of the valley. Ground water in glacial areas typically flows through discontinuous glacial outwash seams encased within clay-rich glacial tills. According to the well log for the PWS well, the aquifer is a six-feet thick gravel seam located at a depth of 210 feet. The aquifer is covered by over 100 feet of dry clay-rich deposits. Ground water flow in the aquifer is interpreted to generally follows the topographic gradient of the Clark Fork River valley. The well for the PWS is approximately 215 feet deep, well below the base of nearby Noxon Reservoir. Recharge to the well for the Cabinet Ranger Station PWS is interpreted to occur along the margins of the valley, where bedrock is exposed against glacial strata, and upgradient in the Clark Fork River valley where the glacial deposits thin and recharge from overlying alluvial sediments may occur.

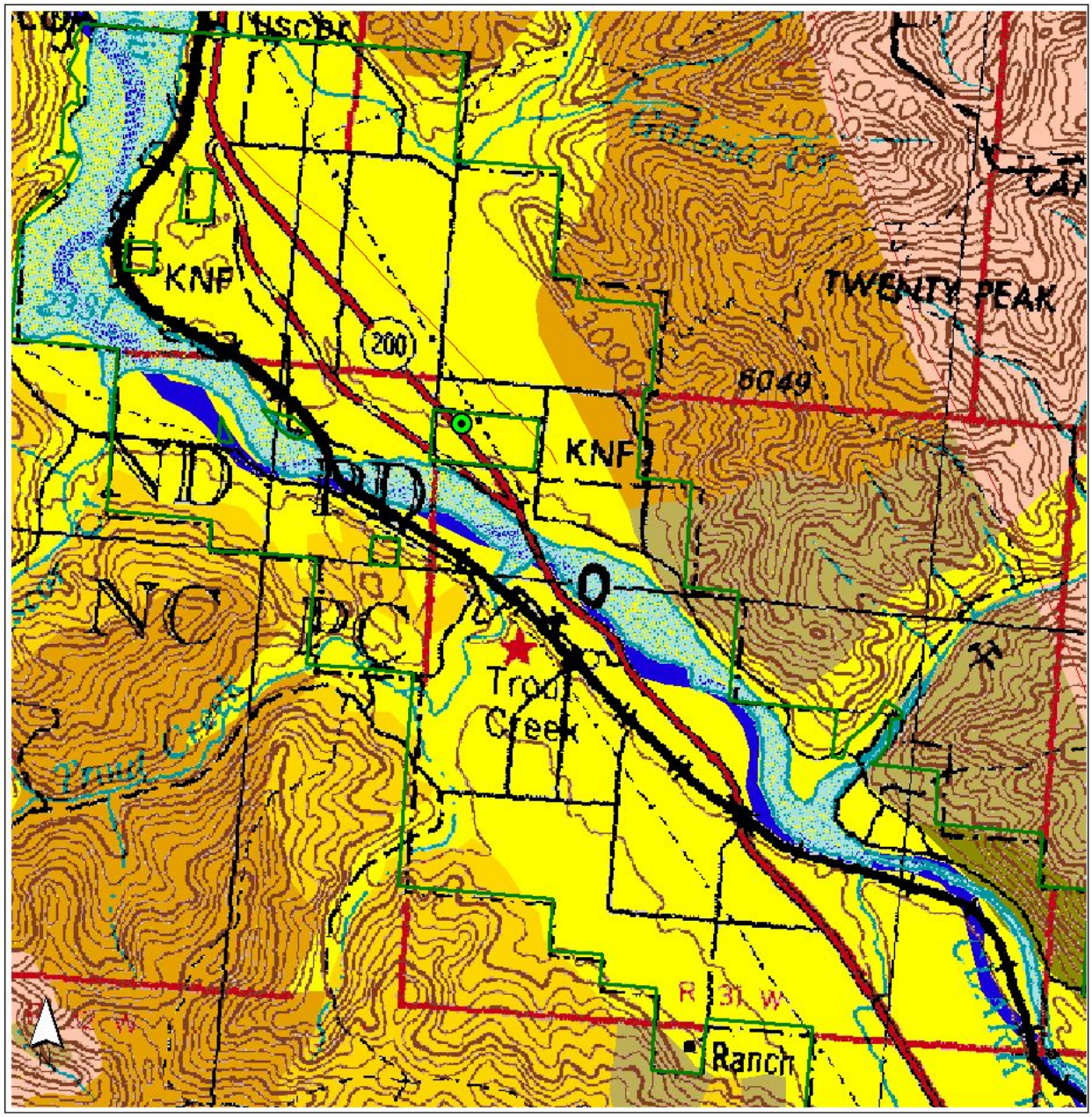

Figure 4 – Cabinet Ranger Station Area Geologic Map

Conceptual Model and Assumptions

A conceptual hydrogeologic model is a simplified representation of the hydrogeologic system. For the Cabinet Ranger Station public water supply, ground water occurs in a confined glacial aquifer. Ground water flow is northwest following the topographic gradient of the valley. Recharge to the aquifer occurs along the margins of the valley where the glacial aquifer is bounded by bedrock, and upstream in the Clark Fork River Valley where glacial strata are not present. At this location, recharge occurs from direct infiltration of precipitation, flow from the underlying bedrock aquifer, and from stream loss where surface water recharges ground water systems. Based on the hydrogeologic setting, the Cabinet Ranger Station water source is a confined aquifer in unconsolidated glacial sediments, which is considered to have a ***high*** source water sensitivity to contamination.

Well Information

The location of the well for the Cabinet Ranger Station is depicted in Figure 2. Information on the source is summarized in Table 1. A copy of the driller construction log for the well is included in Appendix A. The MBMG-GWIC database was queried for well logs in the area (Appendix B), including well information for the PWS well. A log for this well is included in Appendix B. According to the well log for the PWS well (Appendix A), the well was installed in 1961 with 8-inch steel casing to an approximate depth of 207 feet.

Table 1. Source Well Information for Cabinet Ranger Station.

Information	Well 1
PWS Source Code	002
Well Location (T, R, Sec)	T24N, R31W Sec 6 CACB
Well Location (lat, long)	47.8665°N Lat 115.6263°W Long
MBMG #	78705
Water Right #	--
Date Well was Completed	26 Nov 1958
Total Depth	215 feet
Perforated Interval	Open casing
Static Water Level	190 feet
Pumping Water Level	48 feet
Drawdown	0 feet
Yield/Test Pumping Rate	61 gpm
Specific Capacity	--

Delineation Methods and Criteria

The source water protection management areas were defined for a confined aquifer in accordance with the requirements of the DEQ Source Water Protection program (DEQ, 1999). The control and inventory zones around the well comprise a distance of a 100-feet radius and 1,000-feet radius around the wellhead, respectively. The recharge area is delineated as the watershed area upstream from the drinking water source. Since the aquifer may be in connection with surface water in Noxon Reservoir from poorly constructed wells (see Susceptibility Assessment for further information), a surface water buffer zone comprising a buffer of ½ mile around Noxon Reservoir upstream from the PWS is delineated.

Source Water Protection Management Zones

The management areas delineated for the Cabinet Ranger Station PWS are depicted in Figure 5. The inventory zone is present only in alluvial and glacial strata, with no bedrock present. Recharge occurs in the Clark Fork River watershed above the Cabinet Ranger Station. The surface water buffer zone is delineated as a ½ mile wide buffer around Noxon Reservoir upstream from the PWS.

Limiting Factors

The hydrogeologic assessment presented in this section is based on the available information on the area. The approach reflects uncertainties in the available data used to estimate the time of travel distances. The interaction of surface and ground water represents the greatest area of uncertainty in this assessment. Additional limitations in the time of travel calculations result from the use of the Uniform Flow Equation for analysis of flow rates.

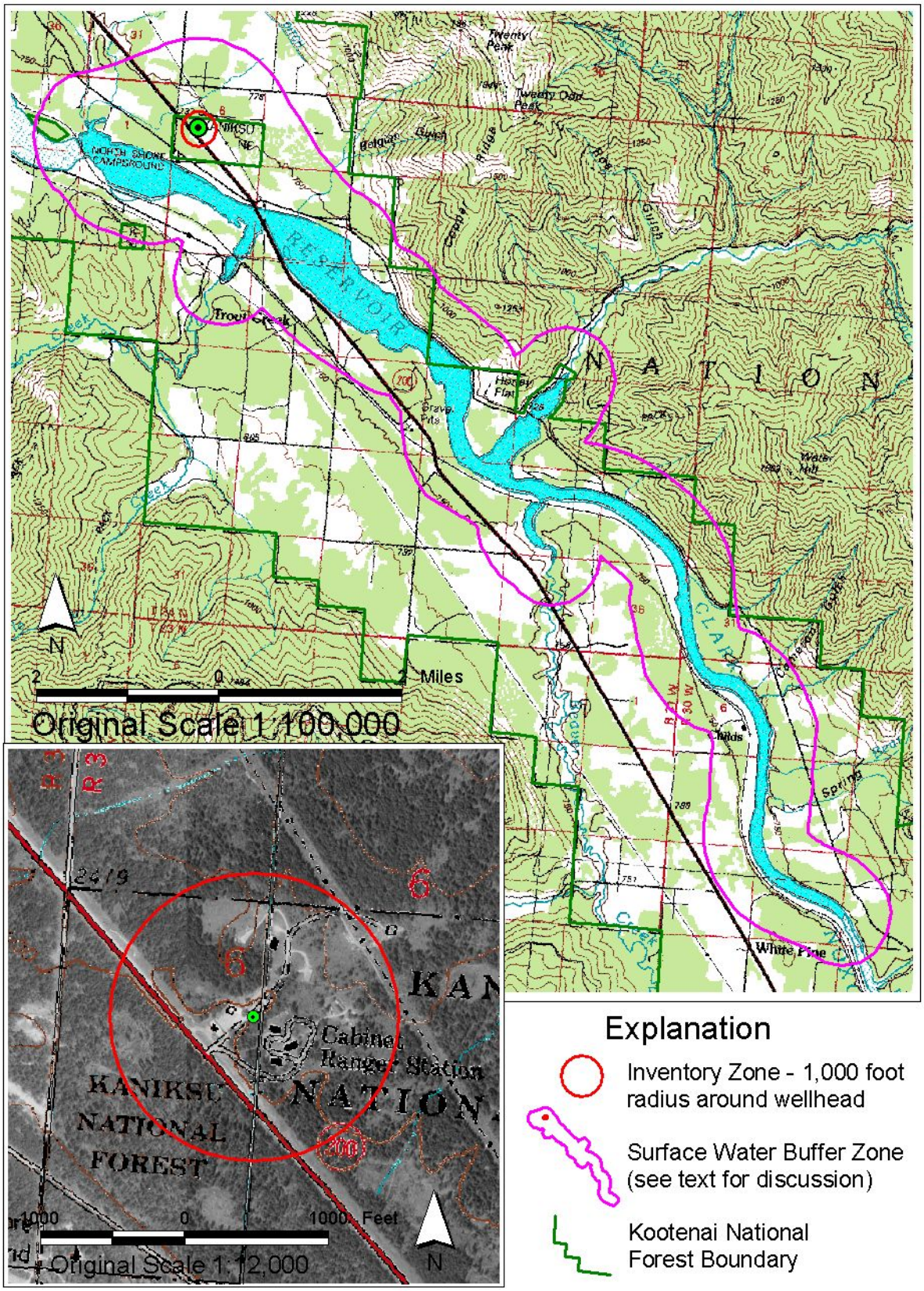

Figure 5 – Source Water Protection Management Areas

INVENTORY

An inventory of potential sources of contamination was conducted for Cabinet Ranger Station well control and inventory zones. Potential sources of all primary drinking water contaminants, including pathogens, were identified. However, only significant potential contaminant sources based on criteria outlined in the Montana Source Water Protection Program (DEQ, 1999) were selected for detailed inventory. These are listed in Table 2. The inventory for the Cabinet Ranger Station PWS focuses on all activities in the control zone, certain sites or land use activities in the inventory zones, and general land uses and large facilities in the recharge region. The inventory results from the various steps are summarized in Table 3. The significant potential contaminant sources in the inventory region for the well includes petroleum from storage tanks or in vehicles on site; and nitrates and pathogens from the septic systems and from agriculture.

Inventory Method

The initial inventory steps comprise querying existing state and federal electronic databases for regulated facilities that use, store or release regulated chemicals. The steps to the database searches, and the results from each step are listed in Appendix D. The assessment of agriculture land use and urban areas, and major transportation routes through the area are shown in Figure 6. The relative density of septic systems in the area is shown in Figure 7, with the location of wells in the area from the MBMG-GWIC database.

The results of the inventory process are summarized in Table 3, which summarizes the properties or sites within the inventory zone study area. The potential contaminants are listed, with a description of the potential release mechanism for the site. In all cases, releases may occur due to unavoidable conditions such as flooding, lightning or fire. The sites where this is the primary potential release mechanism are identified as concerns resulting from such a disaster. For other sites where other release mechanisms may be more common, the potential for a release from such a disaster is assumed. Class V injection wells are classified as waste disposal conduits that discharge directly to shallow ground water. The evaluation of the use of Class V injection wells in Montana is currently the responsibility of the EPA. The Montana Source Water Protection Program identifies specific types of potential contaminant sources as significant, for further evaluation of the susceptibility of the water source to these sources. The categories of significant potential contaminant sources are listed in Table 2.

Table 2 – Significant Potential Contaminant Sources (DEQ, 1999)

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

Inventory Results/Control Zone

The control zone represents the most critical point to protecting the integrity of a wellhead for ground water sources. The land around the control zone for the well includes the ranger station compound with no fencing or other method to limit access to the wellhead. No significant potential contaminant sources were identified in the Control Zone.

Inventory Results/Inventory Region

The inventory region represents the area near the source well where any contamination spilled onto the ground or subsurface has the potential to migrate directly into the PWS source aquifer. A summary of the inventory results of significant potential contaminant sources are listed in Table 3. The potential sources identified include petroleum storage tanks, septic systems, agricultural land use and the main area highway.

Table 3 - Summary of Inventory Results for Cabinet Ranger Station PWS.

Source Type	***Potential Contaminants***	***Description/Concern***
Step 1 Results		
Agricultural Land Use	*Pathogens and Nitrates; Pesticides and Herbicides*	*Non-point source pollution, concentration of fertilizers/chemicals in surface/ground water*
Urban Land Use	*Spills of various chemicals*	*Non-point source pollution, small spills of household chemicals*
Septic Systems	*Pathogens and Nitrates*	*Non-point source pollution, loading o f ground water system with effluent*
Storm Water Discharge Points	*Various chemicals*	*Non-point source releases from urban land use concentrated into point source to ground water; storm sewer system discharges*
EPA-Envirofacts (Step 2)	*No sites identified*	
EPA-PCSs Sites (Step 3)	*No sites identified*	
DEQ Database (Step 4)	*No sites identified*	
Business SIC Code Search ***(Step 5)***	*No sites identified*	
Miscellaneous Others, including Step 6		
Major Roads	*Spills of various chemicals*	*Disaster – spill/release of chemicals and fuels transported on Highway*
Petroleum Storage	*Petroleum Hydrocarbons*	*Disaster – spill/release of chemicals and fuels from storage or during transportation*
Class V Injection Wells	*Various chemicals*	*Direct discharge of chemical to shallow ground water system*

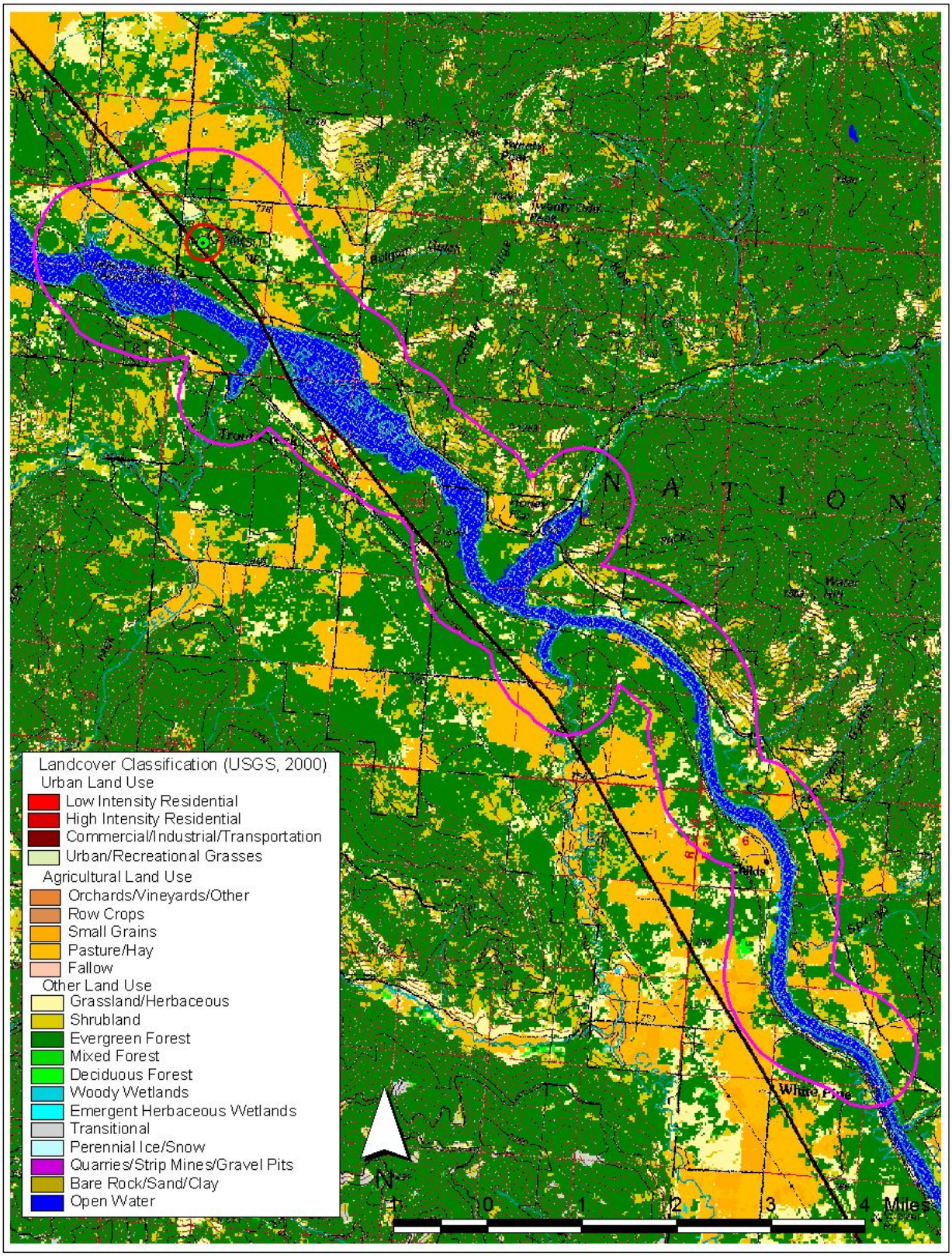

Figure 6 –Area Land Use Classification

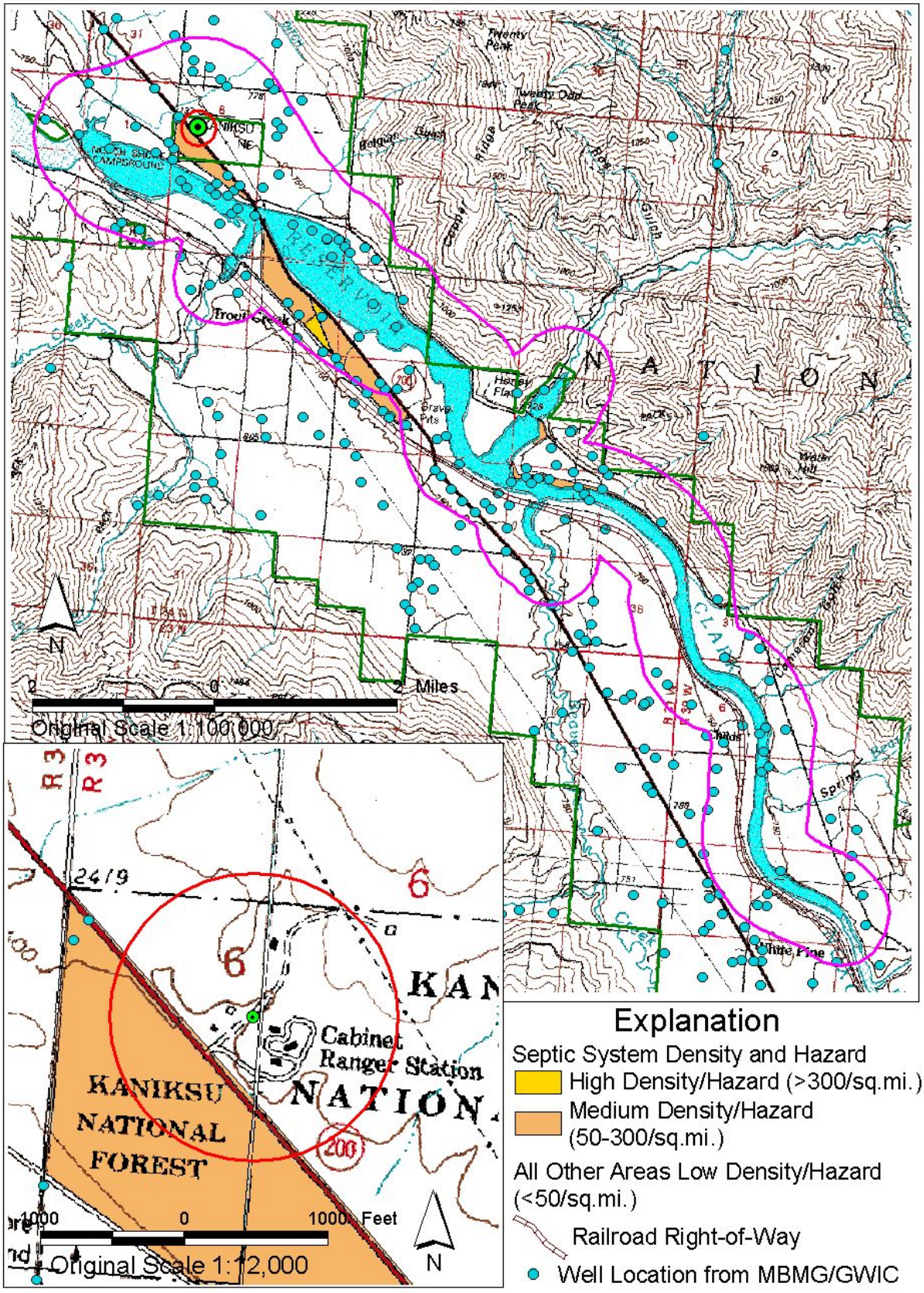

Figure 7 – Septic System Density and Hazard Classfication

Table 4. Significant potential contaminant sources for Cabinet Ranger Station PWS.

Source	*Contaminants*	*Description*
Septic Systems	*Pathogens and Nitrate*	*Area south and southwest of well with medium density, within well inventory zone. Limited areas within Surface Water Buffer Zone*
Storm Water Discharge Points	*Various organic chemicals*	*Not inventoried at this time*
Major Roads	*Various Chemicals*	*MT Highway 200, a major transportation route through the area runs adjacent to the southern part of the facility, concern over an accident and spill of any transported chemicals*
Petroleum Storage	*Petroleum Hydrocarbons*	*Diesel, Unleaded Gasoline and various Fuel Oil Tanks used at facility*

Inventory Results/Surface Water Buffer Zone

The surface water buffer zone is the area of one half mile on each side of Noxon Reservoir, as shown in Figure 5. The inventory of the surface water buffer zones focuses on potential contaminants with acute health risks, such as pathogens or nitrates. The delineated area includes areas with septic systems.

Inventory Results/Recharge Region

The recharge region for the well is the Clark Fork River watershed area above Noxon Reservoir. The area within the watershed near the Cabinet Ranger Station is predominantly national forest land.

Inventory Update

The certified operator for the Cabinet Ranger Station PWS or another qualified representative of the USFS will update the inventory every year. Changes in land uses or potential contaminant sources will be noted and additions made as needed. The complete inventory will be submitted to DEQ every five years to ensure re-certification of the source water delineation and assessment report.

Inventory Limitations

The inventory is limited by the accuracy of information in databases used for the assessment.
The location of Class V injection wells is not complete at this time, and is currently being compiled by EPA for the area.
The data from the MBMG-GWIC database on wells in the area may not be complete, as not all wells are included in the database.

SUSCEPTIBILITY ASSESSMENT

Susceptibility is the potential for a public water supply to draw water contaminated by inventoried sources at concentrations that would pose concern. Susceptibility is assessed in order to prioritize potential pollutant sources for management actions by local entities, in this case the Cabinet Ranger Station PWS.

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

Susceptibility is determined by considering the hazard rating for each potential contaminant source and the existence of barriers that decrease the likelihood that contaminated water will flow to the PWS source (Table 5). Susceptibility ratings are presented for each significant potential contaminant source and each associated contaminant.

Table 5 - Relative susceptibility to specific contaminant sources as determined by hazard and the presence of 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

For point sources, the relative hazard for the potential contaminant sources is assigned based on the type of aquifer. For confined aquifers, hazards for point sources are assigned based on the presence of other wells in the inventory zone, and how the PWS well and other wells in the area are constructed. If the PWS well does not have a proper seal through the confining layer, then the relative hazard for any potential contaminant source within the 1,000-foot inventory area is assigned a relative hazard of high, and those within the one-mile inventory zone are assigned a relative hazard of moderate. If the PWS well has a seal through the confining layer, but other wells are present in the 1,000-foot inventory zone that do not have a seal, then the relative hazard is moderate for point sources in this area and low for potential sources within the remainder of the inventory zone. If all wells in the inventory region have effective seals through the confining layer, then the relative hazard is considered low for point sources within the 1,000-foot inventory area, and very low for other sources within the inventory zone.

After the relative hazard of a potential contaminant source is assigned, the relative susceptibility is determined based on the presence of barriers that may mitigate the potential for a contaminant source to impact a water source. Barriers may represent natural conditions, engineered barriers or management actions. Natural barriers include anything that can be demonstrated as effective in mitigating the migration of any chemicals released at the surface, such as thick clay-rich soils or surface flowing artesian conditions. Engineered barriers represent man-made structure to contain chemicals if they are released, such as spill containment for underground storage tanks. Management barriers are plans that prohibit or control potentially polluting activities, but only if there is a plan or approach that has been formally implemented.

For the Cabinet Ranger Station PWS source, a natural barrier of clay-rich soils was identified for potential surface spills. A barrier for the petroleum storage tanks is a spill response plan which will be prepared by the USFS specifically for the facility.

When the location of septic systems is known, they are treated as point sources. For non-point sources, the relative hazard is assigned based on the relative concentrations present within the delineated inventory zone for the aquifers, following the criteria listed in Table 6.

Table 6 – Relative Hazards for Non-Point Potential Contaminant Sources

Source Type	*High Hazard*	*Moderate Hazard*	*Low Hazard*
Septic Systems	> 300 per sq. mi.	50 – 300 per sq. mi.	< 50 per sq. mi.
Municipal Sanitary Sewer (% Land Use)	> 50% of region	20% – 50% of region	< 20% of region
Cropped Agricultural Land (% Land Use)	> 50% of region	20% – 50% of region	< 20% of region

Susceptibility Assessment Results

The results of the susceptibility assessment for the Cabinet Ranger Station PWS are listed in Table 7, which reviews the relative hazard, barriers and susceptibility ranking of each potential source. Management actions are recommended that may be implemented as management barriers to help reduce the relative susceptibility of the well to each potential contaminant source. The PWS well log does not indicate any information on a sanitary seal for the well. The data from MBMG-GWIC (Figure 7) do not show any additional wells in the inventory zone; however, the potential exists that wells are present not included in GWIC, constructed without proper sanitary seals prior to the establishment of the existing regulations.

The primary threats identified within the inventory zone are septic systems at the facility and south of Highway 200; and the highway itself through the area. The proximity of these sources results in the classification of the potential susceptibility of the well as very high to contamination from each of these sources.

Table 7. Susceptibility assessment of significant potential contaminant sources.

Source	Contaminant	Hazard	Hazard Rating	Barriers	Susceptibility	Management
Control Zone						
Lawn Management	Pesticides/ Herbicides/ Nitrates and Pathogens	Leaching and Runoff	Moderate	None	High	Limit use of fertilizers or other chemicals in area around control zone
Inventory Zone						
Septic Systems (Individual on-site)	Nitrates and Pathogens	Infiltration	Moderate	None	High	Monitor system performance
Septic Systems (General density in inventory zone)	Nitrates and Pathogens	Infiltration	Moderate	None	High	Monitor system performance
Petroleum Storage Tanks	Petroleum Hydrocarbons	Leakage, Runoff and Infiltration	High	Spill Response Plan, Clay-rich soils	Moderate	Locate Tanks downgradient from PWS Well
MT Highway 200	Various Chemicals	Accidental Spill, Runoff and Infiltration	High	Clay-rich soils	High	Develop Emergency Response Plan
Recharge Area and Surface Water Buffer Zone						
Septic Systems	Nitrates and Pathogens	Infiltration	Moderate	Clay-rich soils	Moderate	Monitor system performance

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