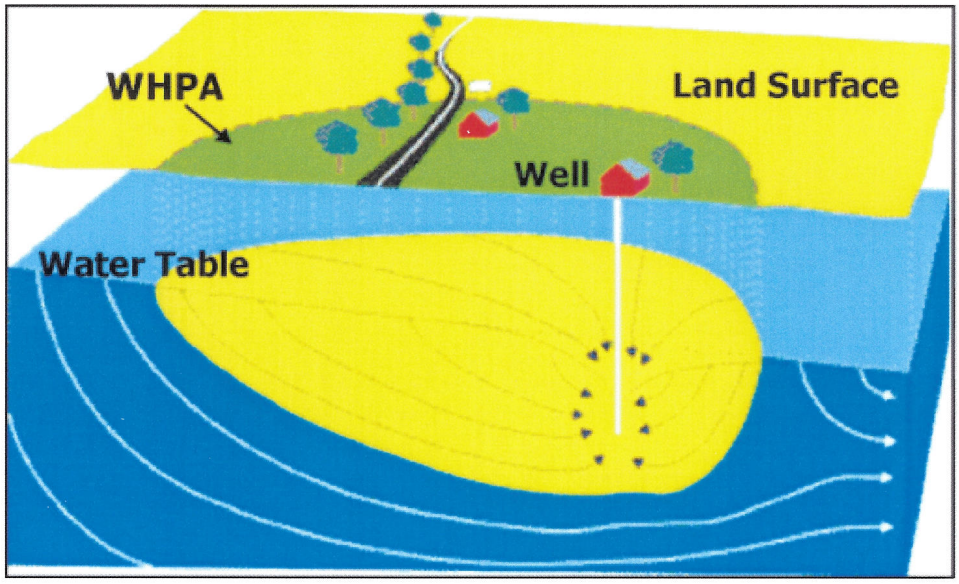
Source Water Assessment
for the Elk Ridge Lake Water System
Washington County, Maryland



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MDE

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SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for the Elk Ridge Lake water system. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Elk Ridge Lake's water supply is one well in an unconfined fractured-rock aquifer. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for this source type.

Point sources of contamination were investigated within the assessment area from field inspections, contaminant inventory databases, and previous studies. The Maryland Office of Planning's 2000 digital land use map for Washington County was used to identify non-point sources of contamination. Well information and water quality data were also reviewed. An aerial photograph and maps showing potential contaminants sources and land use within the Source Water Assessment area are included in the report.

The susceptibility analysis is based on a review of the existing water quality data for the Elk Ridge Lake water system, the presence of potential sources of contamination in the source water assessment area, well integrity, and the inherent vulnerability of the aquifer. The Elk Ridge Lake water supply may be susceptible to contamination by volatile organic compounds. It was determined that Radon-222, a naturally occurring contaminant, may pose a risk to the Elk Ridge Lake water supply. This water supply is not susceptible to contamination by inorganic compounds, synthetic organic compounds, or microbiological contaminants.

INTRODUCTION

The Water Supply Program has conducted a Source Water Assessment for the Elk Ridge Lake water system in Washington County. Elk Ridge Lake is located approximately 7 miles northeast of Harpers Ferry, West Virginia in southern Washington County. The water system serves a population of 60 and has 29 service connections. The water system is owned and operated by the Washington County Water and Sewer department.

WELL INFORMATION

Well information was obtained from the Water Supply Program's database, site visits, well completion reports, sanitary survey inspection reports, and published reports. The Elk Ridge Lake system presently obtains its water supply from one well (Fig. 1). Several other wells are located in the community and may have once been used by the water system, but are currently not connected to the system. A review of the well completion report for Elk Ridge Lake's well indicates that it was drilled after 1973 and should meet construction standards for grouting and casing. Well information is summarized in Table 1.

The Elk Ridge Lake water system has an appropriation permit to draw water from the Harpers formation for an average use of 11,700 gallons per day (gpd) and a maximum of 19,500 gpd in the month of maximum use. Based on the most recent pumpage reports, the average daily use was 6,488 gallons in 2000 and 7,065 gallons in 2001. The months of maximum use for the last two reported years were May 2000 and December 2001 with an average daily use of 7,551 and 9,226 gallons respectively.

SOURCE ID	WELL NAME	PERMIT	TOTAL DEPTH	CASING DEPTH	YEAR DRILLED
05	WELL 5	WA-94-0903	300	90	1997

Table 1. Elk Ridge Lake well information.

HYDROGEOLOGY

Elk Ridge Lake lies within the Blue Ridge physiographic province, which is the mountainous region around Catoctin and South Mountains and is underlain by the oldest sequence of rocks in the County. The Blue Ridge Province is mostly underlain by metamorphiosed igneous and sedmentary rocks that are the eroded remnants of an overturned anticlinorium (Duigon and Dine, 1991). The Elk Ridge Lake well obtains water from the Harpers formation, an unconfined, fractured-rock aquifer, composed of a dark blue and green shale and gray laminated phyllite (Edwards, 1978). The primary porosity and permeability of this aquifer are small due to the dense nature of the metamorphosed rock. Ground water moves principally through secondary porosity,

fractures and joint openings, and is recharged by precipitation percolating through soil and saprolite. Due to the low primary porosity, large production wells are not common in this formation unless significant, water-bearing fractures are encountered.

Ground water systems in crystalline rock tend to be localized and flow is within topographic divides towards the nearest perennial stream (Bolton, 1996). The water table is generally in the saprolite, which is characterized by high porosity and thus, the amount of storage often depends on the thickness of the saprolite. Stream valleys tend to follow fracture traces and as a result wells drilled in draws and stream valleys tend to have higher yields than those on hilltops and slopes.

SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WHPA) is considered the source water assessment area for the system. The source water assessment area for public water systems using wells in fractured-rock aquifers is the watershed drainage area that contributes to the well. The area should be modified to account for geological boundaries, ground water divides, and by annual average recharge needed to supply the well (MD SWAP, 1999).

A fracture trace analysis was completed in the area in support of their ground water appropriation permit. The WHPA is delineated as the modified watershed drainage area needed to supply the appropriated amount using the effective recharge rate. The recharge area for the wells based on an average use of 11,700 gpd and an average drought-year recharge rate of 400 gpd/acre is calculated to be 30 acres. The WHPA was delineated following topographic divides upgradient of the wells and includes the upgradient extent of the fracture trace closest to the well. The WHPA was extended approximately 600 feet north of the well along the fracture trace due to evidence from the pump test that indicates high transmissivity along the fracture trace. The western border of the WHPA follows a fault identified on the geologic map and the eastern border is the estimated 10-foot drawdown contour from observation wells monitored during pump testing of the Elk Ridge well. The WHPA is 87 acres and is illustrated in Figure 2.

POTENTIAL SOURCES OF CONTAMINATION

Potential sources of contamination are classified as either point or non-point sources. Examples of point sources of contamination are leaking underground storage tanks, landfills, discharge permits, large scale feeding operations, and CERCLA sites. These sites are generally associated with commercial or industrial facilities that use chemical substances that may, if inappropriately handled, contaminate ground water via a discrete point location. Non-point sources of contamination are associated with certain types of land use practices such as use of pesticides, application of fertilizers or animal wastes, or septic systems that may lead to ground water contamination over a larger area.

Point Sources

A review of MDE contaminant databases revealed no potential point sources of contamination within the WHPA.

Non-Point Sources

The Maryland Office of Planning's 2000 digital land use coverage of Washington County was used to determine the predominant types of land use in the WHPA (Fig. 3). The land use summary is given in Table 2. The majority of the WHPA is made up of residential and forested land, with a smaller proportion of agricultural areas.

Land Use Type	Total Acres	Percent of WHPA
Low Density Residential	32	36.8
Cropland	5	5.9
Forest	49	55.9
Water	1	1.4
Total	87	100

Table 2. Land Use Summary

Agricultural land (cropland and pasture) is commonly associated with nitrate loading of ground water and also represents a potential source of SOCs depending on fertilizing practices and use of pesticides. Residential areas without sewer service may be a source of nitrate from septic systems. Additionally, residential areas may be a source of nitrate and SOCs if fertilizers, pesticides, and herbicides are not used carefully in lawns and gardens.

The Maryland Office of Planning's 1996 digital sewer map of Washington County shows that the entire WHPA is in an area of the county that is not planned for service.

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database for Safe Drinking Water Act (SDWA) contaminants. The State's SWAP defines a threshold for reporting water quality data as 50% of the Maximum Contaminant Level (MCL). If a monitoring result is greater than 50% of a MCL, this assessment will describe the sources of such a contaminant and if possible, locate the specific sources that are the cause of the elevated contaminant level. All data reported is from the finished (treated) water unless otherwise noted. The Elk Ridge Lake water system currently has chlorination for disinfection, pH for corrosion control, and green sand filtration for iron removal.

A review of the monitoring data for Elk Ridge Lake's water system indicates that the water supply has met drinking water standards with one exception. Tetrachloroethylene (PCE) was detected above the MCL in one sample, but samples collected since then have been non-detect for PCE. Inorganic compounds and synthetic

organic compounds have not been detected above the SWAP threshold level. Radon-222 was the only radionuclide detected at a level of concern. The water quality sampling results are summarized in Table 3.

Contaminant Group	No. of Samples Collected	No. of Samples over 50% of an MCL
Inorganic Compounds (except Nitrate)	49	0
Nitrate	7	0
Radiological Contaminants	3	1*
Volatile Organic Compounds	14	1
Synthetic Organic Compounds	1	0

Table 3. Summary of Water Quality Samples
*Proposed MCL for Radon-222

Inorganic Compounds (IOCs)

Inorganic compounds were not detected above 50% of an MCL. Several unregulated compounds such as Iron, Manganese, Sodium and Zinc have been detected in the water supply at low levels.

Radionuclides

A review of the data shows that the only radionuclide detected at a level of concern was Radon-222. There is currently no MCL for Radon-222, however EPA has proposed an MCL of 300 pCi/L or an alternate of 4000 pCi/L for community water systems if the State has a program to address the more significant risk from radon in indoor air. The EPA received many comments in response to their proposed rule, and promulgation may be delayed. Radon-222 was detected at 1435 pCi/L in the water supply, which is higher than the lower proposed MCL.

Volatile Organic Compounds (VOCs)

A review of the data shows that two volatile organic compounds have been detected above 50% of an MCL. Tetrachloroethylene (PCE) and Trichloroethylene (TCE) were detected in the same sample collected December 15, 2000. The system was placed on quarterly VOC sampling since those results, and subsequent and samples were non-detect for these contaminants. All of the sampling results available for this system are listed in Table 4.

Synthetic Organic Compounds (SOCs)

A review of the data shows that SOCs have not been detected above 50% of an MCL.

Sample Date	Trichloroethylene (ppb)*	Tetrachlorethylene (ppb)*
25-Aug-97	-0.5	-0.5
03-Sep-98	-0.5	-0.5
12-Nov-98	-0.5	-0.5
21-Jan-99	-0.5	-0.5
30-Apr-99	-0.5	-0.5
14-Jul-99	-0.5	-0.5
05-Oct-99	-0.5	-0.5
15-Dec-00	**4.3**	**9.4**
15-Feb-01	-0.5	-0.5
07-May-01	-0.5	-0.5
07-Jun-01	-0.5	-0.5
20-Aug-01	-0.5	-0.5
19-Nov-01	-0.5	-0.5
19-Feb-03	-1.1	-1

Table 4. TCE and PCE Results
*A negative value indicates less than the indicated detection limit
The MCL for both contaminants is 5 ppb.

Microbiological Contaminants

Raw water bacteriological data is available from evaluation for ground water under the direct influence of surface water (GWUDI). A review of the data shows that coliform bacteria were not detected in raw water from the well.

SUSCEPTIBILITY ANALYSIS

The well serving the Elk Ridge Lake water supply draws water from unconfined fractured-rock aquifers. Wells in unconfined aquifers are generally vulnerable to any activity on the land surface that occurs within the wellhead protection area. Therefore, continued monitoring of contaminants is essential in assuring a safe drinking water supply. The *susceptibility* of the source to contamination is determined for each group of contaminants based on the following criteria: 1) the presence of potential contaminant sources within the WHPA, 2) water quality data, 3) well integrity, and 4) the aquifer conditions. Table 5 summarizes the susceptibility of Elk Ridge Lake's water supply to each of the groups of contaminants.

In fractured-rock areas, if a well is constructed properly with the casing extended to competent rock and with sufficient grout, the saprolite serves as a natural filter and protective barrier. Properly constructed wells with no potential sources of contamination in their WHPA should be well protected from contamination.

Inorganic Compounds

The water supply is **not** susceptible to inorganic compounds, based on water quality data and the lack of potential contaminant sources within the WHPA.

Radionuclides

The water supply **may be** susceptible to Radon-222. The source of radionuclides in ground water is the natural occurrence of uranium in rocks. The concentration of constituents such as Radon-222, Radium-226, and Radium-228 can vary considerably in the same aquifer to due to many factors such as pH, exposed surface area of minerals, and other natural conditions. The Radon-222 level is higher than the lower proposed MCL of 300 pCi/L, but lower than 50% of the higher proposed MCL of 4000 pCi/L. Thus, it is unclear whether the system will be determined susceptible to this contaminant. Based on available data, the water supply is **not** susceptible to other radionuclides.

Volatile Organic Compounds

The water supply **may be** susceptible to contamination by VOC's, due to the presence of contaminants at significant concentrations. The levels of TCE and PCE in the December 2000 sample have not been repeated and there are no obvious sources of these contaminants identified in the WHPA. Thus, it is unclear if the water supply is actually susceptible to these contaminants. The sample results may be due to procedural error in laboratory analysis or sampling collection. However, due to the high concentrations, the results cannot be completely disregarded.

The greatest use of tetrachloroethylene (PCE) is in the textile industry for processing, finishing, sizing, and as a component of aerosol dry-cleaning products (US EPA, 2002). Other uses include: an intermediate in the synthesis of fluorocarbons, an insulating/cooling fluid in electric transformers, in typewriter correction fluids, as veterinary medication against worms, and as a grain protectant/fumigant. The most common use of trichloroethylene (TCE) is for vapor degreasing of fabricated metal parts and some textiles (US EPA, 2002). Wastewater from metal finishing, paint and ink formulation, electrical/electronic components, and rubber processing industries also may contain TCE.

Synthetic Organic Compounds

The wells are **not** susceptible to synthetic organic compounds. SOCs were not detected in the water supply. A potential source of SOCs in the WHPA may be pesticide or herbicide use in the agricultural or residential areas. However, because these contaminants have not been detected, it appears that any chemicals that may be used in the WHPA are degrading or being attenuated in the soil and are not reaching the wells.

Microbiological Contaminants

The wells are **not** susceptible to microbiological contaminants. Raw water data shows that coliform bacteria, which is used as an indicator for other microbiological contaminants, was not detected in the water supply.

Contaminant Group	Are Contaminant Sources Present in WHPA?	Are Contaminants Detected Above 50% of MCL?	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible?
Nitrate	YES	NO	NO	YES	NO
Inorganic Compounds (except nitrate)	NO	NO	NO	YES	NO
Radiological Compounds	YES (aquifer)	YES*	NO	YES	YES*
Volatile Organic Compounds	NO	YES	NO	YES	MAYBE
Synthetic Organic Compounds	YES	NO	NO	YES	NO
Microbiological Contaminants	YES	NO	NO	NO	NO

Table 9. Susceptibility Analysis Summary.
*Proposed MCL for Radon-222

MANAGEMENT OF THE SOURCE WATER ASSESSMENT AREA

With the information contained in this report the Washington County Water and Sewer Department are in a position to protect the Elk Ridge Lake water supply by staying aware of the area delineated for source water protection and evaluating future development and land planning. Specific management recommendations for consideration are listed below:

Form a Local Planning Team

- The Water and Sewer Department should contact the County Planning Department to form a local planning team to begin to implement a wellhead protection plan. The team should represent all the interests in the community, such as the water supplier, home association officers, the County Health Department, local business, developers, and property owners, and residents within and near the WHPA. The team should work to reach a consensus on how to protect the water supply.
- A management strategy adopted by the County should be consistent with the level of resources available for implementation. MDE remains available to assist in anyway we can help the process.
- MDE has grant money available for Wellhead Protection projects.

Public Awareness and Outreach

- The Consumer Confidence Report should list that this report is available to the general public through their county library, by contacting the Water and Sewer Department or MDE.
- Conduct educational outreach to the facilities that may present potential contaminant sources. Important topics include (a) appropriate use and application of fertilizers and pesticides, and (b) chemical storage.
- Road signs at the WHPA boundary are an effective way of keeping the relationship of land use and water quality in the public eye, and help in the event of spill notification and response.

Monitoring

- Continue to monitor for all Safe Drinking Water Act contaminants as required by MDE.
- Annual raw water bacteriological samples are a good test for well integrity.

Planning/ New Development

- Review the State's model wellhead protection zoning ordinances for potential adoption. Coordinate with Washington County Department of Planning to adopt a wellhead protection ordinance.

Land Acquisition/Easements

- Loans are available for the purchase of property or easements for protection of the water supply. Eligible property must lie within the designated WHPA. Loans are currently offered at zero percent interest and zero points. Contact the Water Supply Program for more information.

Contingency Plan

- Elk Ridge Lake should have a Contingency Plan for its water system. COMAR 26.04.01.22 requires all community water systems to prepare and submit for approval a plan for providing a safe and adequate drinking water supply under emergency conditions.
- Develop a spill response plan in concert with the Fire Department and other emergency response personnel.

Contaminant Source Inventory Updates/ Inspections

- The Water and Sewer Department should conduct their own field survey of the source water assessment area to ensure that there are no additional potential sources of contamination.
- Periodic inspections and a regular maintenance program for the supply wells will ensure their integrity and protect the aquifer from contamination.

Changes in Use

- The Water and Sewer Department is required to notify MDE if new wells are to be put into service. Drilling a new well outside the current WHPA would modify the area; therefore the Water Supply Program should be notified if a new well is being proposed.

REFERENCES

Bolton, D.W., 1996, Network Description and Initial Water-Quality Data from a Statewide Ground-Water-Quality Network in Maryland: Maryland Geological Survey Report of Investigations No. 60, 167 pp.

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U.S. Environmental Protection Agency, 1991, Delineation of Wellhead Protection Areas in Fractured Rocks: Office of Ground Water and Drinking Water, EPA/570/9-91-009, 144 pp.

U.S. Environmental Protection Agency, 2002, "Technical Factsheet on: Trichloroethylene", URL: http://www.epa.gov/safewater/dwh/t-voc/trichlor.html.

U.S. Environmental Protection Agency, 2002, "Technical Factsheet on: Tetrachloroethylene", URL: http://www.epa.gov/safewater/dwh/t-voc/tetrachl.html

OTHER SOURCES OF DATA

Water Appropriation and Use Permit WA1960G005
Public Water Supply Sanitary Survey Inspection Reports
MDE Water Supply Program Oracle® Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles for Keedysville
USGS Topographic 7.5 Minute Quadrangles for Keedysville
Maryland Office of Planning 2000 Washington County Digital Land Use Map
Maryland Office of Planning 1996 Washington County Digital Sewer Map

FIGURES

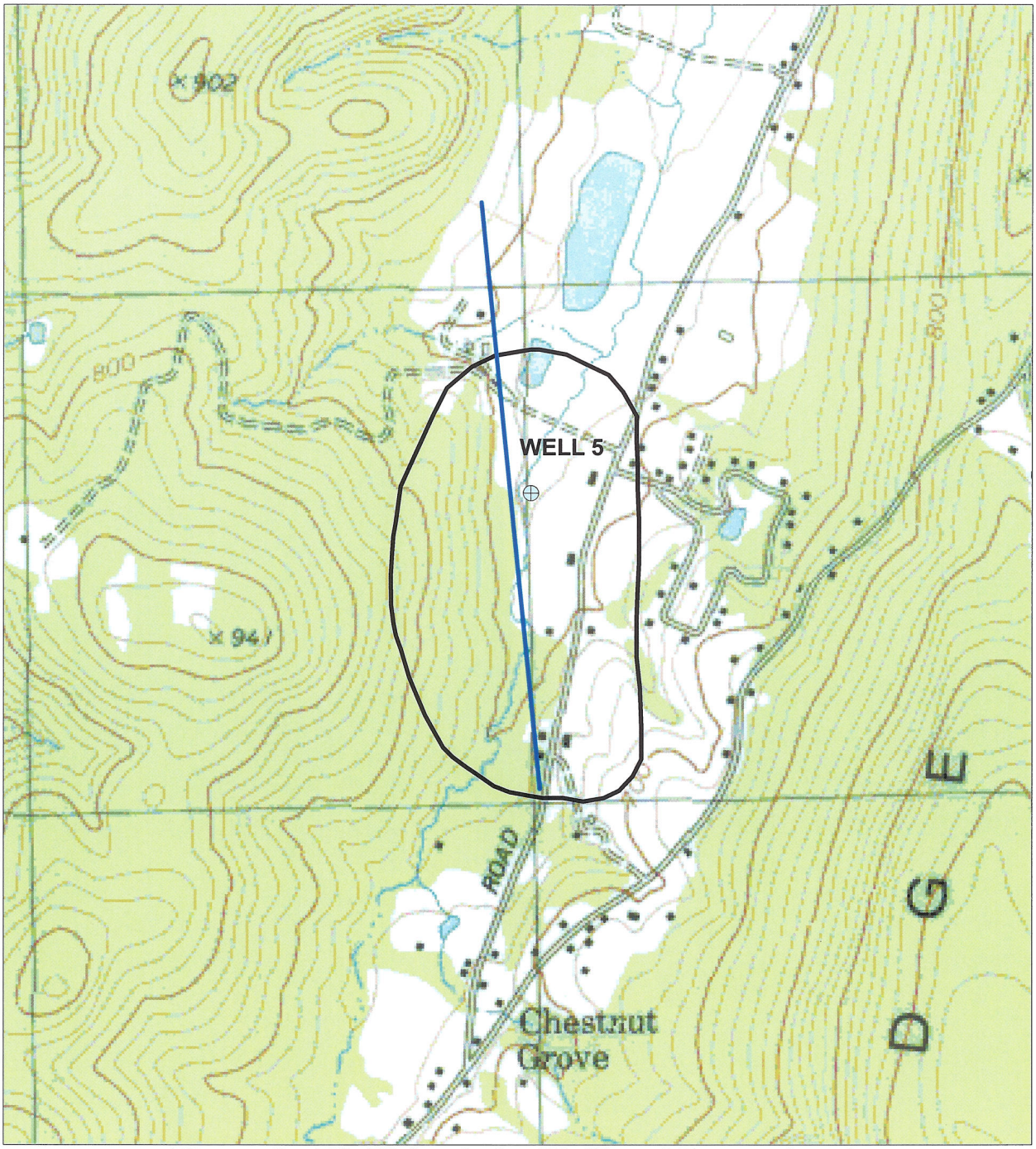

Figure 2. Elk Ridge Lake Wellhead Protection Area

Legend

- Well
- Fracture Trace
- Wellhead Protection Area

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Base Map: USGS 7.5' Quadrangle for Keedysville

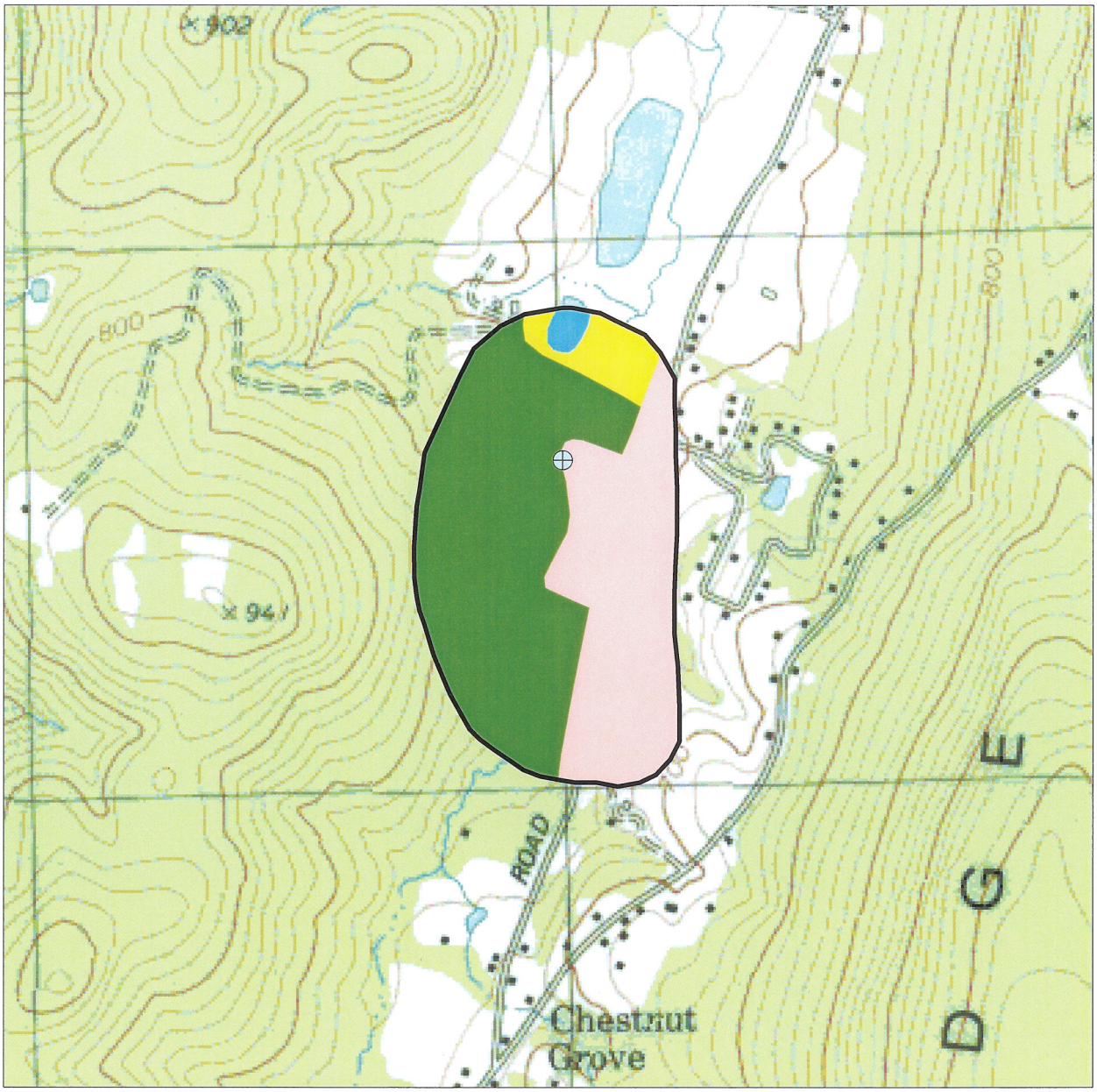

Figure 3. Elk Ridge Lake Wellhead Protection Area with Land Use

Legend

Washington County 2000 Land Use

- Low Density Residential
- Cropland
- Forest
- Water

- Well
- Wellhead Protection Area

N

1000 0 1000 Feet

Base Map: USGS 7.5' Quadrangle for Keedysville