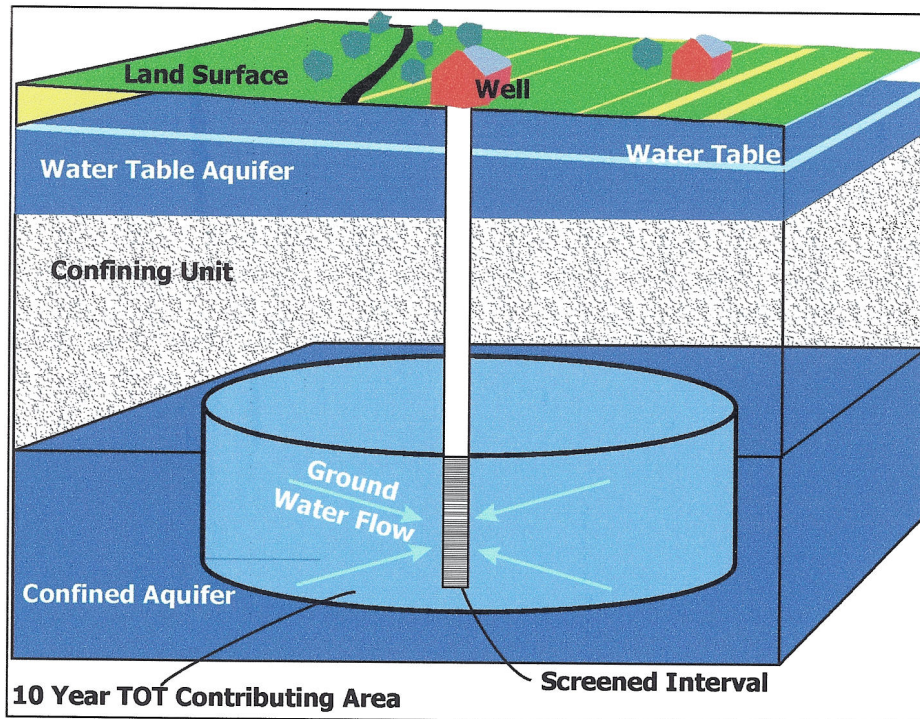


**SOURCE WATER ASSESSMENT  
FOR THE FAIRLEE WATER SYSTEM  
KENT COUNTY, MD**



**Prepared By  
Maryland Department of the Environment  
Water Management Administration  
Water Supply Program  
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## SUMMARY

The Maryland Department of the Environment's (MDE) Water Supply Program (WSP) has conducted a Source Water Assessment for the Fairlee Water System. The major components of this report as described in Maryland's Source Water Assessment Plan (SWAP) are: 1) delineation of an area that contributes water to the source, 2) an inventory of potential sources of contamination, and 3) determining the susceptibility of the water supply to contamination. Recommendations for management of the assessment area conclude this report.

The source of the Fairlee's water supply is a naturally protected confined aquifer in the Coastal Plain. Two wells are currently being used to pump the water out of the aquifer. The source water assessment area was delineated by the WSP using a method approved by the U. S. EPA.

No potential sources of contamination within the assessment area were identified based on MDE site visits, a review of MDE's databases and land use maps. Well information and water quality data were also reviewed. Figures showing land uses and sewer service areas within the Source Water Assessment Area and an aerial photograph of the well location are enclosed at the end of the report.

The susceptibility analysis for the Fairlee water supply is based on a review of the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. It was determined that the Fairlee water supply is not susceptible to inorganic compounds, volatile organic compounds, synthetic organic compounds, radiological compounds or microbiological contaminants.

## INTRODUCTION

The Fairlee Water System serves the communities of Fairlee and Georgetown in Kent County. The water treatment plant and the supply wells are located in Fairlee which is approximately 5 miles west of Chestertown (figure 1). The Fairlee Water System is owned and operated by the Kent County Department of Water and Wastewater Services and serves a population of 770. The water is supplied by two wells (Nos. 2 and 3).

## WELL INFORMATION

A review of the well data and sanitary surveys of the system indicates that Well Nos. 2 and 3 were drilled in 1987 and 1992, respectively, in accordance with the State's current well construction standards, which were implemented in 1973. Both the wells have yields of 250 gallons per minutes (gpm) and are pumped alternately every month. An older shallower well (No. 1) has been abandoned. Table 1 contains a summary of the well construction data.

SOURCE ID	SOURCE NAME	PERMIT NO	TOTAL DEPTH	CASING DEPTH	AQUIFER
02	FAIRLEE 2	KE810726	650'	320	POTOMAC GROUP
03	FAIRLEE 3	KE88409	663'	350'	POTOMAC GROUP

Table 1. Fairlee Well Information.

## HYDROGEOLOGY

The Fairlee wells draw water from the sediments of the Potomac Group of the Coastal Plain. In a recent hydrogeologic report (Drummond, 1998) this aquifer is also referred to as the Upper Patapsco aquifer. The aquifer is confined with the upper confining unit of the Potomac occurring between the depths of 301 and 475 feet below ground surface in the Fairlee area (Earth Data, 1992). A series of water-bearing layers occur between depths of about 475 and 665 feet. These water-bearing units consist mostly of brown, fine to medium sand, with varying amounts of silt. The upper portion of the sequence has a much higher percentage of silt than the lower portion. Individual water-bearing units are separated by clay and silt layers.

A site-specific aquifer test was conducted as part of the water appropriation permit requirements. Based on test results the transmissivity of the aquifer is 20,000 gallons per day per feet and the storage coefficient is 0.000333.

## SOURCE WATER ASSESSMENT AREA DELINEATION

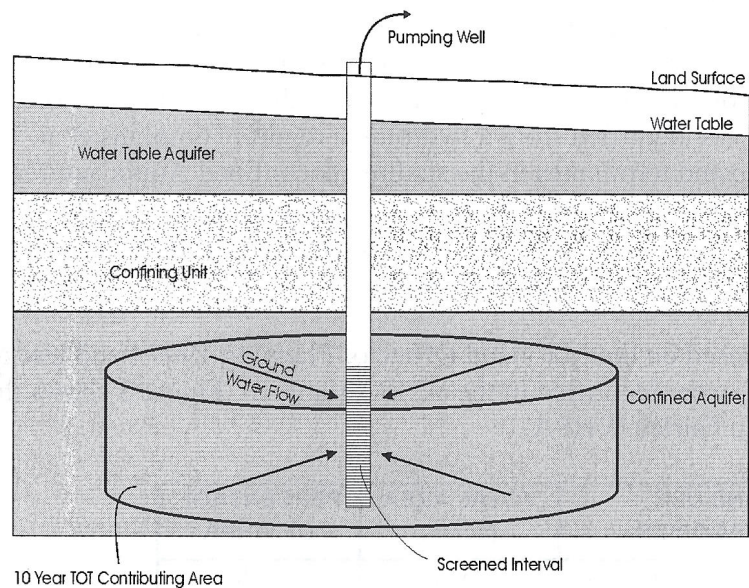
For ground water systems, a Wellhead Protection Area (WHPA) is considered to be the source water assessment area for the system. The WHPA was delineated using the methodology described in Maryland's Source Water Assessment Plan (MDE, 1999). For systems using an average of >10,000 gallons per day, the WHPA is a 10 year time of

travel (TOT) zone of transport determined by using a volumetric equation (Florida Method):

$$r = \sqrt{\frac{Qt}{\pi nH}}$$

- where r = calculated fixed radius (ft)
- Q = pumping rate of well (ft<sup>3</sup>/yr)
- n = aquifer porosity (dimensionless)
- H = length of well screen (ft)
- t = time of travel (yr.)

Figure 1b is a conceptual illustration of the zone of transport for a confined aquifer.



**Figure 1b. Conceptual illustration of a zone of transport for a confined aquifer**

The pumpage used for determining the WHPA was 146,000 gallons per day (7,124,332 ft<sup>3</sup>/yr) which is the permitted daily average quantity. Based on the lithology of the aquifer, a porosity of 25% was assumed for it. The following parameters were used for the above mentioned equation:

Q = 7,124,332 ft<sup>3</sup>/yr; n = 0.25; H = 68ft; t = 10 yrs. The calculated fixed radius for a ten year time of travel resulted in r = 1155 ft.

Fairlee's two wells are located about 95 feet from each other. Hence one circle with a radius of 1250 feet centered between the two wells was delineated as the WHPA for the well field (figure 2). This larger WHPA would incorporate areas that would have to be assessed if either well is used as the main supply well. This WHPA has an area of 113.54 acres.

## POTENTIAL SOURCES OF CONTAMINATION

For this assessment, MDE Waste and Water Management databases were reviewed and a field inspection conducted to identify potential for any direct injection of contaminants into the aquifer in and around the Fairlee WHPA. Commercial facilities in and around the WHPA were inspected by MDE Ground Water Permits Division staff to determine whether there were any unpermitted discharges into ground water. There were no potential sources for direct injection of contaminants into the deeper Potomac aquifer in the Fairlee WHPA.

Potential sources of contamination were identified at two commercial facilities (a convenience store and an auto repair shop) located about 300 feet outside the WHPA (figure 2). There are three underground storage tanks (USTs) - two 2,000-gallon gasoline tanks and one 1,000-gallon kerosene tank at the convenience store. A well on the property was identified from a hydrologic report (Tompkins et al, 1994). The well is only 98 ft. deep and terminates in the shallow unconfined Aquia aquifer. The auto repair shop had two active floor drains for underground discharge of fluids. A Notice of Violation was issued to the facility owner with a recommendation to permanently seal the floor drains or to connect to a public sewer.

Based on the Maryland Office of Planning 1997 Land Use Map, five land use categories were identified in the WHPA (table 2). Figure 3 shows the land use in and around the Fairlee WHPA.

LAND USE CATEGORIES	TOTAL AREA (acres)	PERCENTAGE OF WHPA
Low Density Residential	25.56	22.5
High Density Residential	34.71	30.6
Commercial	5.66	4.9
Cropland	43.21	38.1
Forest	4.40	3.9

**Table 2. Land Use Summary for the Fairlee WHPA.**

A review of the 1995 Kent County Sewer Map shows that 82 % of the WHPA has sewer service with no planned service for the rest of the area (figure 4).

Non-point sources of contamination are usually associated with land use activities in the area. Since Fairlee's source of water supply is a confined aquifer, the existing land use activities should not have an impact on its water quality.

## WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database and system files for Safe Drinking Water Act contaminants. The data described is for finished (treated) water unless otherwise noted. The treatment currently used at Fairlee is

disinfection, pH adjustment for corrosion control, and aeration, coagulation, flocculation, sedimentation and filtration for iron removal.

MDE personnel discussed water quality issues and concerns with Mr. Robert Sipes, Chief Operator for the Fairlee Water System. Mr. Sipes indicated that the only water quality concerns that he had were the presence of iron and low levels of manganese in the raw water. A review of the monitoring or data since 1993 for Fairlee's finished water indicates that the system's water supply currently meets the drinking water standards.

***Inorganic Compounds (IOCs)***

No IOCs above 50% of the MCL have been detected in the Fairlee water supply since 1993. Table 3 lists the IOCs that have been detected in the water supply since 1993.

CONTAMINANT ID	CONTAMINANT NAME	MCL (ppm)	SAMPLE DATE	RESULT (ppm)
1040	NITRATE	10	19-Jan-93	2.2
1040	NITRATE	10	25-Jan-94	1.42
1025	FLUORIDE	4	16-Feb-94	0.2
1010	BARIUM	2	15-Aug-94	0.107
1025	FLUORIDE	4	15-Aug-94	0.28
1055	SULFATE	none	15-Aug-94	21
1025	FLUORIDE	4	18-Mar-97	0.19
1041	NITRITE	1	18-Mar-97	0.004
1055	SULFATE	none	18-Mar-97	11
1052	SODIUM	none	18-Mar-97	32.5
1005	ARSENIC	0.05	3-Jun-97	0.007
1010	BARIUM	2	3-Jun-97	0.06
1052	SODIUM	none	3-Jun-97	26.4
1040	NITRATE	10	18-Jan-00	0.21
1025	FLUORIDE	4	1-Feb-00	0.16
1052	SODIUM	none	1-Feb-00	21.1
1010	BARIUM	2	2-May-00	0.05
1025	FLUORIDE	4	2-May-00	0.21
1052	SODIUM	none	2-May-00	30.4

**Table 3. IOC results for the Fairlee water supply.**

It must be noted that the nitrate detections in 1993 and 1994 were from the shallower Well No. 1, which has been abandoned and is no longer in service. MCLs have not been established for sodium and sulfate. Sulfate has a secondary standard of 250 ppm. Secondary standards are levels established to indicate when taste, odor or color of the water may be offensive. The sodium concentrations may be the result of addition of caustic soda (sodium hydroxide) for corrosion control.

### ***Volatile Organic Compounds (VOCs)***

No VOCs above 50% of the MCL have been detected in the Fairlee water supply since 1993 from 19 samples collected. Very low levels of ethylbenzene and xylenes have been detected in two and four samples, respectively. These detections are shown in table 4. Raw water samples taken at the end of a 24-hour pumping test for Well No. 3 indicated absence of VOCs.

PLANT ID	CONTAMINANT ID	CONTAMINANT NAME	MCL (ppm)	SAMPLE DATE	RESULT (ppm)
1	2955	XYLENES, TOTAL	10000	3-Oct-95	1.4
1	2992	ETHYLBENZENE	700	6-Jul-98	0.8
1	2955	XYLENES, TOTAL	10000	6-Jul-98	2.2
1	2992	ETHYLBENZENE	700	21-Oct-98	1
1	2955	XYLENES, TOTAL	10000	21-Oct-98	3.4
1	2955	XYLENES, TOTAL	10000	11-Apr-00	2
1	2955	XYLENES, TOTAL	10000	11-Apr-00	1.5

**Table 4. VOC (regulated) results for the Fairlee water supply.**

Also detected in nine samples taken between 1994 and 2000 were disinfection by-products known as trihalomethanes – bromodichloromethane, bromoform, chloroform, and dibromochloromethane. Trihalomethanes are currently regulated only for systems serving a population of over 10,000. The current MCL for regulated systems is 100 ppb for the total of the four above mentioned VOCs. The total concentrations of the four trihalomethanes in the Fairlee water supply range from 1.2 ppb to 6.3 ppb. Disinfection by-products are the result of a reaction between chlorine used for disinfection and organic material in the water supply.

### ***Synthetic Organic Compounds (SOCs)***

No SOC has been detected in the Fairlee water supply since 1993.

### ***Radionuclides***

Gross alpha radiation was the only radionuclide that was detected at 50% of the MCL. Other radionuclides that were detected at levels below the 50% of the MCL are listed in Table 5. Currently there is no MCL of radon-222, however EPA has proposed an MCL of 300 picoCuries per liter (pCi/L) or an alternate of 4000 pCi/L if the State has a program to address the more significant risk from radon in indoor air.

CONTAMINANT ID	CONTAMINANT NAME	MCL (pCi/L)	SAMPLE DATE	RESULT (pCi/L)
40AS	GROSS ALPHA (SHORT TERM)	15	2-Sep-98	7.88
41BS	GROSS BETA (SHORT TERM)	50	2-Sep-98	9.23
4100	GROSS BETA (LONG TERM)	50	2-Sep-98	7.45
4004	RADON-222	300/4000 (proposed)	1-Feb-00	80

**Table 5. Radionuclide results for the Fairlee water supply.**



### ***Microbiological Contaminants***

No total or fecal coliform has been detected in Fairlee's raw or finished water since 1993.

## **SUSCEPTIBILITY ANALYSIS**

The aquifer that supplies Fairlee's drinking water is confined and based on the well completion reports several confining beds overlie it. These confining layers would prevent the flow of any surface contamination into the aquifer supplying Fairlee. Only direct injection into the aquifer from point sources within the WHPA like underground injection wells or improperly abandoned wells could cause a potential contamination threat to the supply. The information that was used to conduct the susceptibility analysis is as follows: (1) available water quality data (2) presence of potential contaminant sources in the WHPA (3) aquifer characteristics (4) well integrity and (5) the likelihood of change to the natural conditions.

### ***Inorganic Compound (IOCs)***

No IOCs above 50% of the MCL have been detected in the Fairlee water supply. Nitrate levels detected are probably background levels found in the aquifer. Barium, arsenic, sulfate and iron are naturally occurring minerals in the aquifer material. The sodium may be the result of the treatment process.

Based on the above analysis, the Fairlee water supply is **not** susceptible to IOC contamination.

### ***Volatile Organic Compounds (VOCs)***

Ethylbenzene and xylenes have been detected a few times at very low concentrations. No VOC sources have been identified in the WHPA. According to Mr. Sipes, the source of these VOCs maybe related to the spray painting of boats outside the well field by residents in the community. VOC sources located outside the WHPA like the floor drains and USTs (figure 2) would only have potential impact on the shallower unconfined aquifer.

Based on the above analysis, the Fairlee water supply is **not** susceptible to VOC contamination.

### ***Synthetic Organic Compounds (SOCs)***

No SOC's have been detected in the Fairlee water supply since 1993. There are no sources of SOC contamination in the WHPA that could impact the confined aquifer. Hence the Fairlee water supply is **not** susceptible to SOC contamination.

### ***Radionuclides***

Gross alpha was detected at 50% of the MCL and gross beta radiation and radon-222 detected below 50% of the MCLs. The presence of these contaminants is attributed to decay of naturally occurring minerals like uranium in the aquifer sediments.

Based on the above analysis the Fairlee water supply is **not** susceptible to radionuclides.

### ***Microbiological Contaminants***

Based on coliform sampling data and the aquifer characteristics, the Fairlee water supply is **not** susceptible to microbiological contaminants.

## **MANAGEMENT OF THE WHPA**

### ***Form a Local Planning Team***

- The team should represent all the interests in the community. The County Department of Water and Wastewater, the County Health Department, local planning agencies, local businesses, residents, developers and farmers within and near the WHPA should work to reach a consensus on how to protect the water supply.

### ***Public Awareness and Outreach***

- Pamphlets, flyers and bill stuffers sent to local residents, businesses, and farmers will help educate the general public about Wellhead Protection.
- Placing signs at the WHPA boundaries is a good way to make the public aware of protecting their source of water supply.

### ***Monitoring***

- Continue sampling as required by the Safer Drinking Water Act.
- Annual bacteriological sampling is a good check on well integrity.

### ***Planning/New Development***

- Continue to stress the importance of a Comprehensive Water and Sewer Plan to ensure that new development (residential and commercial) adjacent to the WHPA is sewerred, and that there are no discharges into the aquifer.
- The County Department of Water and Wastewater should work with the County Planning Department to consider countywide wellhead protection implementation. Grants are available from MDE for wellhead protection projects.

### ***Contingency Plan***

- Comar 26.04.01.22 regulations require all community water systems to prepare and submit for approval a plan for providing a safe and adequate drinking water supply under emergency conditions.

### ***Changes in Uses***

- Any increase in pumpage or the addition of new wells to the system will require revision of the WHPA since it is affected by pumpage. It is recommended the system contact the MDE Water Supply Program when an increase in pumpage is applied for or when new proposed wells are being considered.

***Contaminant Source Inventory Updates/ Well Inspections***

- Conduct a detailed survey to ensure that there are no other potential sources of contamination within the WHPA. Updated records of new development within the WHPA should be maintained.
- Work with the County Health Department to ensure that there are no unused wells within the WHPA. An improperly abandoned well can be a potential source of contamination to the aquifer.
- Water operation personnel should have a regular inspection and maintenance program for the wells to ensure their integrity and to protect the aquifer from surficial contamination.

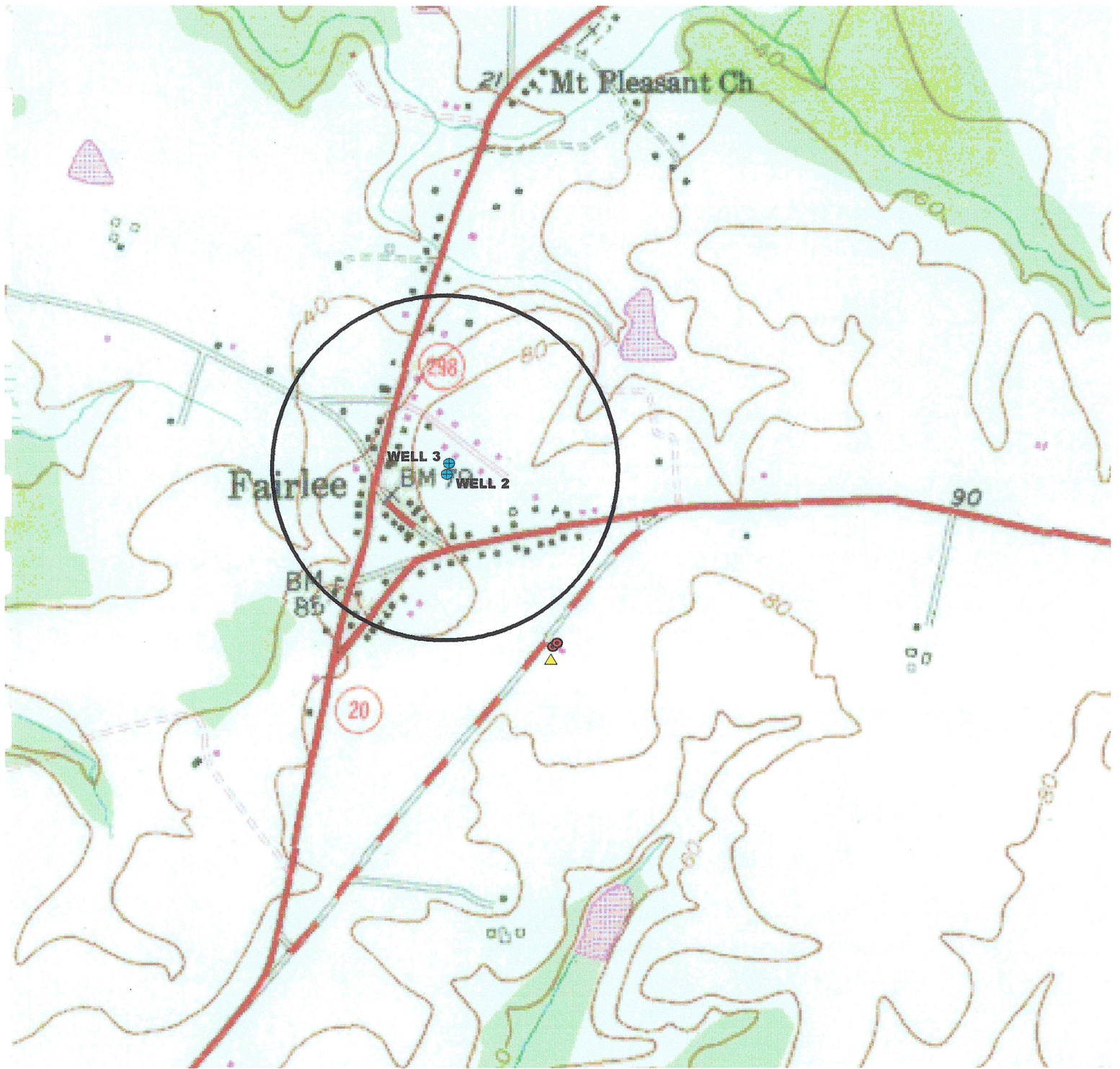
## REFERENCES

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- Earth Data Incorporated, 1992, Results of Drilling and Testing Production Well 3 Fairlee Water System, Kent County Sanitary District, Inc., 17p.
- Maryland Department of the Environment, Public Drinking Water Program, 1994, A Wellhead Protection Plan for the Town of Rock Hall, 9 p.
- Maryland Department of the Environment, Water Supply Program, 1999, Maryland's Source Water Assessment Plan, 36 p.
- Tompkins, M. D., Cooper, B. F., and Drummond, D. D., 1994, Ground-Water and Surface-Water Data for Kent County, Maryland: Maryland Geological Survey Basic Data Report No. 20, 155 p.
- United States Environmental Protection Agency, Office of Ground-Water Protection, 1987, Guidelines for Delineation of Wellhead Protection Areas.

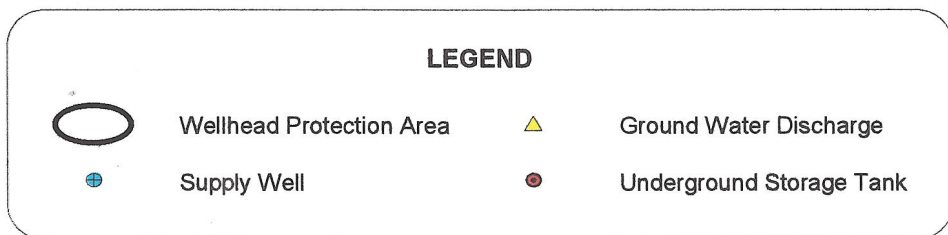
## SOURCES OF DATA

Water Appropriation and Use Permit No. KE 1979G104  
Public Water Supply Inspection Reports  
Monthly Operating Reports  
Monitoring Reports  
MDE Water Supply Program Oracle Database  
MDE Waste Management Sites Database  
Department of Natural Resources Digital Orthophoto Quarter Quad Rock Hall NE 4/8/94  
USGS Topographic 7.5Minute Quadrangle – Rock Hall  
Maryland Office of Planning 1997 Kent County Land Use Map  
Maryland Office of Planning 1995 Kent County Sewer Map

## FIGURES



**Figure 2. Fairlee Wellhead Protection Area with Potential Contaminant Sites**



1000 0 1000 Feet



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Base Map: USGS Topographic 7.5 Minute Quadrangle - Rock Hall, MD



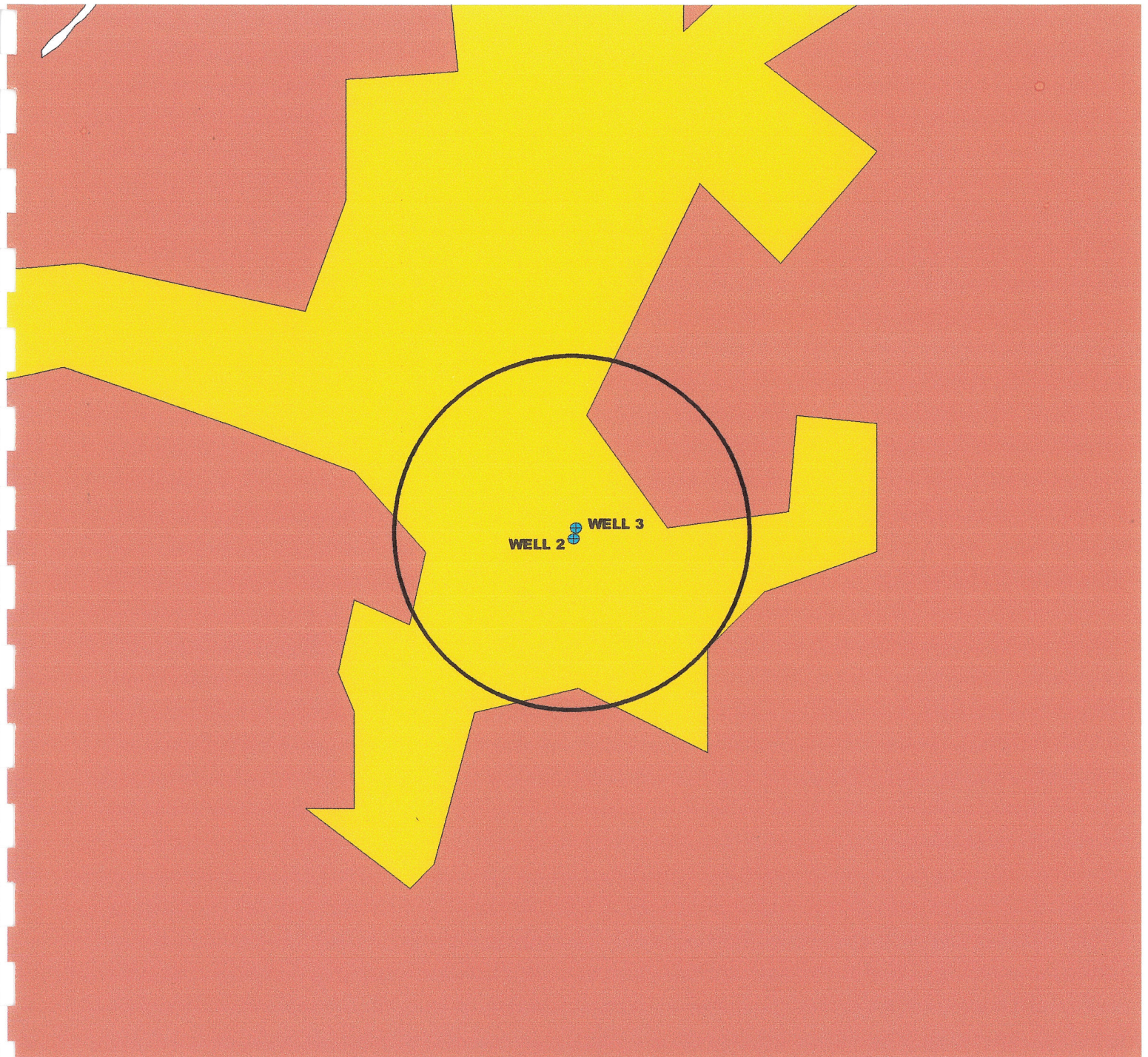
**Figure 3. Land Use Map of the Fairlee Wellhead Protection Area**

**LEGEND**





<b>Land Use</b>			
	Low Density Residential		Cropland
	Medium Density Residential		Forest
	Commercial		Wellhead Protection Area
			Supply Well



Source: MD Office of Planning 1997 Kent County Land Use Map



**Figure 4. Sewer Service Map of the Fairlee Wellhead Protection Area**

Sewer Service Categories		LEGEND	
	No Planned Service		Wellhead Protection Area
	Existing Service		Supply Well



Source: MD Office of Planning 1995 Kent County Sewer Map