



Final

Source Water Assessment

for the

Chesapeake Estates Mobile Home Park Water System

Cecil County, Maryland

Prepared for:

Maryland Department of the Environment
Water Management Administration
Water Supply Program
1800 Washington Boulevard, Suite 625
Baltimore, Maryland 21230-1719

Prepared by:

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May 2003

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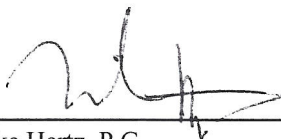
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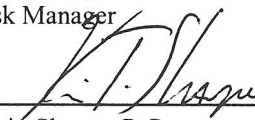
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1	Well information.

LIST OF ACRONYMS AND ABBREVIATIONS

AST	Aboveground Storage Tank
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CHS	Controlled Hazardous Substances
COMAR	Code of Maryland Regulations
DWEL	Drinking Water Equivalent Level
ft	Foot/Feet
gal	Gallon(s)
gpd	Gallon(s) Per Day
GPS	Global Positioning System
GWUDI	Ground Water Under Direct Influence
IOC	Inorganic Compound
L	Liter(s)
LUST	Leaking Underground Storage Tank
MCL	Maximum Contaminant Level
MDE	Maryland Department of the Environment
MGS	Maryland Geological Survey
MHP	Mobile Home Park
PCB	Polychlorinated Biphenyls
PWSID	Public Water System Identification
SDWA	Safe Drinking Water Act
SDWR	Secondary Drinking Water Regulations
SOC	Synthetic Organic Compound
SWAP	Source Water Assessment Plan
SWPA	Source Water Protection Area
µg	Microgram(s)
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WHPA	Wellhead Protection Area

EXECUTIVE SUMMARY

EA Engineering, Science, and Technology was tasked to perform a Source Water Assessment for the Chesapeake Estates Mobile Home Park (MHP) water system in Cecil County, Maryland. This water system is identified as Public Water System Identification (PWSID) 0070211 by the Maryland Department of the Environment (MDE). EA has performed this study under Purchase Order No. U00P3200205, as authorized by the MDE.

The required components of this report as described in Maryland's Source Water Assessment Plan (SWAP) are:

- Delineation of the area that contributes water to the source
- Identification of potential sources of contamination
- Determination of the susceptibility of the water supply to contamination
- Recommendations for protecting the drinking water supply

The source of the Chesapeake Estates MHP's water supply is the Patuxent Formation, which is a confined unconsolidated Coastal Plain aquifer. The Source Water Protection Area (SWPA) for the one supply well was delineated using the volumetric equation as approved by the U.S. Environmental Protection Agency (USEPA) for confined aquifer wells. Using the equation, the SWPA is a circle with a radius of approximately 340 ft (10.1 acres).

Potential point and non-point sources of contamination within the assessment area were identified based on site visits, a review of MDE's databases, and a review of sewer service area and land use maps. Heating oil tanks, septic systems, potential polychlorinated biphenyl (PCB) containing electricity transformers, and pastures were observed within the SWPA. However, these contaminant sources are most likely not a concern as an overlying confining layer naturally protects the ground water aquifer. Well information and water quality data were also reviewed.

The susceptibility analysis for the Chesapeake Estates MHP's 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 Chesapeake Estates MHP's water supply is moderately susceptible to microbiological contaminants and has a low susceptibility to volatile organic compounds, synthetic organic compounds, inorganic compounds, and radiological contaminants.

Recommendations to protect the ground-water supply include conducting raw water ground water under the direct influence (GWUDI) of surface water sampling to assess whether surface water is infiltrating into the aquifer and affecting ground-water quality.

1. INTRODUCTION

EA Engineering, Science, and Technology was tasked to perform a Source Water Assessment for the Chesapeake Estates Mobile Home Park (MHP) water system in Cecil County, Maryland. EA has performed this study under Purchase Order No. U00P3200205, as authorized by the Maryland Department of the Environment (MDE).

The Chesapeake Estates MHP water system serves the Chesapeake Estates MHP in Cecil County. The water treatment plant and the supply well for the system are located within the development. The Chesapeake Estates MHP's water system serves a population of 159 with 55 connections. The water is supplied by one well (Figure 1).

1.1 GROUND-WATER SUPPLY SYSTEM INFORMATION

A review of the well data and sanitary surveys of the system indicates that the well was drilled prior to 1973, and therefore it is unknown whether the well was drilled in accordance with the State's current well construction standards, which were implemented in 1973. The production well was completed approximately 2 ft above grade. The well was observed secure and in good repair. However, no concrete pad or collar was observed around the well. The well has a yield of 11,200 gallons per day (gpd). Table 1 contains a summary of the well construction data.

TABLE 1. WELL INFORMATION

Source ID	Source Name	Permit No.	Total Depth (ft)	Casing Depth (ft)	Aquifer
01	Well 1	CE680110	285	Unknown	Patuxent Formation

Currently, the raw ground water is treated with sodium carbonate (soda ash) for corrosion control, sodium hypochlorite (bleach) for disinfection and water softeners for iron removal. The finished water is stored in four approximately 100-gal bladder tanks and an approximately 100-gal retention tank prior to distribution.

According to the MDE Public Water Supply Inspection Report for the water system dated May 2002, the operator of the water system is Terry L. Farmer.

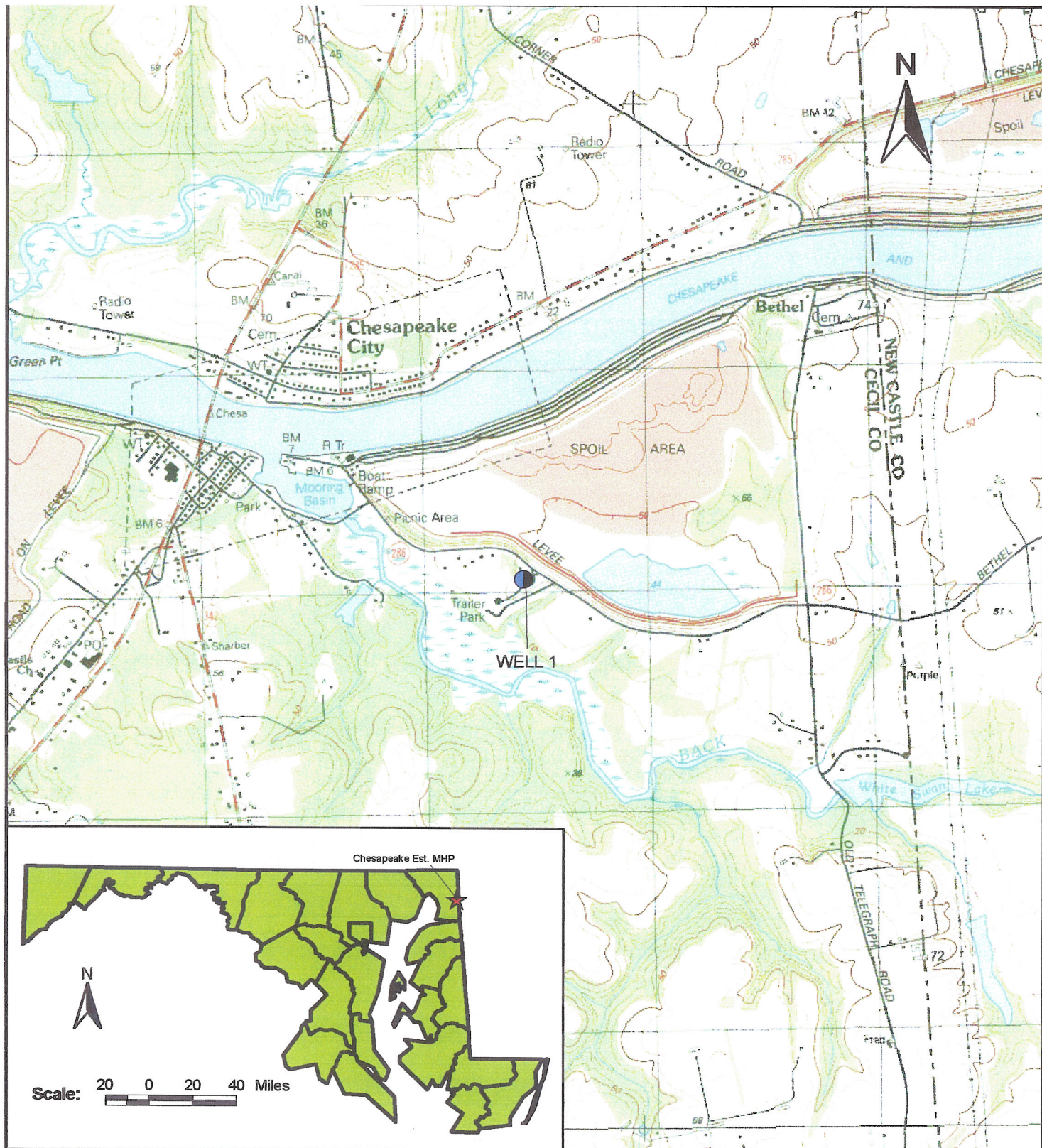
1.2 HYDROGEOLOGY

Cecil County has two distinct types of physiographic provinces, the Piedmont and the Atlantic Coastal Plain, divided by the Fall Line. In the northern third of the county, Precambrian to early

Paleozoic crystalline igneous and metamorphic rock of the Piedmont province is exposed at the surface. In the southern two-thirds of the county, the crystalline rocks are overlain by Coastal Plain deposits consisting largely of unconsolidated pebbly sand, sand, sandy clay, and clay. The deposits form a wedge-shaped mass of materials that range in thickness from inches along the Fall Line to as much as 1,600 ft in the southeastern corner of the County (Overbeck et al. 1958).


The ground water used by the Chesapeake Estates MHP is from a production well drilled into the Patuxent Formation of the Coastal Plain province. The Patuxent Formation is described as “white or light gray to orange-brown, moderately sorted, cross-bedded, argillaceous, angular sands and subrounded quartz gravels with subordinate silts and clays, predominately pale gray” [Maryland Geological Society (MGS) 1968].

The source of the ground water in Cecil County is from precipitation in the form of rainfall or snow melt. The ground water in the unconsolidated sediment of the Coastal Plain resides in between the grains of the unconsolidated sediment. The aquifer that supplies Chesapeake Estates MHP’s drinking water is a confined aquifer. A confined aquifer is naturally protected by relatively overlying impermeable silts and clays. These impermeable layers can prevent direct surface water infiltration. Only direct injection into the aquifer such as underground injection wells, improperly abandoned wells, or poor well construction could allow a potential contaminant to infiltrate into the aquifer, except in areas that contain outcrops of the aquifer, where recharge could occur (Otton et al. 1988).



**Figure 1. Chesapeake Estates MHP
Location Map of Supply Wells
Source Water Assessment Program
2003**

Legend:
 MHP Well

Scale:
 1000 0 1000 2000 Feet

Source: United States Geologic Survey. 1992. 7.5-minute Series Map for Elkton, Maryland.



2. DELINEATION OF THE AREA CONTRIBUTING WATER TO SOURCE

For ground water systems, a Wellhead Protection Area (WHPA) is considered to be the Source Water Protection Area (SWPA) for the system. Consistent with the recommended delineation in the Maryland SWAP (MDE 1999) for a confined aquifer system, a volumetric equation for a 10-year time-of-travel methodology was used. The volumetric equation is:

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

where:

- r = calculated fixed radius (ft)
- Q = pumping rate of the well (ft³/year)
- t = time of travel (year)
- n = aquifer porosity (unitless)
- H = length of well screen (ft)

The current Water Appropriation Permit rate issued by the MDE Water Rights Division (11,200 gpd or 546,542 ft³/year) was used as the pumping rate (Q) for the Chesapeake Estates MHP supply well.

Time of travel (t) for this equation is predetermined to be 10 years.

Aquifer porosity was assumed to be 0.30.

The length of the well screen (H) is unknown as no well construction information is available at the Cecil County Health Department, in U.S. Geological Survey (USGS) publications, or in MDE well construction databases. Therefore, for a conservative estimate in an unconsolidated formation such as the Patuxent Formation, a screen length of 50 ft was chosen.

Using the assumed values above, the calculated fixed radius for the SWPA is approximately 340 ft, which is 10.1 acres in area (Figure 2).

3. INVENTORY OF POTENTIAL CONTAMINANTS WITHIN THE DELINEATED AREA

A field survey was performed on 6 November 2002 to confirm potential sources of contamination around the ground-water wells identified in MDE databases. These databases include the Comprehensive Environmental Response, Compensation, and Liability Act Information System (CERCLIS), which includes National Priority List (Superfund) sites, Maryland Registered Underground Storage Tank (UST) sites, Maryland Leaking Underground Storage Tank (LUST) sites, landfills, pesticide dealers, ground-water discharge permits, colonial tanks, and Controlled Hazardous Substances (CHS) generator sites.

During the field survey, other sources of potential contamination not in the MDE databases were noted and the location was surveyed using a Global Positioning System (GPS) for mapping purposes (Figure 2).

3.1 POINT SOURCES

Approximately three pole-mounted electrical transformers were identified at the Chesapeake Estates MHP. Prior to 1977, many transformers contained polychlorinated biphenyls (PCB) as an insulator. If the transformer leaks, the PCB oil may eventually leach through the soil overburden into the ground-water aquifer.

Several 275-gal aboveground residential heating oil tanks (ASTs) were observed throughout the development. Failure of an AST may impact the ground water with petroleum hydrocarbons.

Septic system drain fields were observed onsite. Septic system discharge could contain contaminants if there is insufficient treatment of biological contaminants such as coliforms and inorganic compounds such as nitrogen. Septic system discharge could also contain contaminants that the systems were not designed to treat, such as solvents and fuels.

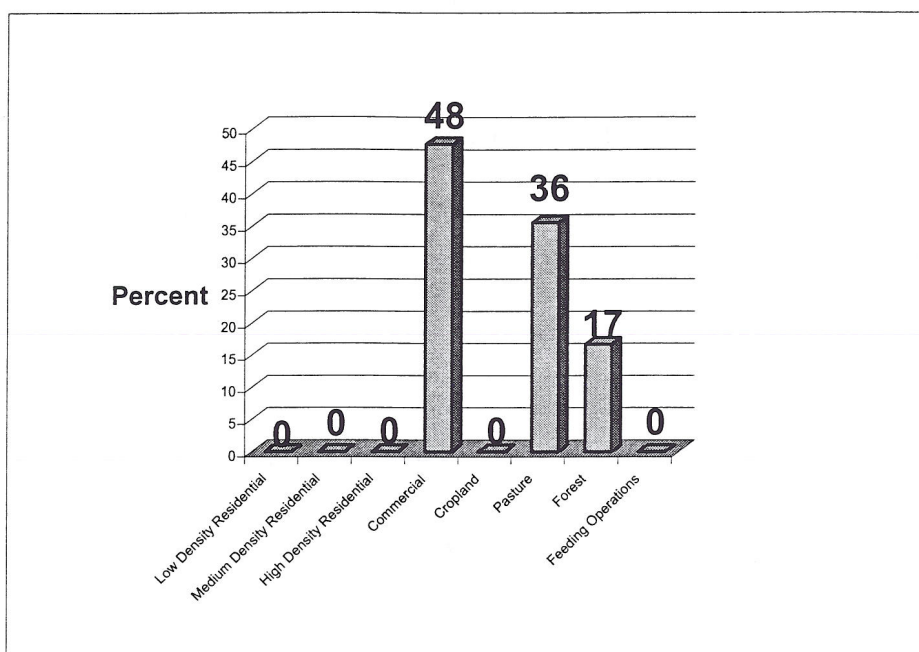
While the aquifer is generally protected from these sources identified in the SWPA, any releases of contaminants at the surface expression of the confined aquifer could be transported and impact the ground water quality.

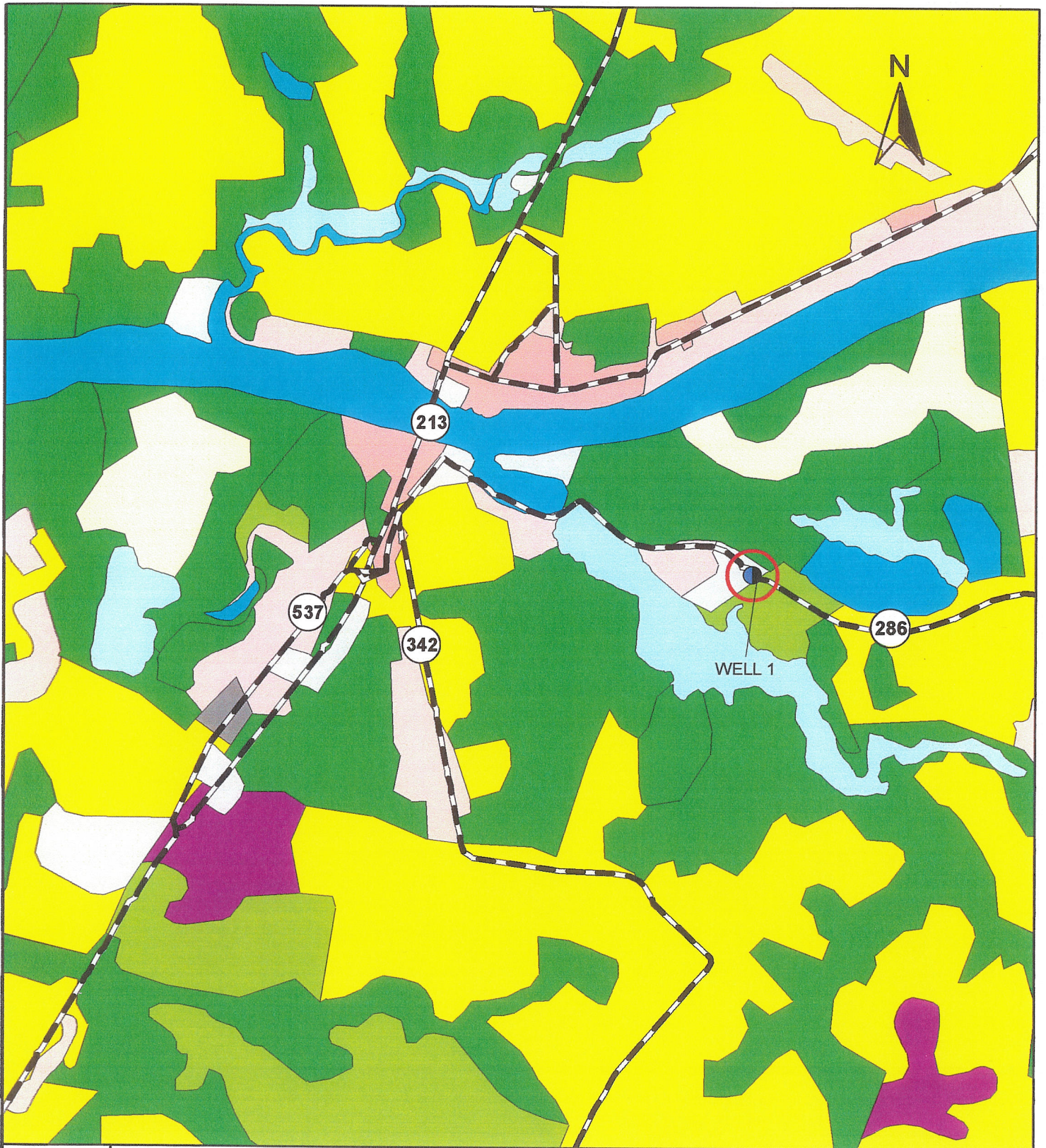
3.2 NON-POINT SOURCES

While the aquifer is generally protected from these non-point sources identified in the SWPA, any releases of contaminants at the surface expression of the confined aquifer could be transported and impact the ground water quality.

Using the Maryland Office of Planning's 2000 Land Use/Land Cover map for Cecil County, potential non-point sources within the SWPA were also evaluated by land use designation (Figure 3). A summary of the percent and acreage of each type of land use is presented in the graphs below.

PERCENTAGE OF EACH LAND USE TYPE





**Figure 3. Chesapeake Estates MHP
Land Use Map of the
Source Water Protection Area
Source Water Assessment Program
2003**

Legend:

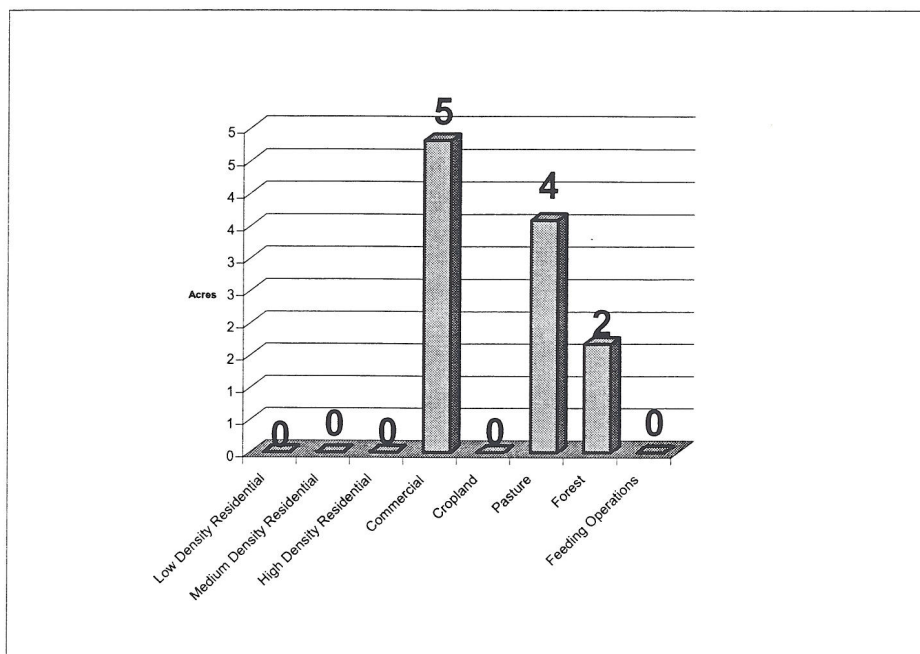
- MHP Well
- SWPA Boundary
- Major Roads
- Cropland
- Pasture
- Forest
- Water
- Wetlands
- Feeding Operations
- Low Density Residential
- Barren Land
- Medium Density Residential
- Commercial

Scale: 1000 0 1000 2000 Feet



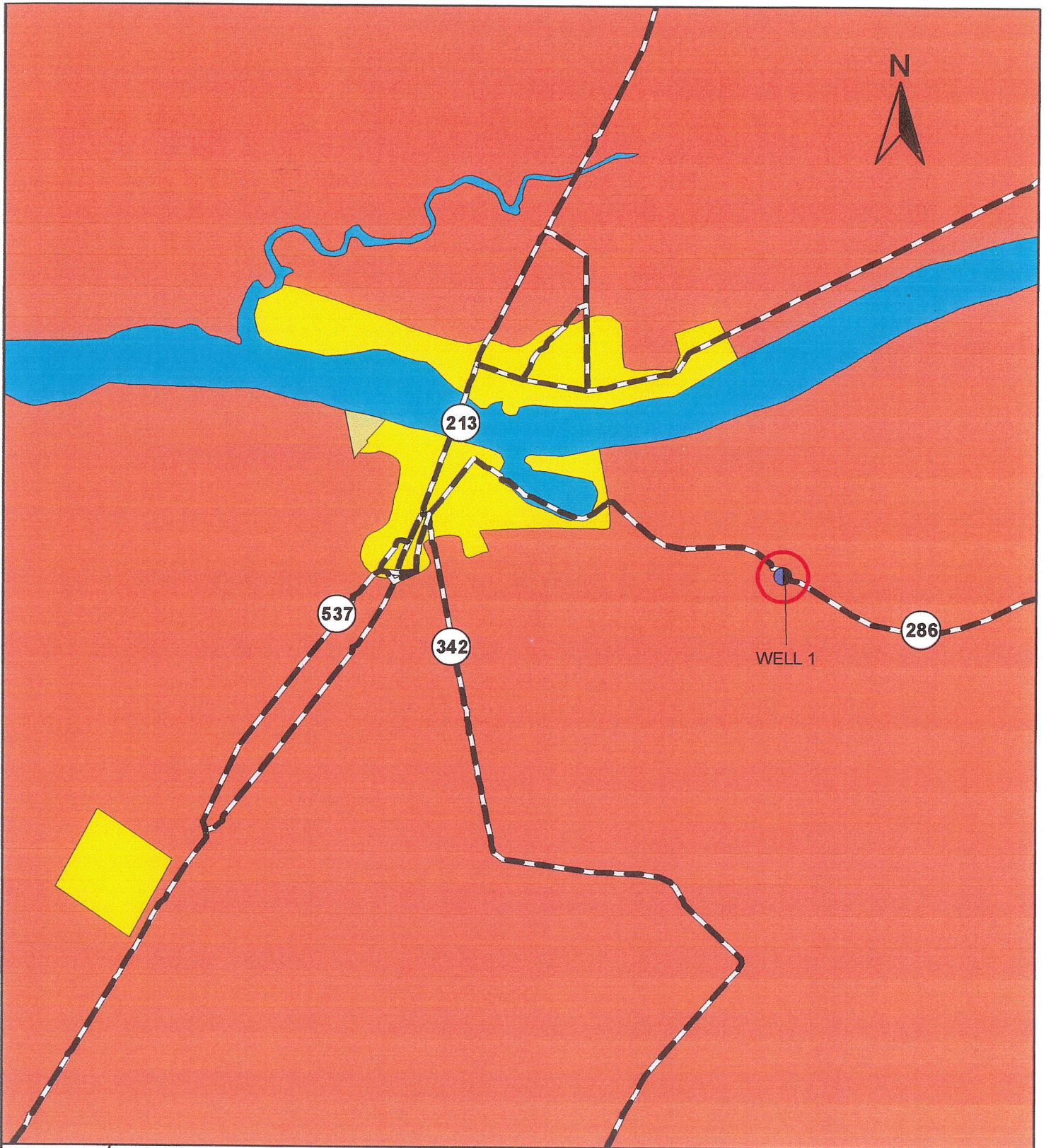
Source: Maryland Office of Planning, 2000.

ACREAGE OF EACH LAND USE TYPE



From an interpretation of the graphs above, pasture (3.6 acres) accounts for a significant portion of the SWPA (10.1 acres). Excessive animal waste in pasture areas can be a source of nitrate pollution in ground water. However, since Chesapeake Estate MHP's ground-water supply is from a confined aquifer, non-point sources will have little to no impact on the ground-water quality.

Using the 1993 Maryland Office of Planning's Cecil County sewerage coverage, potential non-point sources from other septic system users in the SWPA were assessed (Figure 4). By overlaying the SWPA on the sewerage coverage layer in ArcView GIS, it was determined that 100 percent of the SWPA does not have public sewer service nor is planned for service for at least 10 years.



**Figure 4. Chesapeake Estates MHP
Sewer Service Map of the
Source Water Protection Area**

Source Water Assessment Program
2003



Legend:

- | | |
|---------------|--------------------------------------------|
| MHP Well | Sewer |
| SWPA Boundary | No planned service area |
| Major Roads | Existing service area |
| | Area programmed for service within 5 years |
| | Water |

Scale: 1000 0 1000 2000 Feet

Source: Maryland Office of Planning, 1993.

4. REVIEW OF WATER QUALITY DATA

Water quality data was obtained from the MDE Water Supply Program database of Safe Drinking Water Act (SDWA) contaminants. The results reported are for finished (treated) ground water (unless noted).

A review of the water quality data from 1991 to 2002 has been performed for Chesapeake Estates MHP's finished water samples. All detected compounds from ground-water samples collected are shown in Appendix A.

Ground-water analytical results were compared to 50 percent of the United States Environmental Protection Agency (USEPA) Maximum Contaminant Levels (MCLs) or the USEPA Secondary Drinking Water Regulations (SDWR). If no MCL or SDWR is available, the Drinking Water Equivalent Level (DWEL) was substituted as recommended by the USEPA Office of Water.

4.1 GENERAL WATER QUALITY PARAMETERS

No general water quality parameters were reported in the ground-water samples above 50 percent of the comparison criteria.

4.2 VOLATILE ORGANIC COMPOUNDS

No volatile organic compounds (VOCs) were reported in the ground-water samples collected and analyzed.

4.3 SYNTHETIC ORGANIC COMPOUNDS

No synthetic organic compounds (SOCs) were reported in the ground-water samples above 50 percent of the USEPA MCL.

One SOC was reported in water samples collected. Dalapon, a herbicide, was reported in the February 1999 water sample with a concentration of 0.15 µg/L. The current MCL for dalapon is 200 µg/L.

4.4 INORGANIC COMPOUNDS

No inorganic compounds (IOCs) were reported in the ground-water samples above 50 percent of the USEPA MCL. The only IOCs reported in the samples include barium, sodium and sulfate.

4.5 MICROBIOLOGICAL CONTAMINANTS

Monthly ground-water sampling and analysis is performed for total and fecal coliform bacteria. Total coliforms is an analysis specified under the National Primary Drinking Water Regulations.

One routine water sample submitted for analysis in May 1998 was reported to contain both total and fecal coliform bacteria. However, four repeat ground-water samples collected and analyzed did not contain total or fecal coliform bacteria.

Another routine water sample submitted for analysis in May 2000 was reported to contain total coliform bacteria. No fecal coliform was reported in this sample. Three of the four repeat samples collected and submitted for analysis were reported to contain total coliform bacteria.

No other samples collected monthly since January 1997 through August 2002 were reported to contain coliform bacteria.

Since the ground water supplied to the Chesapeake Estates MHP is from a confined aquifer, the confining layers may naturally protect the aquifer from vertical migration of contaminants. Therefore, MDE does not require an assessment of Ground Water Under the Direct Influence (GWUDI) of surface water.

4.6 RADIONUCLIDES

No radionuclides were reported from the ground-water sample analyses. No data was available for radon-222.

5. SUSCEPTIBILITY ANALYSIS

To evaluate the susceptibility of the ground-water source to contamination, the following criteria were used:

1. available water quality data
2. presence of potential contaminant sources in the SWPA
3. aquifer characteristics
4. well integrity
5. the likelihood of change to the natural conditions

The aquifer that supplies Chesapeake Estates MHP's drinking water is a confined aquifer. A confined aquifer is naturally protected by relatively overlying impermeable silts and clays. These impermeable layers can prevent direct surface water infiltration. Only direct injection into the aquifer from point sources within the SWPA such as underground injection wells, improperly abandoned wells, or poor well construction could allow a potential contaminant to infiltrate into the aquifer.

For the Susceptibility Analysis in this report, rankings of "high," "moderate," and "low" susceptibility to contamination were utilized after a review of current information. However, other SWAP reports for the State of Maryland also utilized rankings of "is," "may be," and "is not" susceptible to contamination. For consistency between the ranking systems, the following details their equivalence. The ranking of "highly susceptible" is equivalent to "is susceptible," "moderately susceptible" is equivalent to "may be susceptible," and "low susceptibility" is equivalent to "is not susceptible."

5.1 VOLATILE ORGANIC COMPOUNDS

No VOCs have been reported in any of the water samples collected. The only potential source of VOCs is from the heating oil used in the mobile home park. However, No.2 fuel contains very little VOCs.

Based on the water quality data reviewed, the absence of any known sources or facilities that may cause VOC contamination in the SWPA, and the aquifer characteristics, the water supply at Chesapeake Estates MHP has a low susceptibility to VOCs.

5.2 SYNTHETIC ORGANIC COMPOUNDS

Only one SOC, dalapon, has been reported in any of the water samples collected, and was reported below the MCL.

Two point sources of SOCs were identified at the MHP and included heating oil tanks and potential PCB-oil containing electricity transformers. However, the ground-water aquifer is naturally protected by overlying confining layers. These confining layers generally prevent the downward migration of contaminants. In addition, SOCs have a high affinity to sorb to soil particles and low solubility and is not likely to infiltrate into the ground-water aquifer.

Based on the water quality data reviewed and the aquifer characteristics, the water supply at Chesapeake Estates MHP has a low susceptibility to SOCs.

5.3 INORGANIC COMPOUNDS

No IOC concentrations were reported above 50 percent of the MCL in the ground-water samples analyzed.

Based on the water quality data reviewed and the aquifer characteristics, the water supply at Chesapeake Estates MHP has a low susceptibility to IOCs.

5.4 RADIONUCLIDES

No radionulides were reported in the water samples collected and submitted for analysis. No radon-222 data is available to date for this system.

Based on the water quality data reviewed and the aquifer characteristics, the water supply at Chesapeake Estates MHP has a low susceptibility to radionuclides.

5.5 MICROBIOLOGICAL CONTAMINANTS

Total coliform bacteria has been detected and confirmed during the repeat sampling and analysis for the May 2000 water samples.

Total coliforms are a group of closely related bacteria that are generally harmless. They are natural and common inhabitants of soil and surface water bodies. However, they are not generally found in ground water that is free of surface water or fecal contaminants (USEPA 2001). Therefore, if total coliforms are reported in water samples, there may be a direct pathway between surface water and the ground-water.

While a confined aquifer can naturally protect a water supply from surface contaminants, the well used at Chesapeake Estates MHP was constructed prior to 1973. Therefore, the well may not be constructed to prevent the infiltration of surface water alongside of the well's casing into the aquifer.

Based on the water quality data reviewed, the recent reported total coliforms, and the supply well construction, the water supply at Chesapeake Estates MHP has a moderate susceptibility to microbiological contaminants.

6. RECOMMENDATIONS FOR PROTECTING THE WATER SUPPLY

With the information contained in this report, Chesapeake Estates MHP has a basis for better understanding of the risks to its drinking water supply.

Recommendations for the protection of the ground-water supply are intended for the mobile home park owner and its residents. Specific management recommendations for consideration are listed below.

6.1 PROTECTION TEAM

The management of the mobile home park should be aware of the Source Water Protection Area limits and evaluate the possible effects to the quality of the ground water prior to building or making any changes.

The management of the mobile home park should also contact the owner of the electricity transformers observed onsite to assess whether they contain PCB oil.

6.2 PUBLIC AWARENESS AND OUTREACH

The Executive Summary of this report should be listed in the Consumer Confidence Report for the water system, and should also indicate that the report is available to the general public by contacting the MHP owner, the local library, or MDE.

6.3 MONITORING

The management of the mobile home park should continue to monitor the ground water for all SWDA contaminants as required by MDE.

Annual raw water sampling for microbiological contaminants is a good way to check the integrity of the well.

Due to the construction of the supply well, raw water GWUDI sampling should be performed to assess whether the surface water infiltrating into the aquifer was the cause of the reported total coliform in the May 2000 water sample.

6.4 CONTINGENCY PLAN

As required by the Code of Maryland Regulations (COMAR) 26.04.01.22, all water system owners are required to prepare and submit for approval a plan to provide safe drinking water under emergency conditions.

6.5 CHANGES IN USES

The management of the mobile home park should inform the Water Supply Program at MDE of any changes to pumping rates and when a change in the number of wells used is anticipated. Any changes to the pumping rate and/or the number of supply wells will affect the size and shape of the SWPA.

6.6 CONTAMINANT SOURCE INVENTORY UPDATES/INSPECTIONS

The management of the mobile home park should conduct its own survey of the SWPA to ensure that there are no additional potential sources of contamination.

A regular inspection and maintenance program of the supply well should be considered to prevent a failure in the well's integrity, which may provide a pathway for contaminants to the aquifer.

Depressions around the wellhead should be filled and graded to prevent surface water ponding that may occur during rain events. This will help to prevent surface water infiltration into the well.

A new concrete collar and pad around the wellhead should be considered to help protect the well from potential surface water infiltration along the casing.

7. REFERENCES

The following sources of information were consulted as a part of this investigation:

1. Maryland Department of the Environment (MDE), Water Supply Program. 1999. Maryland's Source Water Assessment Plan, 36 pp.
2. Maryland Geologic Survey (MGS). 1968. *Cecil County Geologic Map adapted from Maryland Geological Survey's Geologic Map of Maryland.*
3. Otton, E. G, R. E Willey, R. A McGregor, G. Achmad, S. N. Hiortdahl, J.M. Gerhart. 1988. *Water Resources and Estimated Effects of Ground-Water Development, Cecil County, Maryland.* United States Department of the Interior, Geologic Survey. Bulletin 34.
4. Overbeck, R.M., T.H. Slaughter, and A.E Hulme, 1958. *Water Resources of Cecil, Kent, and Queen Annes Counties.* Maryland Department of Geology, Mines and Water Resources Bulletin No. 21.
5. United States Environmental Protection Agency (USEPA). 1999. *Proposed Radon in Drinking Water Rule.* Office of Water. EPA 815-F-99-006. October.
6. United States Environmental Protection Agency (USEPA). 2001. *A Small Systems Guide to the Total Coliform Rule.* Office of Water. EPA 816-R-01-017A. June.

SOURCES OF DATA

Water Appropriation and Use Database
Public Water Supply Inspection Reports
Monitoring Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Maryland Office of Planning 2000 Cecil County Land Use Map
Maryland Office of Planning 1993 Cecil County Land Use Map
USGS Topographic 7.5 minute Quadrangle Map – 1992 Elkton, Maryland Quad

Appendix A

Detected Compounds in Ground-Water Samples

SUMMARY OF DETECTED COMPOUNDS IN CHESAPEAKE ESTATES MHP WATER SAMPLES				
Plant ID	Sample Date	Contaminant Name	Result	Unit
Synthetic Organic Compounds				
01	18-Feb-99	DALAPON	0.15	ug/L
Inorganic Compounds				
01	14-Sep-94	BARIUM	0.11	mg/L
01	13-Mar-00	SODIUM	26	mg/L
01	05-Dec-96	SODIUM	32.8	mg/L
01	14-Sep-94	SULFATE	6	mg/L
01	05-Dec-96	SULFATE	6.8	mg/L
General Water Quality Parameters				
01	05-Dec-96	pH	7.5	s.u.
Microbiological Contaminants				
NA	1-May-98	FECAL COLIFORM (ROUTINE)	Positive	NA
NA	1-May-00	TOTAL COLIFORM (ROUTINE)	Positive	NA
NA	1-May-00	TOTAL COLIFORM (REPEAT)	Positive	NA
NA	1-May-00	TOTAL COLIFORM (REPEAT)	Positive	NA
NA	1-May-00	TOTAL COLIFORM (REPEAT)	Positive	NA

s.u. – standard units.

NA – Not applicable