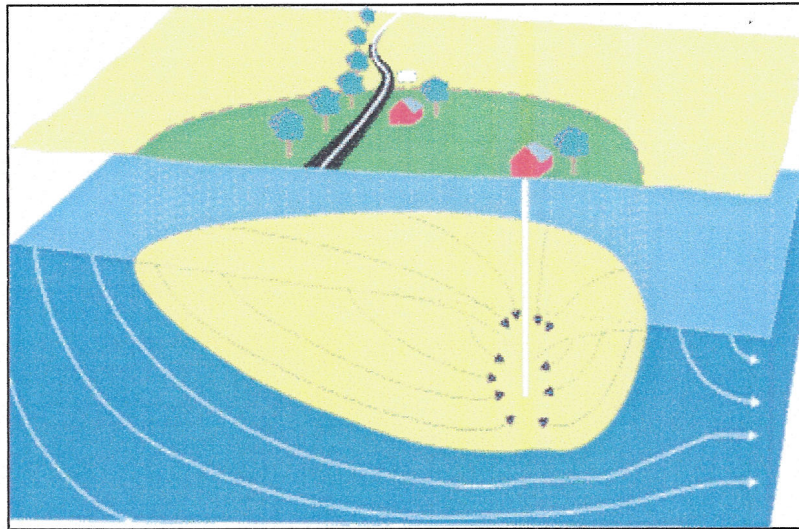


**SOURCE WATER ASSESSMENT
FOR LIBERTY MOBILE HOME PARK
CAROLINE COUNTY, MD**



**Prepared By
Water Management Administration
Water Supply Program
December, 2004**



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SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for the Liberty Mobile Home Park, a community water system in Caroline County. 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 Liberty Mobile Home water supply is an unconfined aquifer in the Coastal Plain known as the Columbia aquifer. One well is 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. Environmental Protection Agency (EPA).

Potential sources of contamination within the assessment areas were researched and identified based on MDE field inspections, a review of MDE's databases and land use maps. Well information and water quality data were also reviewed. Maps showing land uses and sewer service areas in Caroline County and an aerial photograph of the well location are enclosed at the end of the report.

The susceptibility analysis for the Liberty Mobile Home Park is based on a review of the existing water quality data, the presence of potential sources of contamination, aquifer characteristics, and well integrity. It was determined that the Liberty Mobile Home Park's water supply is susceptible to contamination by inorganic compounds, such as nitrate, and to radioactive compounds, such as radium. The system is not susceptible to volatile organic compounds, synthetic organic compounds or microbiological contaminants.

INTRODUCTION

The Water Supply Program (WSP) has conducted a Source Water Assessment for the Liberty Mobile Home Park, a community water system in Caroline County. Liberty Mobile Home Park is located at 410 Liberty Road, on its north side, just outside of the town of Federalsburg. Its water supply system is owned and operated by Mr. Lawrence Passwater who is also a property owner. The system serves 21 lots, though only 19 are being occupied, with the population fluctuating around 40. The water is supplied by one well in the Columbia aquifer. All mobile homes are served by individual on-site septic tanks and disposal areas.

WELL INFORMATION

A review of well completion report and sanitary surveys of the Liberty Mobile Home Park indicate that the well was drilled in July of 1973, the year of the implementation of the State's well construction regulations. The 4-inch well is 50 feet deep with the total depth of main casing of about 40 feet. This shallow well is well vented, has no screen, and is fitted with a jet pump. Its casing is at least one foot above land surface and is fitted with a cap. The well has a pitless adaptor connection, and is just outside of the building that houses a jet pump and two 80-gallon bladder tanks. There is a water meter on the 2-inch polyethylene distribution line. The well is assigned a permit number of CO-73-0102, though no well tag number is attached to the well. Liberty Mobile Home Park operates under the Water Appropriation and Use Permit (CO1973G003) since July of 1973. Based on a site visit, the well seems to be in good condition and appears to be regularly maintained, sealed, and protected to insure integrity. However, the general area around the pump house is overgrown, and needs to be cleared out and regularly maintained. There is no water treatment for this system, and each mobile home site has its own septic system. The supply well has an average yield of about 30 gallons per minute (gpm).

HYDROGEOLOGY

Liberty Mobile Home Park well obtains water from the unconfined Quaternary System Sediments or Columbia Aquifer (110C). The Columbia aquifer contains the youngest deposits on the Eastern Shore. Most of this formation is sand and gravel with some layers of silty clay and clay. These clay layers are broken and thin enough that true confining layers are not present, however, they do slow down the percolating water to some extent. Therefore high permeability and short flow paths are prevailing in the aquifer, which reduce the time available for mineral dissolution. The sand thickness of the Quaternary sediments ranges from 0 to 80 feet across Caroline County. However, these variations in the sand thickness are not necessarily in relation to changes in the elevation of the land. The quantity of water available from these sediments is very high but the water quality can vary dependant upon the local soil types and land use. Water quality impacts from farming and high-density development with on-site septic systems can lead to elevated nitrate levels. Residues of agricultural herbicides and pesticides are less common, but may be present in some wells. As expected in this shallow aquifer, the

water is fairly acidic. Low pH (ranging from 3.8 to 6.7) along with high iron is a concern in some areas where there is more clay and silt. In these areas the percolation rate is slower allowing iron to dissolve in the water. Some sources have levels of iron high enough that the water must be treated before using (DNR, 1987).

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. WHPA was delineated for the Liberty Mobile Home Park well utilizing a study between the United States Geologic Survey and MDE for small users, pumping <10,000 gpd, that have very little effect on the ambient ground water flow in certain unconfined aquifers. Using this information MDE created a wedge shape delineation area for uses under 10,000 gpd from unconfined aquifers, where the general direction of ground water flow is known. The wedge is based on an annual recharge of 1 ft and ground water flow directions. The wedge shape has an angle of 60 degrees that will extend against the ground water flow direction for a length of 1000-ft. The wedge was designed to compensate for uncertainties in ground water flow direction and to provide sufficient recharge area to balance a withdrawal of 10,000 gpd.

POTENTIAL SOURCES OF CONTAMINATION

Potential sources of contamination are classified into two types: point or non-point sources. Examples of point sources of contamination are leaking underground storage tanks, landfills, ground water discharge permits, feed lots, large scale feeding operations, and known ground water contamination 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 are associated with certain land use practices such as pesticide and herbicide applications, land application of sludge or animal wastes, on-site disposal of residential wastewater and row-crop farming, all of which may lead to ground water contamination over a large area. All of these potential sources of contamination are identified at the land surface and therefore have the potential to impact the shallow water table aquifer.

MDE Waste and Water Management databases were reviewed and a field inspection conducted to identify potential sources of contamination for this assessment. The field visit did not show any commercial land use within the wellhead protection area. A previous source of contamination is a former chicken farm located about 200 feet west and north of the Liberty Mobile Home Park's water supply well (Figure 1). Database search of Underground Storage Tank (UST) sites have not revealed any in the vicinity of the Liberty Mobile Home Park. UST sites are facilities that store petroleum on site in underground tanks registered with the MDE Waste Management Administration. Besides a former chicken farm, there are septic drain fields of the mobile homes within 200 feet from the well. Half of the mobile homes are heated by the natural gas and another half maintain above ground oil tanks, all of which are at least 150 feet or more from the well.

Based on the Maryland Office of Planning 2000 Land Use Map, five land use categories are identified within delineated WHPA: commercial, high density residential, low density residential, forest, and cropland (Table 1). Two predominant land uses are forest and low density residential (Figure 2).

LAND USE CATEGORIES	TOTAL AREA (acres)	PERCENTAGE OF WHPA
Low Density Residential	8.81	52.3
High Density Residential	0.86	5.1
Commercial	0.16	1.0
Cropland	0.56	3.3
Forest	6.44	38.3
Total	16.83	100

Table 1. Land Use Summary for the Wellhead Protection Area

A review of Maryland Office of Planning's Caroline County Sewer Map shows that most of the SWAP area has no planned sewer service (Table 2). As mentioned above, the mobile home park is served by on-site wastewater disposal, as are the other residential dwellings within the wellhead protection area. However, a very small portion of the delineated WHPA in the west is identified as undergoing final planning stages and having the sewer service being available in the nearest future (Figure 3).

SEWER SERVICE AREA	TOTAL AREA (acres)	PERCENTAGE OF WHPA
No Planned Service	15.42	91.4
Existing Service	0.15	1.0
Service within 2	1.26	7.6
Total	16.83	100

Table 2. Sewer Service Area Summary for the Liberty Mobile Home WHPA.

WATER QUALITY DATA

Water quality data was reviewed from the Water Supply Program's (WSP) 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 the MCL, this report will describe the sources of such a contaminant and, if possible, locate the specific sources that are the cause of the elevated contaminant level. Liberty Mobile Home Park does not treat its well water.

No Synthetic Organic Compounds (SOCs) or Volatile Organic Compounds (VOCs) have been detected in the Liberty Mobile Home's water supply at the quantities equal to or greater than 50% MCL.

A review of the monitoring data since 1993 for Liberty Mobile Home Park's water supply indicates that it meets the current drinking water standards. The water quality sampling results are summarized in Table 3.

Nitrate		SOCs		VOCs		IOCs (except nitrate)		Radionuclides	
No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL
39	31	3	0	12	0	6	0	4	3

Table 3. Total Water Quality Samples

Inorganic Compounds (IOCs)

A review of the data shows that the only inorganic compound detected above 50% of an MCL is nitrate (Table 1). Nitrate has been routinely detected during water testing in quantities exceeding MCL standard of 10 ppm. The range of values for nitrate detected between the years of 1995 and 2004 fluctuates from 6.71 ppm and 10.4 ppm with majority of samples falling in the 7 ppm to 9 ppm range.

CONTAMINANT NAME	MCL (ppm)	SAMPLE DATE	RESULT (ppm)
NITRATE	10	05-DEC-95	6.71
NITRATE	10	15-FEB-96	7.52
NITRATE	10	02-JAN-97	9.79
NITRATE	10	02-JAN-97	9.79
NITRATE	10	15-APR-97	9.18
NITRATE	10	12-JUN-97	10.4
NITRATE	10	20-JAN-98	7.4
NITRATE	10	22-SEP-98	8.82
NITRATE	10	03-DEC-98	8.6
NITRATE	10	19-JAN-99	7.5
NITRATE	10	13-APR-99	8.5
NITRATE	10	24-AUG-99	8
NITRATE	10	19-OCT-99	8
NITRATE	10	27-JAN-00	8.3
NITRATE	10	06-JUN-00	8.8
NITRATE	10	29-AUG-00	8.3
NITRATE	10	12-DEC-00	8.1
NITRATE	10	11-JAN-01	8.2
NITRATE	10	05-APR-01	7.7
NITRATE	10	10-JUL-01	8.5
NITRATE	10	02-OCT-01	8.9
NITRATE	10	08-JAN-02	8.4
NITRATE	10	16-APR-02	7.9
NITRATE	10	02-JUL-02	7.3
NITRATE	10	31-OCT-02	7.2
NITRATE	10	23-JAN-03	9.1
NITRATE	10	20-MAR-03	7.3
NITRATE	10	15-APR-03	8.1
NITRATE	10	03-JUL-03	7.5
NITRATE	10	09-OCT-03	7.4
NITRATE	10	08-APR-04	7.5

Table 4. Inorganic Compounds (Nitrates) above 50% of the MCL

Radionuclides

There is currently no MCL for radon-222, however EPA has proposed an MCL of 300 picoCuries per Liter (pCi/L) or an alternate of 4,000 pCi/L for community water systems if the state has a program to address the more significant risk from radon in indoor air. Regardless of the standard adopted, levels of radon detected at the Liberty Mobile Home Park are 130 pCi/L, which is less than 50% of even the more conservative standard of 300 pCi/L.

Radium-228 and Combined radium (226 & 228) were detected at levels above 50% MCL in samples taken in years 2000 and 2003 (Table 2). The MCL for these radionuclides is 5 pCi/L. In the year 2000 Radium-228 was detected at 3.44 pCi/L and Combined Radium (226 & 228) was detected at 4.46 pCi/L. In 2003 Combined Radium (226 & 228) was detected at 3.9 pCi/L (Table 1). No other radiological contaminants were detected at levels of concern.

CONTAMINANT NAME	MCL (pCi/L)	SAMPLE DATE	RESULT (pCi/L)
COMBINED RADIUM (226 & 228)	5	23-OCT-00	4.46
RADIUM-228	5	23-OCT-00	3.44
COMBINED RADIUM (226 & 228)	5	25-NOV-03	3.9

Table 5. Radionuclides above 50% of the MCL

Microbiological Contaminants

Routine bacteriological monitoring is conducted in the finished water for each community water system on a monthly basis and measures Total Coliform bacteria. Since Liberty Mobile Home Park does not use disinfection for treatment of its water supply, the bacteriological data gives some indication of the quality of raw water directly from the wells. Total Coliform bacteria are not pathogenic, but are used as an indicator organism for other disease-causing microorganisms. Since 1997 Liberty Mobile Home Park has conducted routine bacteriological sampling 93 times, but no samples had any detections of Total Coliform bacteria.

SUSCEPTIBILITY ANALYSIS

Well serving Liberty Mobile Home Park obtains water from an unconfined aquifer. The unconfined aquifer wells are in general more susceptible to contamination from surface activities. For example, the use of fertilizers in the golf courses, residential lawns, and agricultural fields may all be contributing factors for elevated nitrate levels in the WHPA.

The susceptibility of the source water to contamination is determined for each group of contaminants based on the following criteria: 1) the presence of natural and anthropogenic contaminant sources within the WHPA; 2) water quality data; 3) well integrity; and 4) the aquifer conditions.

The susceptibility analysis is based on current conditions and sample results. If changes occur within the WHPA or sample results for a system change, the system's susceptibility could change. Some common changes that may occur resulting in changes to a well's susceptibility are land use changes within the WHPA, an underground storage tank starting to leak, the well becomes damaged, or changes in uses of local wells completed in the same aquifer. Table 6 summarizes the susceptibility of Liberty Mobile Home Park's water supply to the various contaminants.

Inorganic Compounds (IOCs)

Nitrate has been detected in the Liberty Mobile Home Park water supply. The levels of nitrate have been consistently above 50% of the MCL and there has been no pattern of any increase or decrease with time. Sources of nitrate can generally be traced to land use. Fertilization of agricultural fields and residential lawns, and on-site septic systems are common non-point sources of nitrate in ground water.

The high nitrate levels in the Liberty Mobile Home Park's water supply could be attributed to the close proximity of the former chicken farm. In October of 1987 Townsend chicken operation had been charged with violation and an order to remove their manure pile stored approximately 300 feet away from the nearest trailer in Liberty Mobile Home Park. Another likely source of high nitrate levels is the large number of on-site septic systems in the vicinity of the well. Based on the above discussion, Liberty Mobile Home Park's water supply is susceptible to nitrate, but not to the other IOCs,

Radionuclides

Some contaminants like radionuclides are naturally occurring in the aquifer. The source of radionuclides in ground water can be traced back to the natural occurrence of uranium in rocks. Radionuclides are present in ground water due to radioactive decay of uranium bearing minerals in the sediment that makes up the aquifer material.

Liberty Mobile Home Park **may be** susceptible to Combined Radium (226 & 228) due to the presence of this contaminant in 2000 and 2003 water samples.

Synthetic Organic Compounds (SOCs)

No SOC's have been detected in the Liberty Mobile Home Park water supply. Therefore, this system is **not** susceptible to SOC contamination.

Volatile Organic Compounds (VOCs)

Since no VOC have been found in the Liberty Mobile Home Park's water supply, it is **not** susceptible to these contaminants.

Microbiological Contaminants

Ground water is generally thought to be not susceptible to contaminants by pathogenic microorganisms due to the natural filtration ability of soil and aquifer material. There is about 300 feet between the water supply well and the nearest on-site septic system. Based on coliform sampling data and the aquifer characteristics, the Liberty Mobile Home

Park's water supply is **not** susceptible to bacterial or protozoan contaminants present on the surface, including Giardia and Cryptosporidium.

CONTAMINANT TYPE	Are Contaminant Sources present in the WHPA?	Are Contaminants detected in WQ samples at 50% of the MCL?	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible to the Contaminant?
Nitrate	YES	YES	NO	YES	YES
Inorganic Compounds (except nitrate)	NO	NO	NO	YES	NO
Volatile Organic Compounds	NO	YES	NO	YES	NO
Synthetic Organic Compounds	NO	NO	NO	YES	NO
Radionuclides	YES*	YES	NO	YES	YES
Microbiological Contaminants	NO	NO	NO	NO	NO

Table 6. Susceptibility Chart for Liberty MHP's Water Supply

*naturally occurring

MANAGEMENT OF THE SOURCE WATER ASSESSMENT AREA

This report recognizes the importance of maintaining the integrity of the water supply system at Liberty Mobile Home Park. The report also identified specific area (SWAP area) immediately surrounding the water supply well as one that has the greatest potential to influence the quality of the water supply. On-site septic systems are the active threats present within the wellhead protection area. The owner of Liberty Mobile Home Park water system is in a position to protect this water supply by staying aware of the areas delineated for source water protection and evaluating future development and land use planning. Specific management recommendations for consideration are listed below.

- The Consumer Confidence Report should list that this report is available to the general public through their county library, or by contacting MDE.
- Providing the Mobile Home Park residents with the information on the proper use and protection of their on-site wastewater disposal.
- The sanitary integrity of the water supply system must be maintained. Sanitary defects noted in county sanitary surveys should be corrected. All work on the water system should be performed in a sanitary manner and followed with a one-time disinfection.
- Installing new two-piece well caps is a good way to reduce potential contamination from insects. Caulking of the electrical conduit is needed to ensure a sanitary seal.

- Continue SDWA required monitoring for VOCs, nitrate, other IOCs, SOC's and radiological contaminants.
- Should the nitrate levels in the future rise above MCL of 10 ppm, the owner should consider drilling a new water supply well into a deeper confined aquifer or connecting to the town of Federalsburg's water distribution system.
- Annual sampling for microbiological contaminants is a good check on well integrity.
- Any increase in pumpage or addition of new wells to the system may require revision of the WHPA. The system is required to contact the Water Supply Program when an increase in pumpage is applied for or when new wells are being considered.
- Periodic inspections and a regular maintenance program for the supply well will ensure its integrity and protect the aquifer from contamination.
- All water system owners should have a Contingency Plan for their 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.

REFERENCES

Maryland Department of the Environment (MDE), Water Supply Program, 1999, Maryland's Source Water Assessment Plan.

Maryland Department of Natural Resources (DNR), 1987, The Quantity and Natural Quality of Ground Water in Maryland: DNR Water Resources Administration.

Maryland Geological Survey Report of Investigations No. 40, 1984, by Bachman, J.L. and J.M. Wilson, The Columbia Aquifer of the Eastern Shore of Maryland, Part 1 Hydrogeology, 144 pp.

Other Sources of Data

Water Appropriation and User Permits
Caroline County Sanitary Survey Inspection Reports
MDE Water Supply Program (PDWIS) Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles
USGS Topographic 7.5 Minute Quadrangles
Maryland Office of Planning 2000 Caroline County Land Use Map
Maryland Office of Planning 1996 Caroline County Sewer Map
ADC Maps of Caroline County
SpecPrint Tax Maps of Caroline County
Maryland Department of Assessments and Taxation Real Property Database

FIGURES

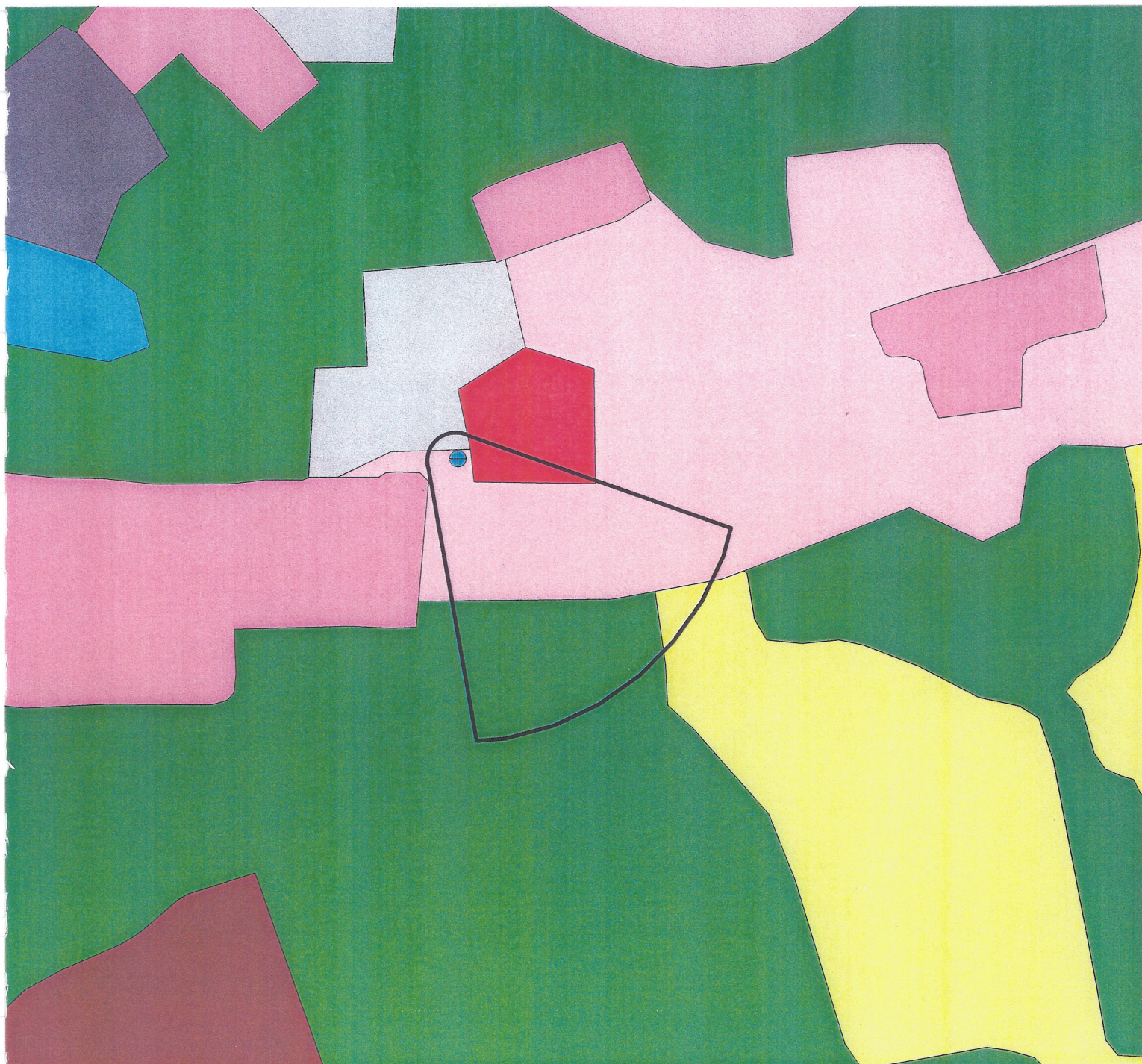
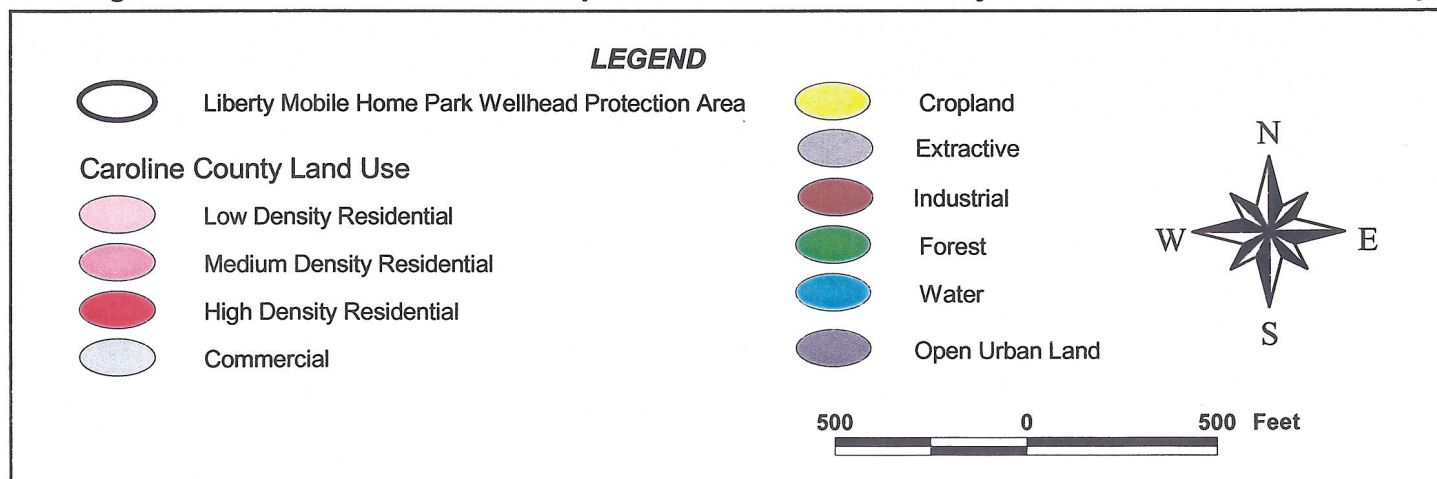


Figure 2: Land Use in the wellhead protection area of the Liberty Mobile Home Park and vicinity



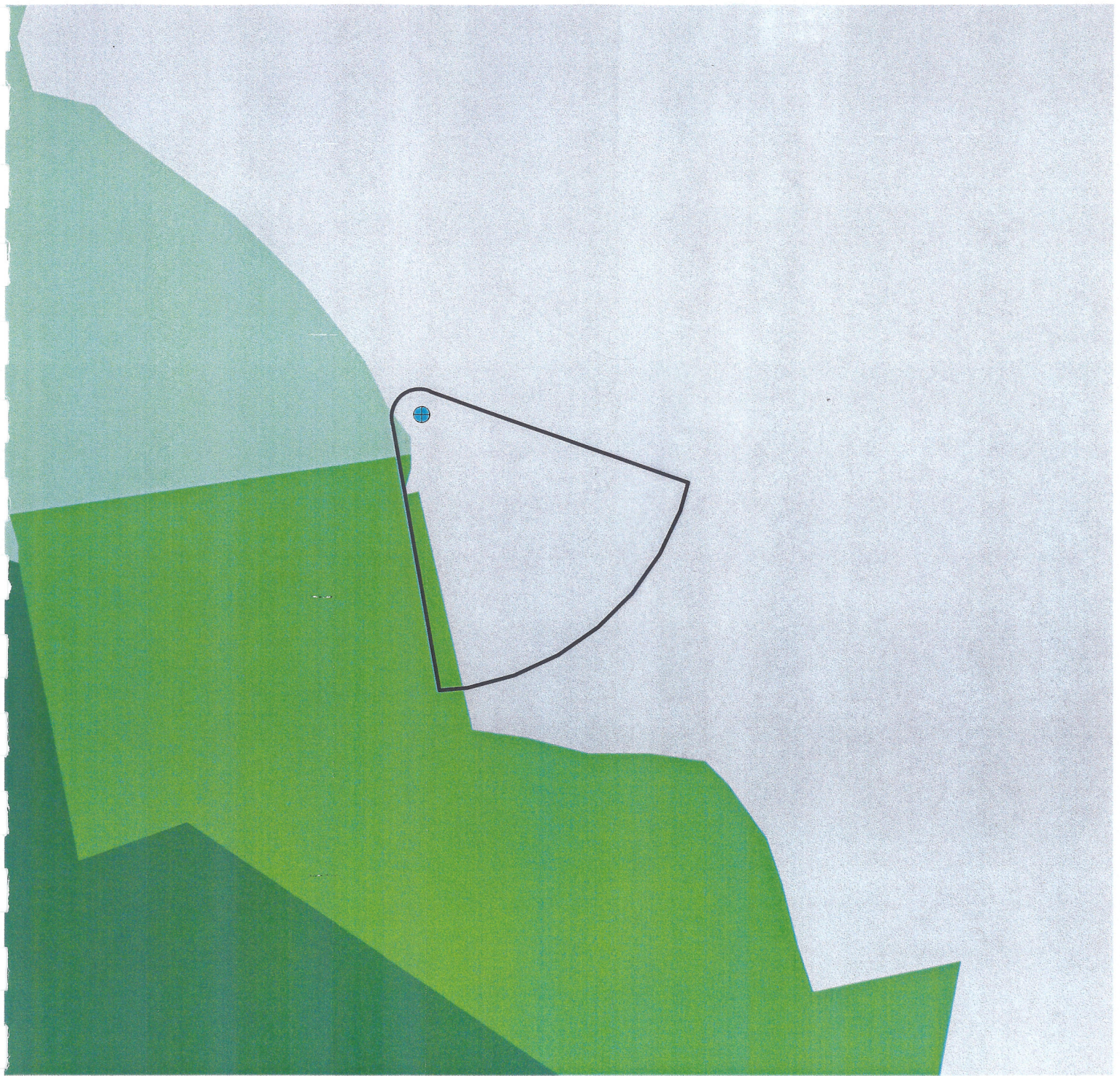


Figure 3: Liberty Mobile Home Park WHPA with Sewerage Coverage Map

LEGEND

-  Supply Well
-  Liberty Mobile Home Park Wellhead Protection Area
- Caroline County Sewer Coverage**
 -  no planned service
 -  existing system
 -  final planning stages
 -  service within 2 years

