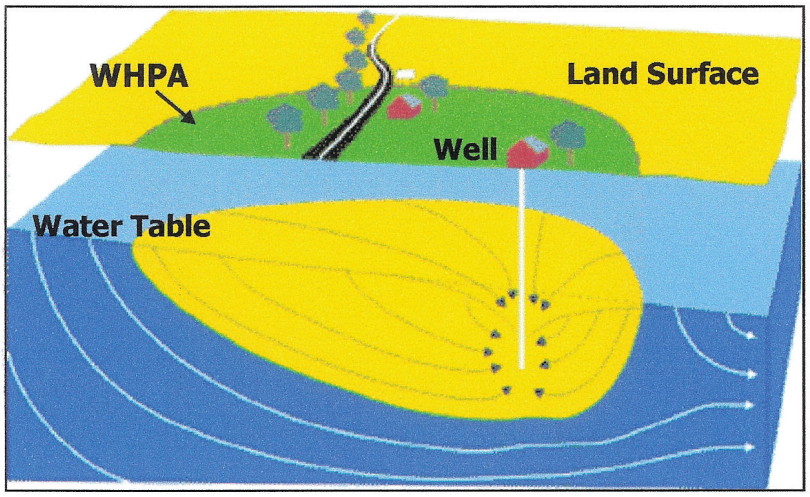
SOURCE WATER ASSESSMENT

FOR THE TOWN OF VIENNA

DORCHESTER COUNTY, MD



Prepared By
Maryland Department of the Environment
Water Management Administration
Water Supply Program
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MDE

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SUMMARY

The Maryland Department of the Environment Water Supply Program (WSP) has conducted a Source Water Assessment for the Town of Vienna. The required 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) 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 for the Town of Vienna's water supply is a shallow, unconfined aquifer in the Coastal Plain known as the Pleistocene aquifer. The Town currently uses two wells to obtain their drinking water. The source water assessment area for the Town's wells was delineated by the WSP using a U.S. EPA approved method specifically designed for each source.

Potential sources of contamination within the assessment area were identified based on site visits, database reviews, and land use maps. Well information and water quality data were also reviewed. Figures showing land use and potential contaminant sources within the source water assessment area and an aerial photograph of the well locations are enclosed at the end of the report.

The susceptibility analysis of Vienna's water supply was based on the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. It was determined that Vienna's water supply is susceptible to contamination by nitrates, but is not susceptible to volatile organic compounds (VOCs), synthetic organic compounds (SOCs), radionuclides, and microbiological contaminants. Iron and manganese, naturally occurring constituents of the Pleistocene aquifer, are removed through filtration at the Water Treatment Plant.

INTRODUCTION

The Town of Vienna is located off MD Routes 50 and 331 just west of the Nanticoke River in Dorchester County. The meandering river is the divide between Dorchester County to the west and Wicomico County to the east. The Water Treatment Plant is located to the south of the Town along Elliott Island Road. The Town's water supply system serves a population of 280 and has 165 connections.

WELL INFORMATION

A review of the well completion reports and sanitary surveys indicate that the supply wells meet the State's well construction standards. The water is supplied by two wells (Nos. 1 & 2) each with an average yield of 125 gallons per minute (gpm). Table 1 is a summary of the well construction data.

PLANT	SOURCE NAME	PERMIT	TOTAL DEPTH	CASING DEPTH	AQUIFER
1	Well 1	DO-81-0145	66	40	Pleistocene Series
1	Well 2	DO-81-0146	65	35	Pleistocene Series

Table 1. Town of Vienna Well Information

The locations of the wells and the water treatment plant are shown on Figure 1. Two former supply wells located in Town along Race and Water Streets have been disconnected from the system and are no longer in-use. A third former well located near the Town Hall along Market and Middle Streets was retained as an emergency back-up supply but currently is not in-service.

HYDROGEOLOGY

Vienna's wells draw water from the Pleistocene aquifer, which is unconfined in this area. The channel sediments in Vienna that make up this aquifer are known as the Kent Island Formation (Bachman, 1984). Based on well log data, the sediments consist of alternating layers of sand and clay. The Kent Island Formation is interpreted to be an estuarine deposit with some fluvial sediments (Owens & Denny, 1979). Both wells are screened within the permeable sand layers.

The thickness of the Pleistocene aquifer in Vienna is approximately 60 feet. An average transmissivity of 33,062 gallons per day per foot (4,420 ft^2/day) was estimated for this aquifer (Bachman, 1984). The ground water flow direction is toward the

southeast at a gradient of 0.00015. Based on the type of geologic material, a porosity of 30% was assumed for this aquifer (Fetter, 1988).

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. According to Maryland's Source Water Assessment Plan document approved by EPA (MDE, 1999), systems using >10,000 gallons per day (gpd) located in unconfined Coastal Plain aquifers are to be delineated using the EPA's WHPA Code ground water model. The pumpage used for the delineations was 80,000 gpd or 10,695 ft^3/day. This amount is based on the daily average quantity from the current Water Appropriation and Use Permit issued by the MDE Water Rights Division. The model was run for each well based on simulation time limits of one and ten years respectively.

Delineation Zones **(see Figure 2)**

Zone 1: Zone 1 is the WHPA delineated using a 1-year time-of travel (TOT) criterion. Zone 1 serves as the first zone of protection. The one-year criterion was based on the maximum survival times of microbial organisms in ground water. Wells 1 and 2 are within about 250 feet of each other, therefore the resulting capture zones were combined together to form one oval-shaped Zone 1 WHPA (Figure 2). The length of this WHPA is about 920 feet.

Zone 2: Zone 2 is the WHPA delineated using a 10-year TOT criterion. It would take any contaminant present at the Zone 2 boundary 10 years to reach the well (if it moves at the same rate as the ground water), using the permitted quantity. Zone 2 provides adequate time for facilities outside the WHPA to address chemical contamination before it reaches the wells. Due to the close proximity of the wells the resulting capture zones show interference effects. Therefore, the Zone 2 WHPAs for each well were combined to form one larger oval-shaped WHPA (Figure 2). The total area of this combined Zone 2 is 32.6 acres.

POTENTIAL SOURCES OF CONTAMINATION

For this assessment, MDE Waste and Water Management databases were reviewed, staff consulted, and field inspections conducted, to identify potential sources of contamination in and around the Vienna WHPA. In addition, on February 25, 2000, MDE staff completed a field survey of the Vienna WHPA and wells, and interviewed the President and Commissioner of the Town of Vienna, Mr. Jim Hicks, regarding any water quality concerns and potential ground water contamination sources in the area. No potential point sources were identified within the Vienna WHPA.

Review of the MDE Discharge Permits database indicates that a permit was issued for the Town of Vienna Water Treatment Plant to discharge an average of 4,000

gpd of filter backwash water to a pond behind the plant (Figure 1). The pond is about 60 feet wide by 80 feet long and 5 feet deep. The filter backwash water contains chlorine, potassium permanganate, lime and fluoride additions all from the treatment of raw water at the plant. Potassium permanganate and ferro-greensand filters are used to remove precipitated iron and manganese from the raw water. Iron and manganese levels in the filter backwash water leaving the plant average about 3 parts per million (ppm) for iron and 0.13 ppm for manganese. The overflow from the pond goes to a ditch that flows along Elliott Island road to a stream that empties into the Nanticoke River. The surface discharge is monitored by MDE for total iron, manganese and residual chlorine levels.

Since the wells are located outside the Town boundaries in an agricultural and forested area, there is currently no threat of petroleum-related contaminants from underground storage tanks (USTs) in the WHPA. Records show that USTs at commercial establishments located within or near the Town have been removed and/or upgraded to current State regulations.

A review and consultation with other MDE Waste and Water Management Administration Program databases and personnel was conducted. Currently, there is no record of any hazardous waste sites, solid waste facilities, ground water contamination sites, pesticide dealers, and open floor drains that discharge to ground water, within the Vienna WHPA.

Pesticides and herbicides used in agriculture are potential non-point sources of synthetic organic compounds (SOCs). In addition, the application of fertilizers on agricultural fields is a potential non-point source of nitrate. Figure 1 shows the close proximity of the Vienna wells to nearby cropland.

Based on the Maryland Office of Planning's 1997 Land Use Map, the land use within the WHPA is as follows:

LAND USE	TOTAL AREA (Acres)	PERCENTAGE OF WHPA
Cropland	5.7	17
Forest	26.9	83

Table 2. Land Use Summary within WHPA Zone 2

The breakdown of land use within the WHPA Zones is shown in Figure 3.

A review of the Maryland Office of Planning 1994 Dorchester County Sewerage Coverage Map indicates that there are no plans for public sewerage service in this area. Currently, 100 % of the land within the WHPA is forest and cropland.

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 from the finished (treated) water unless otherwise noted. The treatment currently used at Vienna is hypochlorination for disinfection, pH adjustment and orthophosphate inhibitors for corrosion control, potassium permanganate and greensand filtration for iron and manganese removal, and fluoridation.

A review of the monitoring data since 1995 for Vienna's finished water indicates that the system's water supply meets the drinking water standards. No contaminants have been detected above the 50% Maximum Contaminant Level (MCL) since 1995.

Inorganic Compounds (IOCs)

Despite the wells being adjacent to active farmland to the north, east and south, (Figure 3) nitrate detects since 1995 have not exceeded 3.9 ppm. Table 2 indicates that 83% of the WHPA is forested, and therefore, low nitrate levels are anticipated for ground water under forestlands. The MCL for nitrate is 10 ppm.

Typical raw water data at Vienna's wells show iron levels of 13 ppm and manganese levels of 6 ppm respectively. Iron and manganese are naturally occurring elements present within the Pleistocene sediments in the Vienna area. There is currently no MCL for iron and manganese, as they are considered secondary constituents. However, these elements can cause severe damage to a water system if not properly controlled. Taste, color and odor problems in drinking water can result from excessive iron and manganese levels. Vienna is well aware of these problems and is currently treating for them at the Water Treatment Plant. The treatment methods were described earlier in the Potential Sources of Contamination section. According to the EPA Drinking Water Regulations, finished water Secondary Maximum Contaminant Levels (SMCLs) were established for iron at 0.3 ppm and for manganese at 0.05 ppm respectively.

Volatile Organic Compounds (VOCs)

The only VOC detects that have been reported over the past five years of sampling data are the disinfection by-products known as trihalomethanes. Chloroform was detected at 1.1 ppb (8/26/96), at 2.0 ppb (9/17/97) and at 17.3 ppb (5/25/99). Bromodichloromethane was detected at 3.5 ppb (5/25/99) and at 0.6 ppb (9/17/97). Dibromochloromethane and bromoform were not detected. Trihalomethanes are currently regulated for systems serving a population of over 10,000. The current MCL for regulated systems is 100 ppb for the total of these four VOCs. By the year 2003, this MCL total will be reduced to 80 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)

Dalapon was detected at 0.069 ppb on 8/22/95 and at 2.34 ppb on 5/25/99. The MCL for dalapon is 200 ppb. Low levels of dalapon are periodically detected in laboratory samples that may not represent actual water quality of the system.

Radionuclides

Gross alpha was not detected. No sampling data is available for Radon-222 at the present time.

Microbiological Contaminants

Ground Water Under Direct Influence of Surface Water (GWUDI) sampling was conducted for Well 1 on 2/2/99 and for Well 2 on 1/20/99. A wet weather sample was collected for Well 1 as required by MDE. All results were negative for the presence of total and fecal coliform.

SUSCEPTIBILITY ANALYSIS

Vienna's wells draw water from an unconfined aquifer. In general, water supplies in unconfined aquifers are susceptible to contamination from land use activities. Therefore, continued routine monitoring of contaminants is essential in assuring a safe drinking water supply. The criteria that was used to conduct the susceptibility analysis is as follows: (1) evaluation of available water quality data, (2) review of the contaminant sources within the WHPA, (3) evaluation of the aquifer characteristics, (4) evaluation of the well integrity, and (5) evaluation of the likelihood of change to the natural conditions.

Inorganic Compounds (IOCs)

The Town of Vienna's water supply **is** susceptible to nitrate contamination. Even though nitrate levels have not exceeded the 50% MCL threshold since 1995, a source of nitrate exists within the WHPA. Sources of nitrate can generally be traced back to land use. Fertilization of agricultural fields and residential lawns, and on-site septic systems are non-point sources of nitrate in ground water. Figure 1 shows active cropland adjacent to Vienna's wells. In addition, Figures 1 and 2 indicate that there is one residential dwelling to the southwest of the Water Treatment Plant at the WHPA boundary. Nitrates present in the water source are more likely related to fertilizers rather than from septic systems because 100% of the WHPA is currently agricultural and forested land.

Volatile Organic Compounds (VOCs)

Review of sampling data reported since 1995 indicates that no VOCs have been detected at Vienna. As mentioned earlier, the current WHPA boundaries and wells are far removed from the Town and should pose no potential VOC threat to the wells (Figure 3). The WHPA Zone boundaries will increase only if increased water demands for the Town are required. There is no evidence that an increase in water pumpage is necessary for the Town at the present time. Therefore, Vienna's water supply is **not** susceptible to VOC contamination.

Synthetic Organic Compounds (SOCs)

The current land use indicates that non-point sources exist within the WHPA that could potentially contaminate the water supply with SOCs. Pesticides and chemicals used in agricultural operations are a potential threat. The wells at Vienna draw from an unconfined aquifer in the Coastal Plain. Based on data since 1995, no SOC detects close to the 50% MCL threshold have been reported for Vienna. A review of the well logs for Wells 1 and 2 indicates that alternating clay layers from 7 to 13 feet thick are present in the upper sections of the aquifer. The clay layers may inhibit the infiltration of SOCs from entering the water supply. Based on the limited data available, Vienna's water supply is **not** susceptible to SOC contamination.

Radionuclides

No gross alpha radiation was detected in water samples at Vienna. Sampling data is not available for Radon-222 for Vienna's water supply at the present time. The source of radon in ground water can be traced back to the natural occurrence of uranium in rocks. Based on limited sampling data, Vienna's water supply is **not** susceptible to radiological contaminants.

Microbiological Contaminants

The nearest natural surface water body to Vienna's wells is an unnamed stream about 1,100 feet to the northeast that flows into the Nanticoke River (Figure 2). Based on coliform sampling data, the wells were determined **not** to be susceptible to protozoans or bacteriological contaminants. The wells may be susceptible to viral contaminants, as these are much smaller, can survive longer, and may not be as effectively filtered by the aquifer as protozoans and bacteria. Future monitoring will be needed to determine susceptibility to viruses.

MANAGEMENT OF THE WHPA

Form a Local Planning Team

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

Public Awareness and Outreach

- Placing signs at the WHPA boundaries is a good way to make the public aware of protecting their source of water supply and to help in the event of spill notification and response.

Cooperative Efforts with Other Agencies

- Request the assistance of the University of Maryland Agricultural Extension Service, the Soil Conservation Service to work with the nearby farmer to adopt Best Management Practices (BMP's) for cropland located within the WHPA.
- The nearby farmer can also participate in the New Conservation Reserve Program (CREP) applicable to the cropland located within the WHPA. Government funding is available to qualified farmers equal to the cost and financial benefit of farming the area. The Natural Resources Conservation Service is responsible for determining the relative environmental benefits of each acre offered for participation.

Monitoring

- Cropland currently makes up 17% of the land use within the WHPA. It is recommended that the Town continue to monitor the nitrate values closely and continue sampling for nitrates annually.
- Continue to monitor for all Safe Drinking Water Act Contaminants as required by MDE.
- Annual sampling for microbiological contaminants is a good check on well integrity.

Planning/New Development

- Prior to any new development in the area, the Town should work with Dorchester County to adopt a local land use ordinance to protect future water quality. The State of Maryland Wellhead Protection Ordinance may be used as a template.

Land Acquisition/Easements

- The availability of loans for purchasing land or easements for the purpose of protecting a designated WHPA is available from MDE. Loans are offered at zero percent interest and zero points.
- The preservation of the existing forested recharge area is the single most important step that the Town of Vienna can take to ensure the long-term safety of its water supply.

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 at the Water Treatment Plant or the addition of new wells will require revision of the WHPA since it is affected by pumpage. The Town is required to contact the MDE Water Supply Program when an increase in pumpage is applied for and when proposed new wells are being considered.

Contaminant Source Inventory Updates/Well Inspections

- The Town should conduct its own 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.
- The Town should have a regular inspection and maintenance program for the supply wells to ensure their integrity and to protect the aquifer from surficial contamination.
- Ensure that all unused wells are properly abandoned and sealed as per COMAR 26.04.04.11.

REFERENCES

Bachman, L.J., and Wilson, J.M., 1984, The Columbia Aquifer of the Eastern Shore of Maryland: Maryland Geological Survey Report of Investigations 40, 144 p.

Blandford, T.N., and Huyakorn, P.S., 1991, WHPA, A Modular Semi-Analytical Model for the Delineation of Wellhead Protection Areas, version 2: U.S. Environmental Protection Agency, Office of Groundwater, Washington DC.

Fetter, C.W., 1988, Applied Hydrogeology, Second Edition, Merrill Publishing Company, 592 p.

Maryland Department of the Environment, Water Supply Program, 1999, Maryland's Source Water Assessment Plan, 36 p.

Owens, J.P., and Denny, C.S., 1979, Upper Cenozoic deposits of the central Delmarva Peninsula, Maryland and Delaware: U.S. Geological Survey Professional Paper 1067-A, 28 p.

OTHER SOURCES OF DATA

Water Appropriation and Use Permit No. DO79G004
Public Water Supply Inspection Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Department of Natural Resources 1995 Digital Orthophoto Quarter Quadrangles for Mardela Springs NW
USGS 7.5 Minute Series Orthophoto (Topographic) Map, Mardela Springs Quadrangle
Maryland Office of Planning 1997 Dorchester & Wicomico County Land Use Maps
Maryland Office of Planning 1994 Dorchester County Sewerage Coverage Map

FIGURES

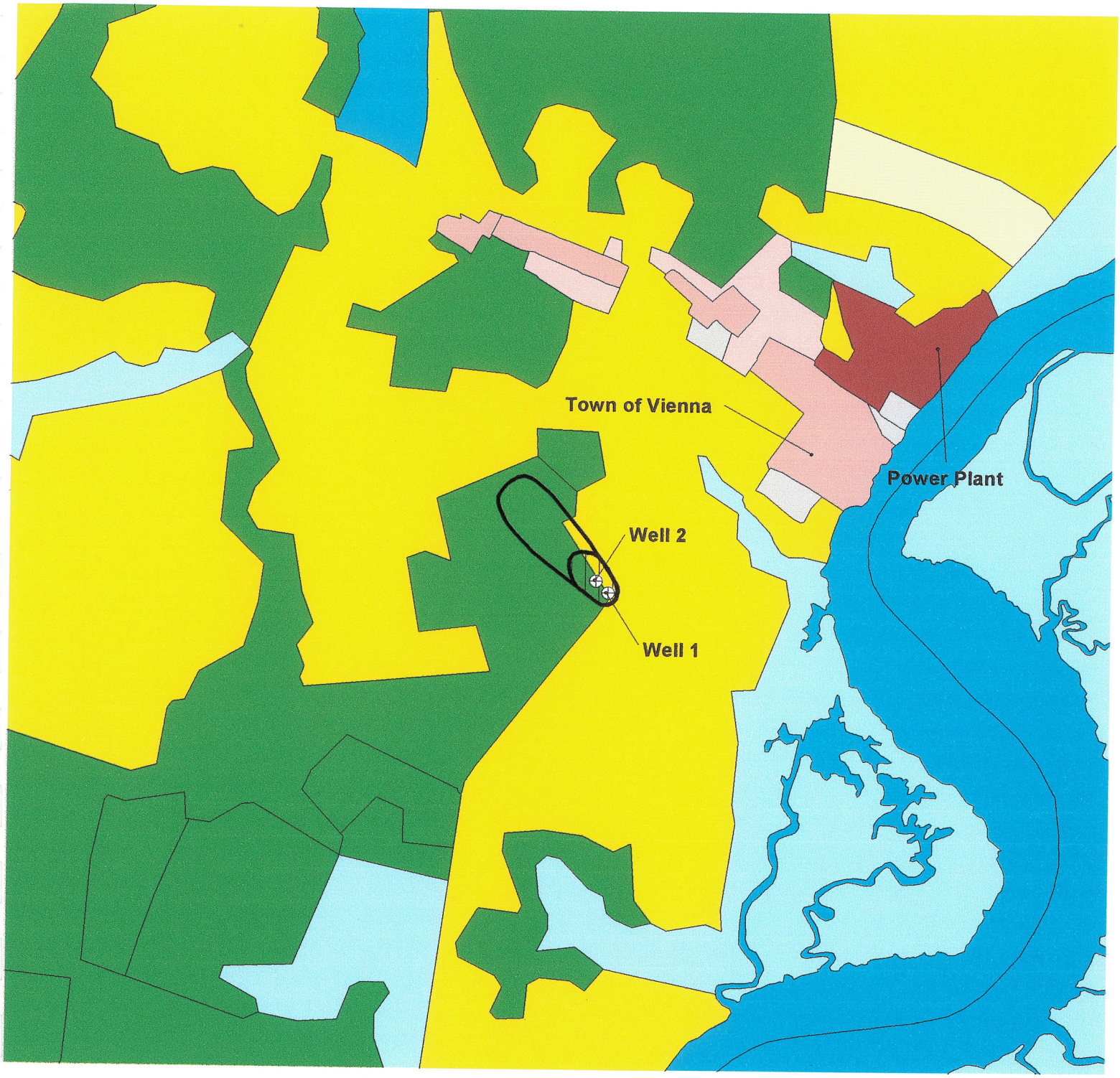

Figure 3. Land Use Map of Vienna Wellhead Protection Area

LEGEND

Land Use

- Cropland
- Forest
- Supply Wells

WHPA Zones

- Zone 1
- Zone 2

2000 0 2000 Feet

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Source: MD Office of Planning 1997 Dorchester & Wicomico County Land Use Maps