S.S. Papadopulos & Associates, Inc.
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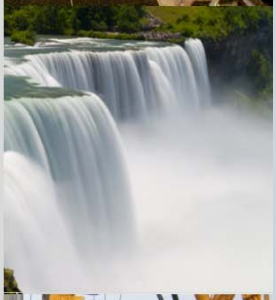


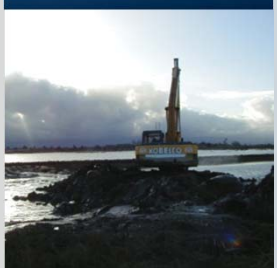

Source Water Protection Plan for the Glen Burnie, Maryland Public Water System

October, 2013

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Source Water Protection Plan for the Glen Burnie, Maryland Public Water System

Prepared for:
Maryland Department of the Environment
Water Supply Program
(Purchase Order # P2400301)

Prepared by:

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October, 2013

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List of Acronyms

AAC	Anne Arundel County
AGPD	Average Gallons per Day
BMP	Best Management Practices
BWI	Baltimore-Washington International Airport
CEM	Chesapeake Environmental Management
CHS	Generators of Hazardous Waste
DBR	Disinfection Byproducts Rule
EOC	Emergency Operations Committee
EOM	Emergency Operations Management
EOP	Emergency Operations Plan
ESD	Environmental Site Design
ESF	Emergency Support Function
GIS	Geographic Information System
GPD	Gallons per Day
HMP	Hazard Mitigation Plan
IOC	Inorganic Compounds
MCL	Maximum Contaminant Level
MDE	Maryland Department of the Environment
MGPD	Maximum Gallons per Day
OCP	Oil Control Program
PCE	Tetrachloroethylene
PCS	Potential Contaminant Source
PWS	Public Water Supply
PWSID	Public Water Supply Identification
SOC	Synthetic Organic Compounds
SPCC	Spill Prevention, Control, and Countermeasure
SSP&A	S.S. Papadopulos& Associates
SWAA	Source Water Assessment Area
SWM	Stormwater Management
SWPP	Source Water Protection Plan
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
TTHM	Total Trihalomethanes
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
WHPA	Wellhead protection area
WHPO	Wellhead Protection Ordinance
WRP	Water Resources Plan

REPORT

Section 1
Introduction

This Source Water Protection Plan (SWPP) was prepared by S.S. Papadopulos & Associates (SSP&A) and Chesapeake Environmental Management (CEM). It addresses the unconfined and semi-confined wells of the Glen Burnie Public Water System, which are located within northern Anne Arundel County, Maryland. The plan was initiated and funded by the Maryland Department of the Environment (MDE) under Purchase Order # P2400301.

In the early 2000s, the MDE completed or contracted completion of Source Water Assessments (SWAAs) for public water systems (PWS) across the state. These reports were developed in accordance with Maryland's Source Water Assessment Plan (1999). The content of these reports included

- Delineation of Source Water Assessment Areas (SWAAs)
- Identifying Potential Sources of Contamination, and
- Completing a Susceptibility Analysis for each PWS source.

A Source Water Assessment and Wellhead Protection Plan for the Glen Burnie groundwater sources was completed in 2003 (URS Corporation, 2003). A significant portion of the current report is an update to the previous SWAA Report, including an update to the SWAA delineations.

In completing this report, MDE provided assistance through access to files, databases, and GIS data. The report contents were discussed with representatives of MDE and Anne Arundel County prior to finalization to help ensure that recommendations for Source Water Protection were consistent with the County's needs and resources.

Section 2
Background

The Glen Burnie area is located in northern Anne Arundel County (AAC; Figure 1) south of the Baltimore-Washington International Airport (BWI). The AAC public water system is divided into a number of pressure zones. The wells addressed in this report comprise portions of the Glen Burnie Low 220, Glen Burnie High 295, and Airport Square 350 Zones (URS Corporation, 2003; Anne Arundel County, 2009; Anne Arundel County, pers. comm., 2013). The well fields are distributed over an area of about 5 square miles south and southeast of BWI. Prominent geographic features include Furnace Creek and Marley Creek, which drain eastward toward the Patapsco River / Baltimore Harbor section of the Chesapeake Bay. The Telegraph Road and Stevenson Road well fields are located within the Severn River Watershed. Topography in the area of these well fields generally slopes eastward, with a range from about 200 feet to sea level.

2.1 Groundwater Sources; System Operations

There are a total of nine (9) wells addressed in this report (Table 1), although some are currently inactive or only withdraw water on a seasonal basis. All are as part of the Glen Burnie system (PWSID 020017) and potentially withdraw water from unconfined or semi-confined portions of the Cretaceous age Patapsco Formation. An additional eighteen (18) wells are permitted to withdraw groundwater from the confined portions of the Patapsco Aquifer. The confined wells are not addressed in this report, as they are considered to be less susceptible to contamination due to their stratigraphic position. Additional water supply is also purchased from the City of Baltimore, but it is not addressed here.

The nine semi-confined and unconfined wells are associated with six (6) Water Appropriation Permits (Table 2). For the Water Appropriation Permits in Table 2, each WAPID is associated with its own Treatment Plant (TP). Water quality data discussed below is reported by Treatment Plant (TP), so that water quality from well fields with more than one well (e.g. Harundale) represents mixed, finished water.

The Crain Highway 2-ASR well (Table 1) is not currently used for water withdrawals, but may be used for aquifer storage and recovery (ASR) in the future. It is covered under an active Water Appropriation Permit, however, and is therefore listed in Table 1 for the sake of completeness. Similarly, the Glendale well, while covered by an active permit, is not currently in use. Currently, the four Harundale and the Elvaton Road wells are only used seasonally.

The total amount of water currently permitted for withdrawal from these wells is 5,790,000 gallons a day, on average (AGPD). Data provided by MDE indicate that since 1979, the groundwater extraction from unconfined and semi-confined wells has been decreasing approximately linearly (Figure 2). In the past ten years (2002 to 2011), the water withdrawals from 12 currently or previously active wells have ranged from about 3.3 million gallons per day to 4.7 million gallons per day. Over the same time period, the average extraction rate has been approximately 4.2 million gallons per day, or 2,940 gallons per minute (gpm). In recent years, both the Crain Highway and Quarterfield wells have been abandoned, water use from the Harundale and Elvaton well fields has been reduced to seasonal, and the Phillip Drive and

Glendale sources remain inactive. A recently installed pipeline provides water from the recently upgraded Arnold wellfield and treatment plant.

2.2 Previous Source Water Assessment and Protection Reports

A Source Water Assessment and Wellhead Protection Plan for the Glen Burnie groundwater sources was completed in 2003 (URS Corporation, 2003). As part of that assessment, URS Corporation utilized a groundwater flow model of the subject area using the software MODLFOW. The Wellhead Protection Plan developed by URS Corporation (2003) also incorporated an evaluation of groundwater quality data and a susceptibility analysis. Those items are updated in this report as well.

Recommendations provided by URS (2003) included:

- Limit development and land use associated with activities that may compromise the Wellhead Protection Areas (WHPAs)
- Initiate cleanups at contaminated sites to minimize the likelihood that a WHPA will be compromised
- Support education/public awareness programs to inform residents and businesses about the susceptibility of the groundwater resources and various measures that can be taken to protect those resources
- Develop plans that can be implemented to reduce potential impacts to the WHPA in the case of an accident and provide alternative drinking water supplies.

Specific tasks recommended for the County's consideration included:

- Develop a Work/Planning Team that is composed of the various County agencies and Community Groups
- Review the delineation of the land area to be protected
- Develop and review potential management strategies
- Develop selection criteria to evaluate management strategies
- Prioritize the selection criteria
- Apply criteria to select management strategies
- Implement newly adopted Wellhead Protection Management Strategies
- Determine well screen depths for all wells that are unknown
- Inspect drums stored on residential property
- Analyze raw water twice a year
- Collect discrete samples from individual wells rather than composite water from treatment plants
- Assess the current suite of parameters being analyzed
- Request information from BWI Airport about wells, potential contamination sites, and operations
- Establish regular intervals to update this plan, including the groundwater model
- Continue to perform focused investigations like the radium study
- Form an integrated team of County departments to share responsibility for keeping the plan up to date

- Extend the groundwater model domain so particles can be tracked back more than 70 years
- Install and sample sentry wells upgradient of the PWS wells as an early warning system, or evaluate existing private wells for the same purpose
- Eliminate potential contaminant sources not cited as significant in the SWAP report
- Establish a wellhead protection fund.

Section 3
Source Water Assessment

This section of the report provides the updated Source Water Assessment for the unconfined and semi-confined Glen Burnie wells.

3.1 Hydrogeology and Hydrology

The Glen Burnie area is located within the Glen Burnie Rolling Upland District of the Atlantic Coastal Plain Physiographic Province (Reger and Cleaves, 2008; Figure 3). This region consists primarily of unconsolidated sand, silt and clay layers, including both Cretaceous units of the Potomac Group, and overlying Quaternary sediments. The total thickness of the Cretaceous units (Patapsco and Patuxent aquifers) in the vicinity of the Dorsey Road well field is approximately 600 ft (Achmad, 1991; Andreasen, 2007). The depth of the wells addressed here range from 115 to 346 ft.

The Upper and Lower Patapsco aquifers, part of the Lower Cretaceous-age Patapsco Formation, are composed of fine- to coarse-grained quartz sand with trace amounts of lignite and spherical sandstone grains. The sands are interbedded with gray, red, and mottled clays. The aquifers dip to the southeast at approximately 40 to 60 ft/mile, over which the number and thickness of clay layers increase downdip (Andreason, 2007). A schematic diagram illustrating the aquifers in Anne Arundel County and groundwater flow toward wells is provided as Figure 4.

The altitude of the top of the Upper Patapsco aquifer ranges from approximately 40 ft above sea level in central Anne Arundel County to approximately 650 ft below sea level at Rose Haven (Figure 5). The altitude of the top of the Lower Patapsco aquifer ranges from approximately 65 ft above sea level in north-central Anne Arundel County to approximately 1,300 ft below sea level at Rose Haven (Andreason, 2007). Water is recharged to the Cretaceous aquifer by infiltration in the outcrops areas and vertically through sands, gravels, and fines in unconfined and confined areas. Because of their relative shallow depths and the absence of a thick, regionally persistent aquitard, these wells are classified as semi-confined and unconfined by MDE.

3.2 Review of Water Quality Data

Maryland's Water Supply Program provided SSP&A with compiled analytical data reported for the Glen Burnie PWS from 1990 to 2011. For the purposes of this analysis, ten (10) full years' worth of data are reviewed (2001 to 2010), for the unconfined and semi-confined well fields. Data discussed here are compared to the US Environmental Protection Agency (USEPA)'s Maximum Contaminant levels (MCLs) and Maryland groundwater cleanup standards (MDE, 2008). As per Maryland's SWAP guidance (MDE, 1999), water quality data are also compared to values of ½ the MCL as an indicator of system susceptibility to contamination.

3.2.1 Volatile Organic Compounds (VOCs)

For the period from 2001 through 2010, more than 11,000 VOC analyses were reported for the Glen Burnie wells. During this time period, a number of VOCs were detected (Table 3):

- Tetrachloroethylene (PCE)
- Methylene Chloride
- Trihalomethanes
  - Bromodichloromethane
  - Bromoform
  - Chloroform
  - Dibromochloromethane

Tetrachloroethylene (PCE) is a chlorinated solvent widely used in dry cleaning as well as for industrial applications. Detections of this compound were reported for both the Glendale Treatment Plant (TP 07; currently inactive) and the Harundale Treatment Plant (TP 15; currently seasonal). PCE was first detected in the Glendale water in the 1990s at concentrations in excess of the MCL (5 ug/L). The well was taken out of service in 1998 (URS Corporation, 2003) and remains inactive today. Concentrations of PCE in the Harundale well field were first reported in 1996, and have persisted until the current time (Figure 6). The average concentrations have dropped since 2000. Nonetheless, about 80% of the reported PCE concentrations exceeded ½ the MCL in that time period, and about 90% of the annual average concentrations exceeded ½ the MCL. More recently, the volatile organic compounds methyl tertiary butyl ether (MTBE) and xylene have also been detected in the Harundale wells at sub-ppb levels (Anne Arundel County, 2011; Anne Arundel County, pers. comm., 2013).

Trihalomethanes are formed when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water. These are regulated as a group – the Total Trihalomehtanes (TTHM). The USEPA has established a Maximum Contaminant Level (MCL) of 80 ug/l for the TTHMs. Under USEPA's Stage 2 Disinfection Byproducts Rule (DBR), compliance with this standard is based upon an annual average value at each location. As shown in Table 3, for the period from 2001 to 2010, there were no exceedances of the TTHM level in finished (treated) water. The annual averages - which are used to establish compliance - have never exceeded 40 ug/L (1/2 the MCL), although some individual TTHM results have exceeded ½ the MCL.

3.2.2 Synthetic Organic Contaminants (SOCs)

Synthetic organic compounds reported for the unconfined and semi-confined wells of the Glen Burnie Public Water System are summarized in Table 4. The contaminants detected were:

- Pentachlorophenol
- Di(2-Ethylhexyl) Phthalate

Neither of these compounds was reported more than once in any treatment plant, and thus are not likely to be indicative of any significant contamination. All detections were below both the MCL and ½ the MCL.

Di (2-Ethylhexyl) phthalate is a plasticizer and common laboratory contaminant and may not be indicative of groundwater quality. This compound was not detected in excess of relevant groundwater standards. Pentachlorophenol is an organochlorine compound used primarily as a disinfectant and pesticide. While potentially an anthropogenic contaminant associated with use at the surface, the single detection in 2008 is not likely indicative of significant contamination concerns.

3.2.3 Inorganic Compounds

Inorganic compounds reported for the Unconfined and Semi-Confined wells of the Glen Burnie PWS are summarized in Table 5. Many of these compounds can have both natural and man-made (anthropogenic) sources.

3.2.3.1 Radionuclides

Among the compounds of concern for these wells are the radionuclide parameters

- gross alpha, and
- combined radium (radium 226 &radium 228).

Historically, Patapsco Formation water in the Glen Burnie area has shown naturally elevated concentrations of radionuclides. Elevated radionuclide results for the Potomac Group Aquifers have been widely reported for the northern Anne Arundel County (Bolton, 2000; Chew, 2009), and these data most likely reflect the interaction of naturally occurring radionuclides and relatively low groundwater pH (Bolton, 2000;Szabo et al., 2010, Szabo et al., 2012). A study of radium concentrations in groundwater across the US found the highest concentration in acidic groundwater of quartzose Atlantic coastal plain aquifers (Szabo et al., 2012). Cessation of use of the Glendale well was, in part, a response to treatment issues associated with these elevated radionuclides.

The two parameters listed above, gross alpha and combined radium, have MCLs of 15 pCi/L and 5 pCi/L respectively. While none of the Glen Burnie samples exceeded the former limit in the past 10 years, several samples did exceed ½ the Gross Alpha MCL of 15 pCi/L. Figure 7 illustrates these data, and indicates that for most of the past decade, reported gross alpha concentrations have fallen below the ½ MCL criteria since 2006.

For these same wells, the combined and individual radium results (Figure 8) do show exceedances of the MCL (5 pCi/L) at the Elvaton Road, Glendale and Harundale Treatment Plants within the past 10 years. The actual levels vary both temporally and by treatment plant. Except for the Telegraph Road Plant, all of the finished water data commonly exceeded one-half the MCL for combined radium.

3.2.3.2 Nitrate

Nitrate is a naturally-occurring ion that is also a contaminant associated with agricultural fertilizers and septic systems/sewage. None of the nitrate measurements reported for the Glen Burnie wells exceeded the MCL (10 mg/l) or ½ the MCL (5 mg/L). Review of the time series

(Figure 9) suggests that nitrate has increased in concentration slowly over the past decade, but actual concentrations are below the criteria set by MDE.

3.2.4 Coliform Bacteria

Total coliforms are a group of closely related, mostly harmless bacteria that live in soil and water as well as the gut of animals. The extent to which total coliforms are present in source water can indicate the general quality of that water and the likelihood that the water is contaminated with fecal matter from animals or humans. Total coliforms are currently controlled in drinking water regulations (Total Coliform Rule) because their presence above the standard indicates problems in treatment or in the distribution system. EPA requires all PWS to monitor for total coliforms in distribution systems. If total coliforms are found, then the public water system must further analyze that total coliform-positive sample to determine which specific types of coliforms (i.e., fecal coliforms or *E. coli*) are present.

Table 6 summarizes the coliform results for the entire Glen Burnie system for the years 2001 to 2010. During this period, more than 19,000 samples were reported, with 3 positive results for total coliform and a single confirmed positive detection in repeat samples. There were no detections of fecal coliform bacteria.

3.3 Source Water Assessment Areas

The Source Water Assessment Area describes the geographic boundary of areas providing water to public water system sources. As per Maryland's Source Water Assessment Program Guidance (MDE, 1999), the preferred tool for delineating SWAAs in semi-confined aquifers is three-dimensional groundwater model and particle tracking. In addition, while the MDE (1999) guidance recommends a tool such as the (now outdated) program WHPA for unconfined aquifers, a 3-dimensional groundwater flow model such as MODFLOW is also suitable.

3.3.1 MODFLOW Model

For this report, SSP&A reviewed, modified, and relied upon a MODFLOW model that was developed by URS Corporation (2003) for the same purpose. That model was expanded from an earlier model developed by Wilson and Achmad (1995). SSP&A evaluated the model files for their suitability in the current study, and modified as necessary to complete this evaluation.

The groundwater flow model is discretized into 130 rows and 116 columns with a total of 45,240 cells (Figure 10). Out of these, 23,444 are active while the rest are inactive. In plan view, the model cells are approximately 500 ft by 500 ft. The model consists of 3 layers which, from top to bottom represent, the Upper Patapsco aquifer (predominantly unconfined), an underlying leaky confining unit of lower permeability, and the Lower Patapsco aquifer (semi-confined aquifer). In areas where Layer 2 transmits water readily to the deeper model Layer 3, the Lower Patapsco is considered to be under "semi-confined" conditions. The bottom of the Lower Patapsco aquifer forms the vertical base of this model. Additional details of the conceptual hydrogeologic model for the study area are provided in Wilson and Achmad (1995) and URS (2003).

SSP&A reviewed the extent of the model and the input parameters and determined that no modifications to the boundary conditions or model extent were required for the updated analysis. The pumping rates for each well were updated, however, based upon the permitted average daily appropriation from MDE's database (Table 2), as well as Water Appropriation Permit GIS files provided by AAC, and summaries in Andreasen (2007).

In addition to the Glen Burnie municipal wells that are the subject of this report, other wells were included in the model if 1) they are permitted to extract > 10,000 GPD, and 2) they are screened within the Upper or Lower Patapsco Formation. These included:

- Pioneer City Production Wells
- International Paper Production Well
- Schiller Irrigation Wells
- Pumphrey Irrigation Wells
- Southland Corporation Remediation Wells

For the Glen Burnie PWS wells in this report, if more than one well was covered by a single water appropriation permit, the pumping was allocated equally between the wells.

3.3.2 SWAA Results

Modeling Results are illustrated in Figure 11. The general groundwater flow direction in the Patapsco Aquifer is toward the east and southeast, with localized depressions associated with each of the pumping wells. Sensitivity runs were completed to determine if the groundwater flow near the Telegraph Road and Stevenson Road sources differed substantially with the seasonal pumping at Harundale and Elvaton Road sources on and off. The results indicated no significant change in groundwater flow at those locations during the seasonal pumping and non-pumping scenarios. Consequently, all results below are based upon model runs assuming all the active wells are operating at their average daily permitted rate.

As per MDE (1999), particle tracking was implemented on the simulated potentiometric surface to calculate both 1-year and 10-year travel times toward each of the wells. The original particle paths, as well as a polygon delimiting areas are shown on Figure 11 for reference. The resultant Source Water Assessment Areas (10-year, Zone 2) comprise four polygons totaling 1,304 acres (2.0 square miles) of land area. The smaller 1-year, Zone 1 SWAAs comprise a total of 184 acres, or about 0.3 square miles.

3.4 Land Use

Figure 12 and Table 7 illustrate the land use within the SWAAs for the groundwater sources. As to be expected from their location in the developed area of northern Anne Arundel County, the total land use within the Zone 1 and Zone 2 SWAAs is dominated by residential uses (~58% single-family housing, in total). Natural open space, industrial and government/institutional land uses make up most of the rest. Natural open spaces are largely associated with the immediate vicinity of the wellheads.

Water and Sewer Service areas for the Glen Burnie area are represented in Figure 13. As can be seen in Figure 13a, the entire area covered by the calculated SWAAs currently receives

water service or has future water service planned. Similarly, the entire SWAA footprint area is associated with current or planned sewer service.

3.5 Potential Contaminant Sources

In January, 2013, staff of Chesapeake Environmental Management (CEM) completed a survey of the Glen Burnie area to identify any Potential Contaminant Sources (PCS) that might be located within or near the SWAAs. Identification and description of these PCS will assist in understanding current conditions with regard to threats to groundwater quality and contribute to the susceptibility analysis.

Prior to the field Survey, SSP&A obtained database and shape file layers from MDE, USEPA, and AAC to assist in identifying existing and new PCS. These layers included those generated during the previous SWAA evaluation (2003-2005), MD oil control program (OCP) sites, registered generators of hazardous waste, registered pesticide dealers, existing and out-of-service underground storage tanks, and Land Remediation Program sites. These were used to create preliminary maps and tables from which CEM staff worked to identify existing PCS.

As shown on Figure 14 and Table 8, there are 51 identified potential point contaminant sources identified in the area around the existing and out-of service wells (Table 1). Few of these PCS actually fall within the boundaries of the SWAAs, however. Removal from service of the Quarterfield, Glendale, Crain Highway and Phillip Drive wells has significantly reduced the overlap of PCS and SWAA footprints. The PCS mapped include gasoline stations, other registered underground storage tank (UST) locations, sites in Maryland's voluntary cleanup program for soil and groundwater contamination, and dry cleaning facilities. Registered residential heating oil tanks are not shown, nor are above-ground propane tanks (which were identified in the previous SWAP investigations). Because of the continually changing nature of land use and frequent redevelopment, this list is invariably incomplete. Nonetheless, it does illustrate the types of potential contaminant sources that are present in and around the SWAAs, and highlights potential contaminant types that might be anticipated in case of releases.

The Kop-Flex Land Remediation Program (LRP) site was identified on this map because groundwater contamination in residential wells has recently been identified from this site (AAC pers. comm., 2013). This contamination consisting of volatile organic compounds, including 1,4-dioxane is present in the Patuxent Formation at depths of up to 250 feet. This location is generally upgradient of the Glen Burnie wells.

3.6 Susceptibility Analysis

As outlined in MDE's Source Water Assessment Program Plan (1999), the goal of a Susceptibility Analysis is to assess the potential for a water supply source to be contaminated at concentrations that would pose a concern, or be affected in a way that is detrimental to the operation, health of consumers, or long-term viability of the supply. The methodology relies on existing water quality data, and an evaluation of potential contaminants of concern and their sources. Specifically, if any potential contaminant of concern exceeds ½ the Federal MCL for 10% of the results, a more detailed evaluation is warranted.

Because the Glen Burnie wells addressed here are open to semi-confined and unconfined portions of the Patapsco aquifer, all of these sources are potentially susceptible to contamination

from surface sources. The point sources previously identified in or near the SWAAs include potential sources of gasoline, motor oil, tetrachloroethylene, and other man-made chemicals, including fertilizers and pesticides.

Section 4
Existing Provisions to Protect Groundwater

This section addresses existing provisions in place to protect Glen Burnie's water supply.

4.1 Anne Arundel County Water Resources Plan (WRP)

The Anne Arundel County Water Resources Plan of its General Development Plan was adopted in 2009. The WRP documents existing water resources including supply capacity and treatment requirements. The WRP also identifies various goals for source water protection including watershed management plans, septic system and wastewater treatment facility nitrogen reductions, and plans for meeting water demands for the projected population growth.

The 2009 Water Resources Plan section on water supply quotes recommendations of two separate Advisory Committees that addressed the adequacy of existing resources to manage and protect the state's water resources. Recommendations relevant to Anne Arundel County (Southern Maryland) are shown in Table 9.

Because some of these recommendations originated from a committee focused on state-wide issues, they address statewide water supply issues. Notably, the comprehensive multi-county approach to groundwater management, through a regional groundwater flow model to be developed by the USGS and MGS has not been completed at this time (D. Andreason, pers. comm, 2013), although some studies addressing the Patapsco and other aquifers in Anne Arundel County have been completed (Andreason, 2007). Other actions and goals cited in the Water Resources Plan are also cited in Table 9.

4.2 Anne Arundel County Master Plan for Water Supply and Sewerage Systems

The Master Plan for Water Supply and Sewerage Systems (Master Plan) was amended in 2013. The Master Plan refers to the Wellhead Protection Program (URS Corporation 2003) as a model ordinance to be used for development of a Wellhead Protection Ordinance (WHPO). Potential contaminant sources have been identified along with hydrogeologic studies of the County. Private water supplies are currently regulated under a Groundwater Protection Plan, and the County will use MDE's model ordinance as a guideline for implementing a Wellhead Protection Ordinance for public water supply systems.

4.3 Glen Burnie Small Area Plan

The Glen Burnie Small Area Plan was adopted in 2004. Most of Glen Burnie is currently within the water and sewer service area. Those areas not in the existing water or sewer service area are generally still within the planned service area. The Small Area Plan does not specifically discuss goals for protection of water supply source quantity and quality. There are however, goals established for preparing and implementing watershed management plan strategies for several watersheds in the area. The Glen Burnie Plan also seeks to provide open spaces and environmental stewardship opportunities.

Section 5
Recommendations for Source Water Protection

The following recommendations are provided for Protection of Glen Burnie's Source Water. A phased implementation or prioritization may be appropriate.

5.1 Contingency Planning for Emergency Spill Response

Emergency response for Anne Arundel County is currently governed by two primary plans – the AAC 2012 Hazard Mitigation Plan Update (HMP), and the AAC Emergency Operations Plan (EOP) of 2010. The HMP was updated in 2012 to address only responses to natural hazards[1], whereas the Emergency Operations Plan (EOP) outlines the organization for integrated emergency management and coordinated response. The purpose of the EOP is to implement a comprehensive emergency management program for AAC that seeks to mitigate the effects of a hazard, to prepare for a disaster, to respond during emergencies.

The EOP is meant to be a living document and serve as a guideline for best practices in terms of emergency response, and can be edited as appropriate to accurately reflect the evolving situation in Anne Arundel County. Within the EOP, specific responsibilities and functions are assigned to departments within the AAC government, and these agencies are expected to update the plan regarding their specific Emergency Support Functions (ESFs) as necessary to remain current. Each Anne Arundel County department or agency included in the EOP has responsibility for developing and maintaining the ESF's that pertain directly to them. Overall coordination of the EOP maintenance process is carried out by the Anne Arundel County Office of Emergency Management (EOM).

Currently, several portions of the EOP cite agencies and actions appropriate for addressing potential threats to the Glen Burnie water supply. For example, Annex #3 to the EOP lists agency responsibilities for types of emergency. For hazardous materials emergencies, the primary lead agency is the Fire Department, with secondary responsibilities assigned to the Office of Emergency Management, the Department of Health, the Police Department and Public Works Department. In addition, the Maryland Departments of Agriculture and Environment are listed as having secondary responsibilities. For Utilities and Energy emergencies, the AAC Department of Public Works is the Primary Lead Agency.

The AAC Department of Public Works is included within the Operations Section of the AAC Emergency Operations Center. The Operations Section coordinates the use of resources within the EOC and communicates with field forces. It also develops, refines, and implements the joint response and recovery strategy, oversees the deployment of response and recovery resources. The Department of Public Works – Utilities Division is also incorporated into the EOCs Logistics Section.

The Department of Public Works – Utilities Division is the Primary Agency responsible for ESF #12 – Utilities and Energy. Support agencies for this ESF include Constellation Energy/Baltimore Gas and Electric (BGE), the Department of Health, the Office of Information

[1] Specific hazards removed from the 2005 Plan in 2012 included hazardous materials incidents, mass transportation accidents, pipeline accidents and public health emergencies.

Technology, the Office of Emergency Management, the Public Information Officer and the Division of Highways.

5.1.1 Recommended Modification to Emergency Support Function (ESF) #12

Section II.A.10 of ESF #12 currently addresses "utility outages [that] may require the County to take action to protect public health and safety and public and private property." These types of outages include:

a. Water or Wastewater Outage
b. Electrical or Natural Gas Outage
c. Telecommunications Outage
d. General

Under the first category – water or wastewater outage – actions listed include curtailment of general water services, arranging for alternate water supplies, and provisions for temporary sanitation in case of a wastewater supply interruption. In addition, provision for emergency communications are addressed under ESF #2 – Communications. Collectively, these items are the key elements of a Contingency Plan required for potential contamination of groundwater resources.

To ensure that appropriate emergency response and contingency planning is available to address the specific threats associated with groundwater contamination, the following action is recommended:

Develop a brief (1-page) Addendum to ESF #12 that specifically lists

- Source of alternate water supply for the Glen Burnie unconfined and semi-confined wells
- Responsible Agencies for oversight of groundwater contamination issues
- Steps to be taken in case of groundwater contamination:
  - Ensuring that the responsible parties, and relevant Federal, State and County agencies are notified of the need for site investigation and remediation
  - Cooperation with MDE's Oil Control Program, Water Supply Program and other Programs as needed
  - Cooperation with AAC Department of Health
  - Cooperation with the United States Environmental Protection Agency (if warranted)
  - If necessary, use of technical consultants to assist the AAC's evaluation of water quality, and any steps the AAC may need to take to restore surface water or groundwater quality and/or treat contamination.
- Appropriate documentation of known Contaminant Sources should be attached to the Addendum (e.g. Table 8 and Figure 14 from this report, and as updated in future Source Water evaluation reports).

5.2 Zoning and Water System Management

5.2.1 Wellhead Protection Ordinance

It is recommended that Anne Arundel County adopt a Wellhead Protection Ordinance (WHPO) incorporating commonly accepted Best Management Practices (BMPS) for water resource protection. The goals identified in the County Water Resources Plan should be incorporated into the WHPO, including protections for water quality as well as water quantity. This plan should also reflect local community values as well as reflect the specific threats posed to water by the existing land use and PCSs identified.

Two primary options exist for how to approach the WHPO. The first includes itemization of prohibited and permitted land uses within the SWAAs. The second approach emphasizes Best Management Practices (BMPs) that harmonize with and extend the existing stormwater and other relevant regulations, without specifically prohibiting specific uses. Acceptable land uses and/or approaches can be differentiated by Zone; with Zone 1 representing the 1-year travel time polygons and Zone 2 representing the 10-year travel time polygons. These two zones form the Source Water Assessment Area.

Much of the area overlain by the Glen Burnie SWAAs is already developed, and with implementation of prohibited land uses in a WHPO could conceivably lead to the creation of non-conforming uses. Land use within the Zone 1 areas is largely residential however, and dominated by single-family dwellings. These areas are unlikely to currently exhibit the typical prohibited uses of a WHPO (industrial and commercial storage/use of chemicals, high-density agricultural use). In contrast, the larger Zone 2 areas have more varied land use, and would be more appropriately addressed by implementation of BMPS, as it may not be in AAC's best interest to create non-conforming land uses.

The Maryland Model Wellhead Protection Ordinance (MDE, 2007) provides a framework for differentiating between SWAA zones. Appendix A provides an example of this WHPO, as modified for the Glen Burnie area of AAC. As currently defined, the iterated land uses in Zone 2 are designated "conditional uses", as far as the county can be assured that no harm to water resources will occur. Section 6.7 of the model WHPO outlines some of these BMPS appropriate to common land uses. Use of this language would require the permit review process to consider elements of the WHPO. Alternately, the County may choose simply to promote these BMPs via stormwater and construction requirements and public education; this approach would minimize any additional staff time required for reviewing permit applications.

In addition, because of the high density of development in northern Anne Arundel County, some additional BMPs are recommended. Specific examples that may be appended to the WHPO for Glen Burnie include:

- Stormwater Management: Within the Wellhead Protection Area for Glen Burnie, stormwater management (SWM) regulations are administered locally by the Anne

Arundel County Government. These regulations generally reflect the state standards issued by MDE in the 2000 Maryland Stormwater Design Manual Volumes I & II, As Amended (Manual). This Source Water Protection Plan (SWPP) does not alter the fundamental standards, processes, or responsibilities currently in place. Instead, this SWPP seeks to enhance the application of the newly adopted Environmental Site Design Standards (ESD) contained in the 2009 update of the Manual. In the event a regulated activity requires SWM, the responsible party shall exhaustively consider the options covered under the Environmental Site Design Standards section of the MDE SWM regulations prior to considering more traditional SWM techniques. In particular, SWM BMPs to be considered first would include those whose infiltration rates would benefit aquifer recharge.

- Setback Distances: Currently, the statewide SWM regulations require setback distances between SWM facilities and private water wells. This regulation seeks to prevent and minimize water contamination. It is recommended that Anne Arundel County research and consider the implementation of a setback distance between public wellhead areas and nearby SWM facilities.
- Stormwater Hotspots: The MDE Stormwater Management Program currently identifies several types of land uses that are considered to have a higher concentration of specific pollutants in their stormwater. These contaminants, including hydrocarbons, heavy metals, and toxicants, can have an adverse impact on water quality requiring closer regulation. Portions of the hotspot regulations directly address SWM issues, but these uses are also likely governed by the National Pollutant Discharge Elimination Systems (NPDES) permit system. A NPDES permitted facility is required to develop and implement a Stormwater Pollution Prevention Plan (SWPPP). It is recommended that AAC review and maintain copies of the SWPPP required of each entity subject to the NPDES system. Furthermore, it is recommended that the requirements for the creation and implementation of SWPPPs be expanded to encompass land uses and activities regardless of the application of NPDES regulations. In other words, all activities considered to be a hotspot by MDE (Table 2.6 of MDE's SWM) should be required to develop and implement a SWPPP, maintain and update it, and file it with the county. These SWPPPs should address any materials or processes that may pose a threat to groundwater conditions if contamination is not prevented. No section of this SWPP shall be construed to conflict with any regulations or requirements of a NPDES regulated activity or use. The SWPPP shall be developed according to "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices" (EPA Document #EPA832-R-92-006) or similar EPA published summary documents for specific industries.
- Commercial Activities: It is recommended that Anne Arundel County develop and implement public outreach and education efforts targeting business owners within the SWAAs (Zones 1 and 2). These efforts should focus on identifying business activities that could impact groundwater such as hazardous material use, storage and disposal, and alerting business owners to BMPs for reducing potential impacts. The PCS highlighted in Tables 8 and 10 and Figure 14 represent a subset of likely business types.

- Residential Activities: It is recommended that Anne Arundel County develop and implement public outreach and education efforts targeting homeowners and residents within the SWAAs (Zones 1 and 2). These efforts should focus on identifying common household activities, such as basic car maintenance, lawn fertilizer application[2], or household hazardous waste use and disposal, and should seek to identify ways to work with the residents to minimize the impacts associated with these activities. The County should provide guidance on best management practices that can be implemented around the home with the goal being to prevent and minimize impacts to groundwater quantity and quality.

5.2.2 Digital Information/Mapping Resources

The County should continue to develop mapping and Geographic Information Systems (GIS) resources. This effort will allow government to maintain and update high-precision geographic information related to SWAAs, water resources, PCS locations, potential effluent sources, and also provide the ability to generate custom maps. It is recommended that the SWAAs (as currently defined and subsequently updated) be permanently incorporated into the zoning and planning process as a required GIS layer.

These maps can be very useful in communicating information to the public and decision makers as it regards water policy and emergency response. At a minimum, AAC should maintain hard copy maps that depict the boundaries of the SWAAs, PCS, critical infrastructure, emergency transportation options, and areas of high vulnerability.

5.2.3 Source Water Assessment Areas and Source Water Protection Planning

It is recommended that he County update the delineation of SWAAs, and complete a new inventory of Potential Contaminant Sources, and a new Susceptibility Analysis at regular intervals; an interval of every 6 years is recommended, consistent with updates to the AAC Comprehensive Plan. This interval will be sufficient to account for identifying new trends in groundwater monitoring data, zoning and land use. An updated Source Water Protection Plan should be completed and provided to the town council after each review.

Between the completion of each new SWPP, the Department of Public Works and the Department of Planning should work together to implement the recommendations of the most current SWPP, including prohibited and accepted land uses within each SWAA.

Coincident with this review of water supply susceptibility, AAC should continue to review the WHPO regulations approximately every six years. This will provide the County with the opportunity to adjust items such as the prohibited land uses and will help to ensure that the WHPO regulations remain viable to implement.

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[2] Since nitrate levels are increasing, educating the public about preventing groundwater contamination through appropriate suburban landscaping techniques and more cautious use of fertilizers would be an obvious step to directly address concerns raised here.

5.3 Planning / New Development

It is recommended that AAC continue to preserve buffers for existing water supplies and identify opportunities for buffer protection of any new water supplies. Implementation of a Wellhead Protection Ordinance would directly address many other concerns associated with new development.

5.3.1 Transfer On-Site Septic to Regional Sewer System

All the SWAAs currently occupy areas with current, or planned future sewer service. AAC should continue to promote the transition of residential lands and businesses from on-site septic disposal to regional wastewater treatment facilities. This transition will help to reduce the potential for bacterial contamination of groundwater resources. Any future expansion of the service area should attempt to transition new parcels into the regional wastewater treatment facility.

This should be addressed by focusing on those lands that are within new or existing sewer service areas but are not yet connected, identifying new development adjacent to existing sewer infrastructure, then looking at expansion of the service areas. This will also help the region meet other nutrient reduction goals such as the TMDL regulations.

5.4 Public / Governmental Interaction

5.4.1 Establish Inter-Governmental Communication Protocol

It is recommended that AAC plans to meet with MDE to explicitly detail the responsibilities of each party with regard to wellhead protection, water quality monitoring, remediation, and similar activities. This agreement would include the creation of two meeting dates per year for the County and relevant agencies to meet with each other and discuss the state of the water resources under consideration. Items to be included in this discussion would include newly submitted groundwater withdrawal applications, current monitoring efforts and results, enforcement and remediation efforts, regulatory changes, and significant development proposals.

5.4.2 Public Awareness and Outreach

It is recommended that the County appoint an individual or agency to be responsible for communicating the importance of groundwater protection amongst the citizens and business interests of the Glen Burnie area.

5.4.3 Development of Outreach Strategy

The individual or agency identified above should develop a robust outreach strategy that is focused on educating residents on how water issues affect each of them and how they can take steps to minimize their impacts. These efforts would include the development of educational materials and their distribution (with, for example, water quality reports and water bills),

outreach events (sponsoring Water Day-type events at local schools to educate children), and sponsoring commercial programs designed to highlight local businesses who voluntarily enter into water protection or conservation programs.

The County may also develop a program that recognizes local businesses that take specific steps to reduce their water quality and quantity impacts. This could include elements such as:

- Installation of water efficient plumbing hardware;
- Use of newer stormwater management facilities that promote water infiltration;
- Identification and implementation of business-specific practices that save water (i.e. for a flower delivery business, instead of washing the vehicle in their parking lot where the effluent flows into nearby storm drains, the vehicle is washed in a car wash that recycles its greywater or treats the effluent before discharge).

Existing County community outreach programs that address water the water treatment program may serve as a platform on which to build new subject matter on hydrology and groundwater protection.

5.5 Land Acquisition and Easements

5.5.1 Acquisition of Land

It is recommended that Anne Arundel County and/or state agencies pursue the acquisition of additional lands within the SWAAs and/or watersheds of concern to the degree that such lands become available. The return on investment for these sources should be measured by proximity to the sources, relative size of the parcel, and by the opportunity to create or preserve natural areas on that site.

5.5.2 Creation of Easements

It is recommended that AAC strive to create conservation easements on parcels that offer opportunities to improve water quality. While there may be limited opportunities for such easements, any options should be evaluated. These conservation easements could be offered with terms similar to agricultural easements offered by the Maryland Department of Agriculture in that they have a 25 year life-span and offer tax incentives to the property owner for their creation and maintenance. These easements would prohibit the development of any structures or utilities within the preserved areas. The existing land use should be considered when evaluating potential properties since those with inherent water quality risks, such as industrial activities.

5.5.3 Funding Opportunities

It is recommended that AAC pursue means of outside funding to complement existing funding for water quality improvement and community outreach efforts to offset additional costs incurred by protection measures and recommended actions identified. EPA and MDE provide opportunities for grants and loans through various programs targeted for specific purposes. Table 11 provides information pertaining to each funding opportunity and contact information to pursue funding. A number of these programs, however, from MDE, and USEPA provide funding for public education that would be consistent with the recommendations of this report.

5.6 Implementation Schedule

Table 11 is a matrix summarizing the results of this report. It includes a listing of possible threats to water quality and supply, recommended actions, together with estimated costs, sources of funding, and schedule. Some potential costs and schedules are poorly defined at this time, and dependent upon further County action. These are noted as "TBD" in the table.

Section 6
Conclusions and Summary

The Source Water Assessment for Anne Arundel County's Semi-Confined and Unconfined wells of the Glen Burnie Public Water System has been updated to account for the current permitted water withdrawals. New Source Water Assessment Areas (SWAAs) have been delineated by updating the MODFLOW model used by URS (2003) in the previous Source Water Protection Plan. The SWAAs comprise about 3.5 square miles associated with 9 wells and 6 Water Appropriation Permits.

The susceptibility analysis for the Glen Burnie PWS finds that all of the groundwater and surface water sources are potentially susceptible to surface contamination, including VOCs, IOCs, and SOCs. The point sources previously identified in or near the SWAAs include potential sources of gasoline, motor oil, tetrachloroethylene (PCE), and other man-made chemicals, including fertilizers and pesticides. PCE has been detected in finished water from both the Glendale and Harundale Plants. In addition, natural occurring radionuclides as measured by the combined Radium data exceeded one-half the MCL at all Treatment Plants except for the Telegraph Road plant. Elevated radium and gross alpha values in groundwater are a known concern for large parts of Anne Arundel County, and are not a surface contamination issue.

Nitrate levels are generally below both the MCL of 10 mg/L and MDE's susceptibility flag of 5 mg/L. Review of the time series suggests that nitrate has increased in concentration slowly over the past decade, but actual concentrations are well below the criteria set by MDE.

Recommendations to the Anne Arundel County for management of the unconfined and semi-confined wells of the Glen Burnie system include the following:

- Develop a brief Addendum to ESF #12 of the AAC Emergency Operations Plan to specifically address
  - Source of alternate water supply for the Glen Burnie unconfined and semi-confined wells
  - Responsible Agencies for oversight of groundwater contamination issues
  - Steps to be taken in case of groundwater contamination
  - Documentation of known Contaminant Sources
- Implementation of a Wellhead Protection Ordinance focusing on Best Management Practices (BMPs) that address activities within Zone 1 and Zone 2 of the SWAAs, including
  - Stormwater Management, emphasizing environmental site design (ESD)
  - Additional oversight of potential SWM hotspots within SWAAs, including requirements for SWPPs from all business types cited in Table 2.6 of MDE's current SWM Manual
  - Setback Distances of SWM facilities from PWS wells
  - Commercial Activities at likely PCS – BMPs for handling of hazardous materials

  - Residential Activities – BMPS for handing of hazardous materials including fertilizers
- Continuing to update and maintain Digital Information/Mapping Resources, and incorporating the SWAAs into those resources
- Continuing to transfer on-site septic to regional systems
- Establishing an Inter-Governmental Communication Protocol to enhance communication about water issues between the state and county
- Public Awareness and Outreach
  - Development of Outreach Strategy to provide public education on groundwater protection and SWAAs
- Land Acquisition and Easements – where possible
  - Acquisition of Land in proximity to wellheads and within SWAAs
  - Creation of Easements in proximity to wellheads and within SWAAs

Section 7
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FIGURES

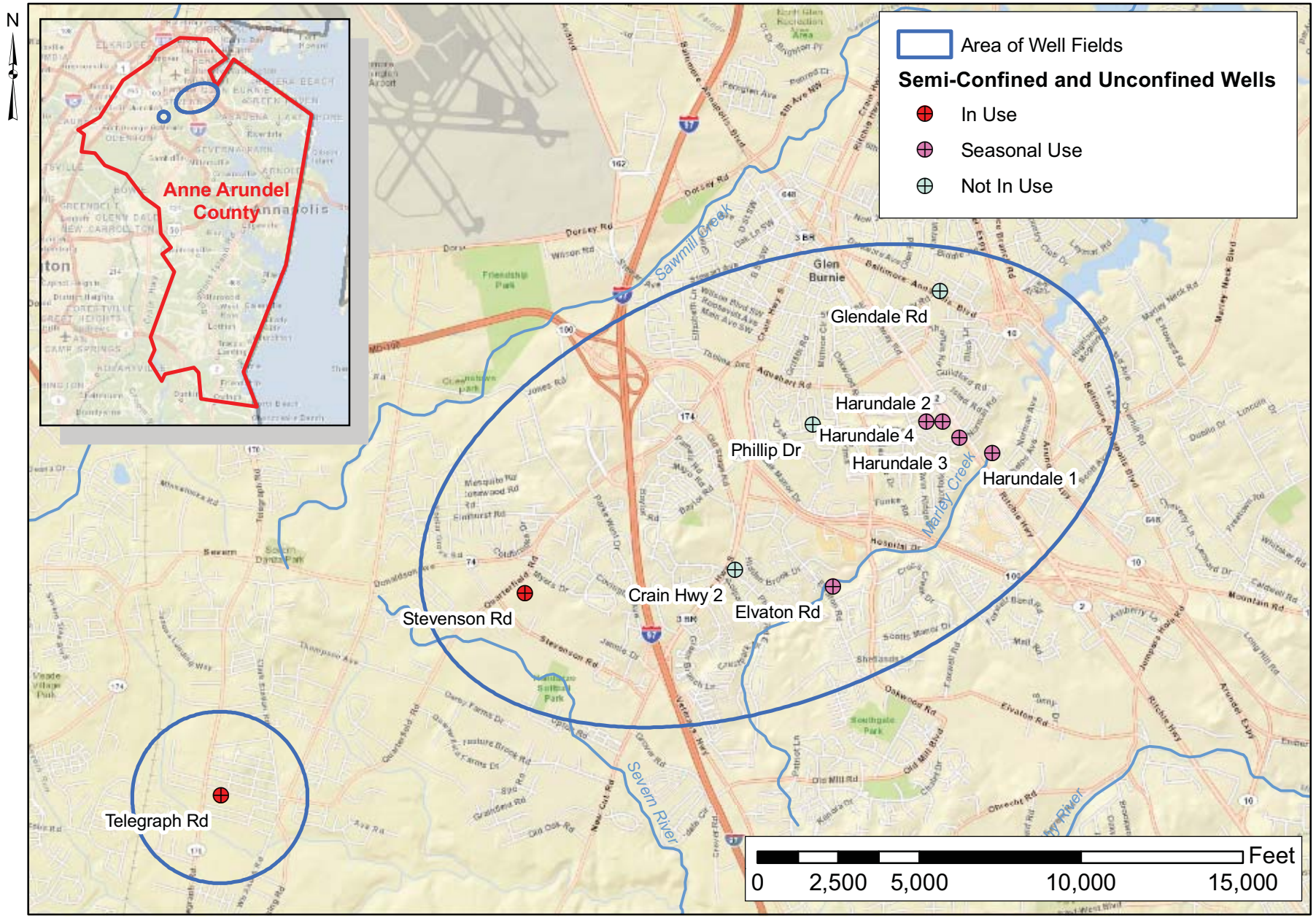

Figure 1 Location of Glen Burnie, Maryland and Unconfined and Semi-Confined Sources of the Glen Burnie PWS

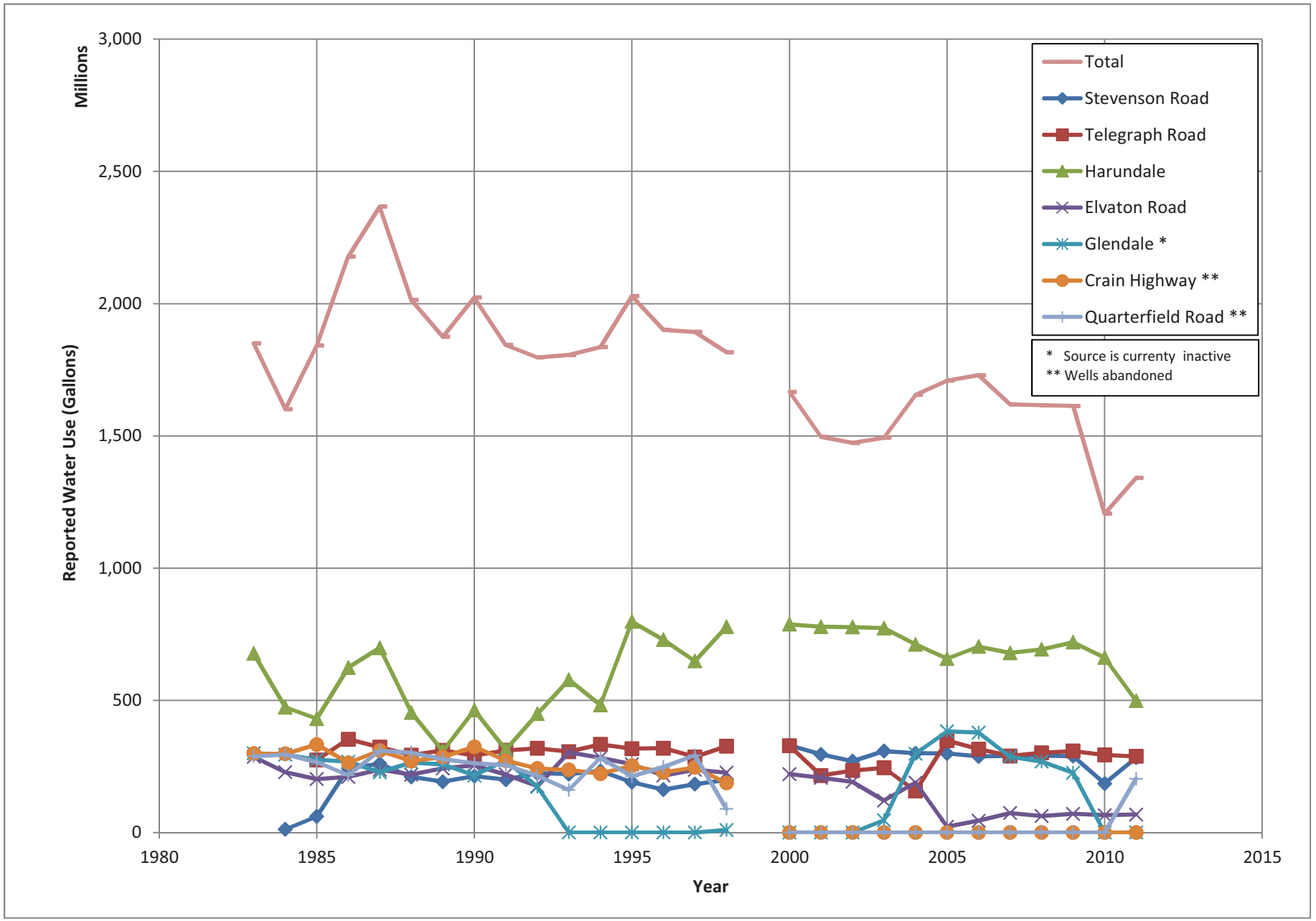

Figure 2 Reported Water Use for the Unconfined and Semi-Confined Sources of the Glen Burnie Public Water System

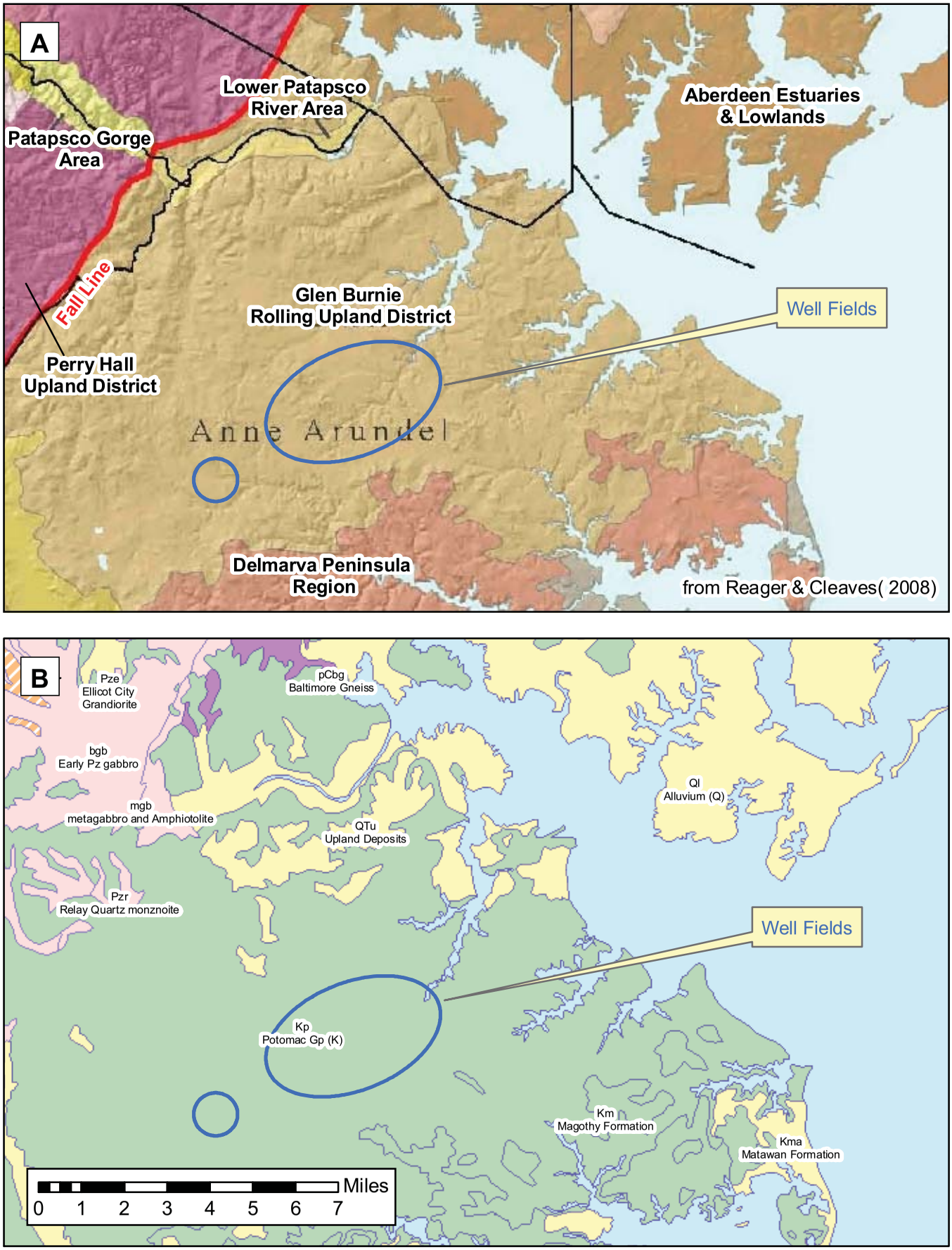

Figure 3 Physiographic Provinces of Maryland (A) and Bedrock Geology (B) in northern Anee Arundel County

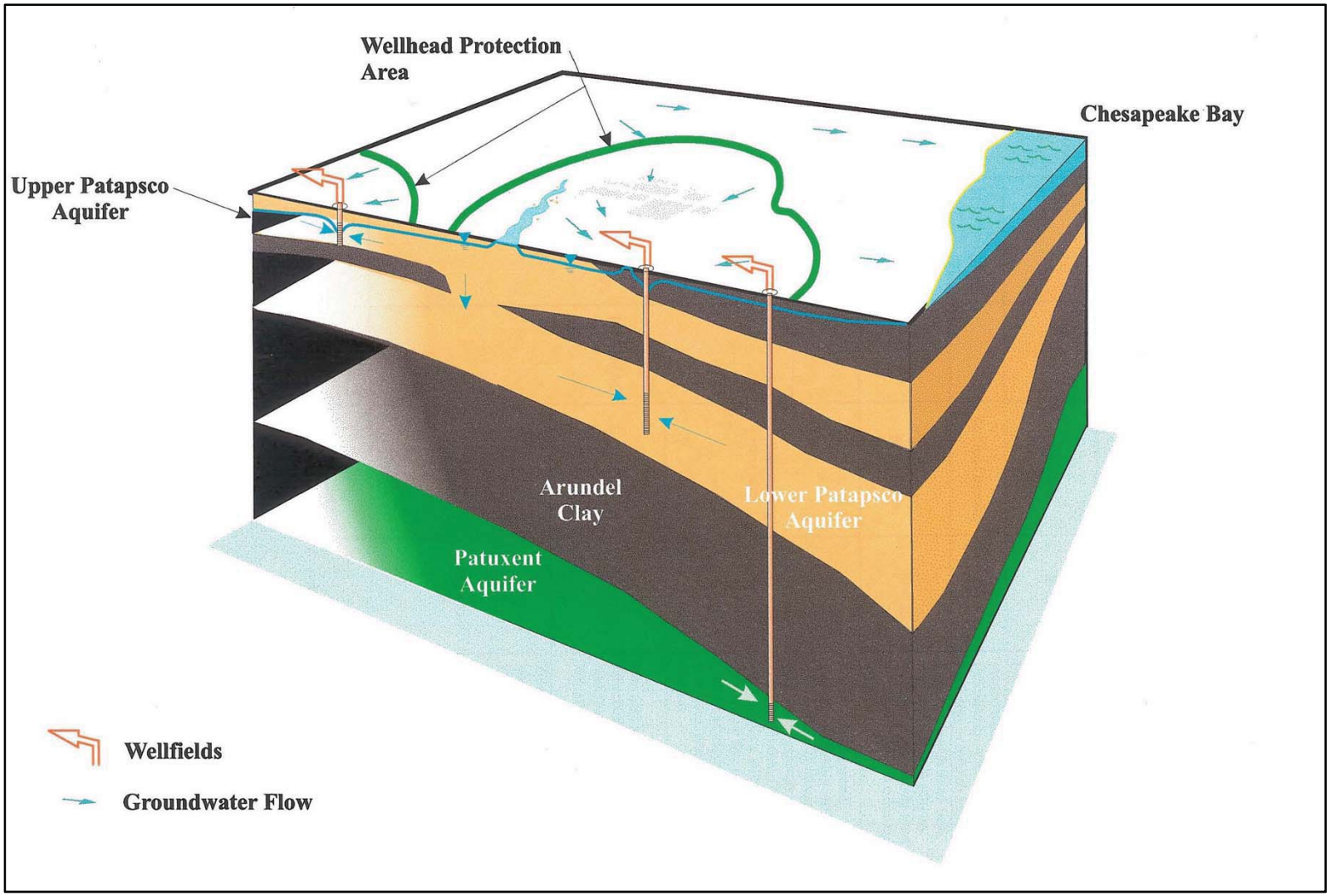

Figure 4 Schematic Groundwater Flow Beneath Anne Arundel County (from URS Corporation, 2003).

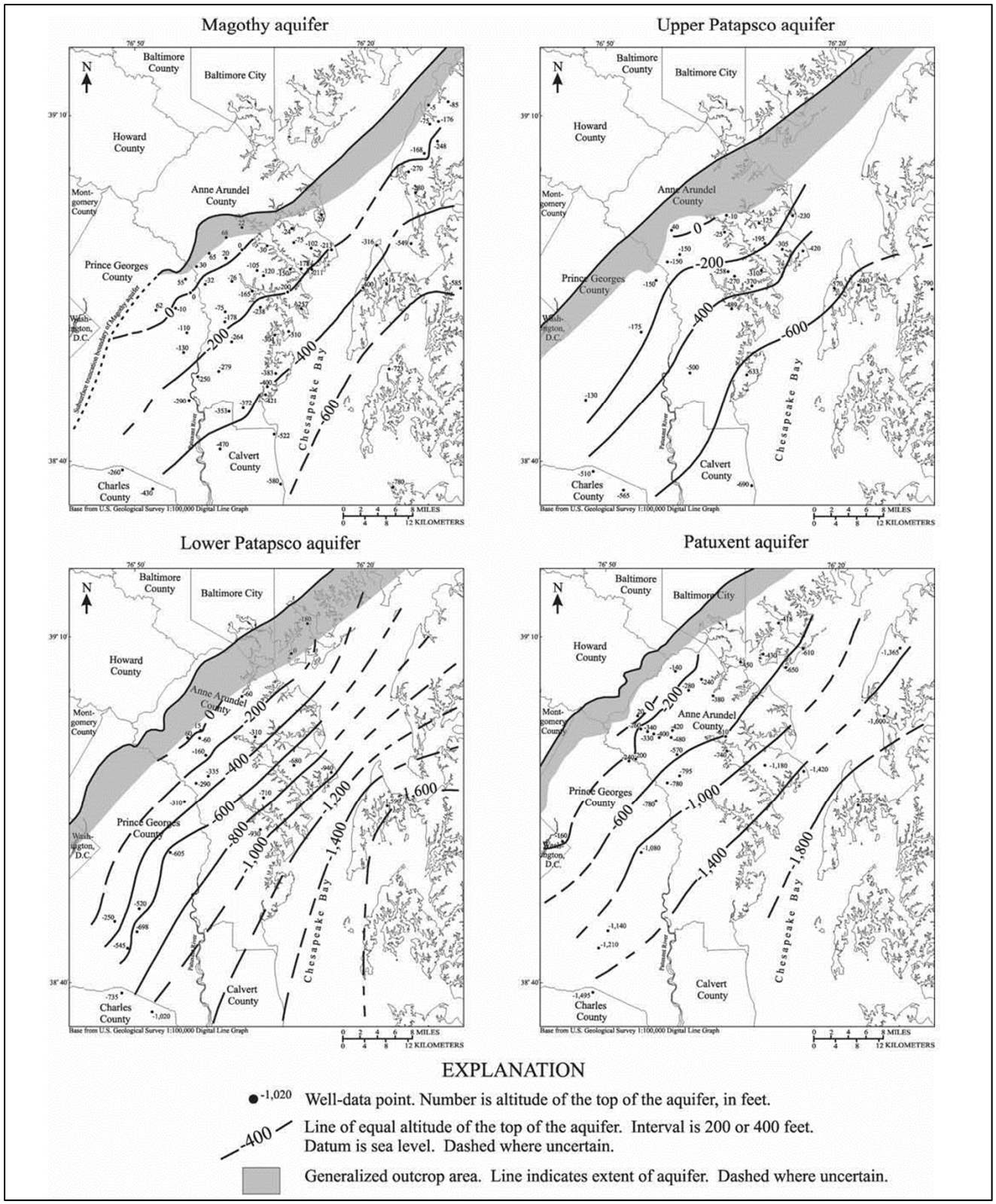

Figure 5 Altitude of the top of the Magothy, Upper Patapsco, Lower Patapsco, and Patuxent aquifers (from Andreason, 2007)

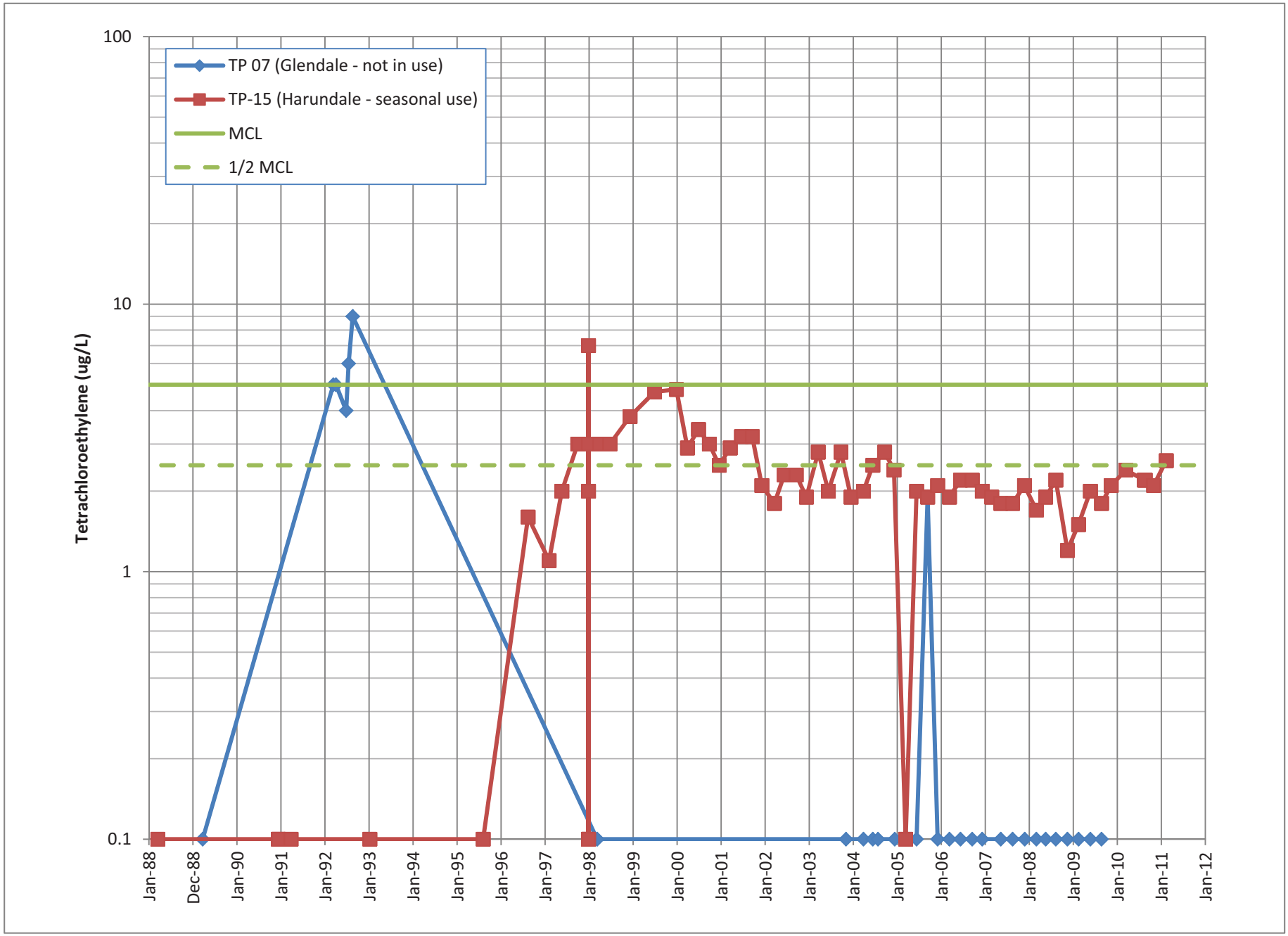

Figure 6 Reported Tetrachloroethylene (PCE) Concentrations from the Glendale and Harundale Treatment Plants, 1988 to present

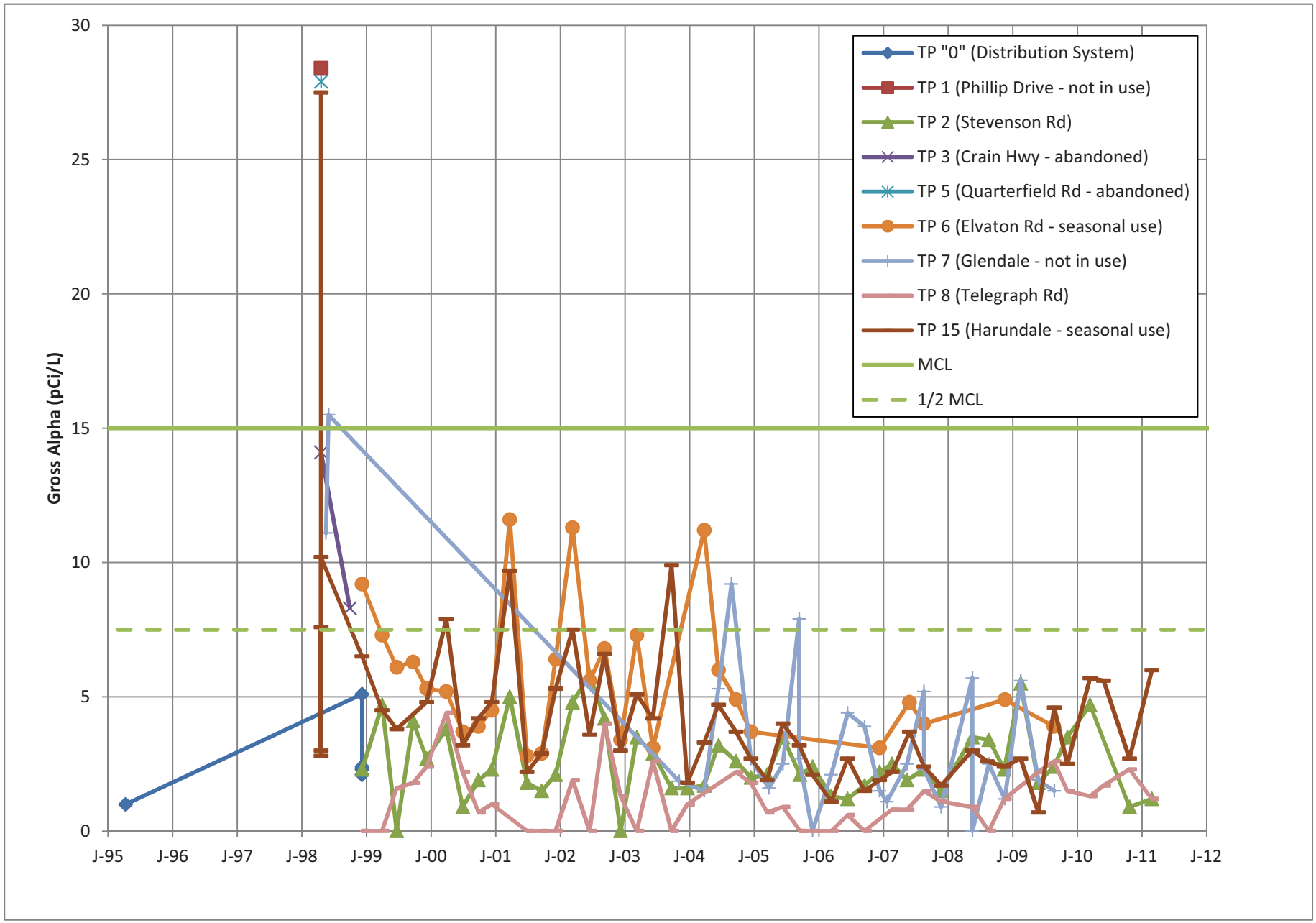

Figure 7 Gross Alpha (Radionuclide) Concentrations Reported for the Unconfined and Semi-Confined Sources of the Glen Burnie Public Water System

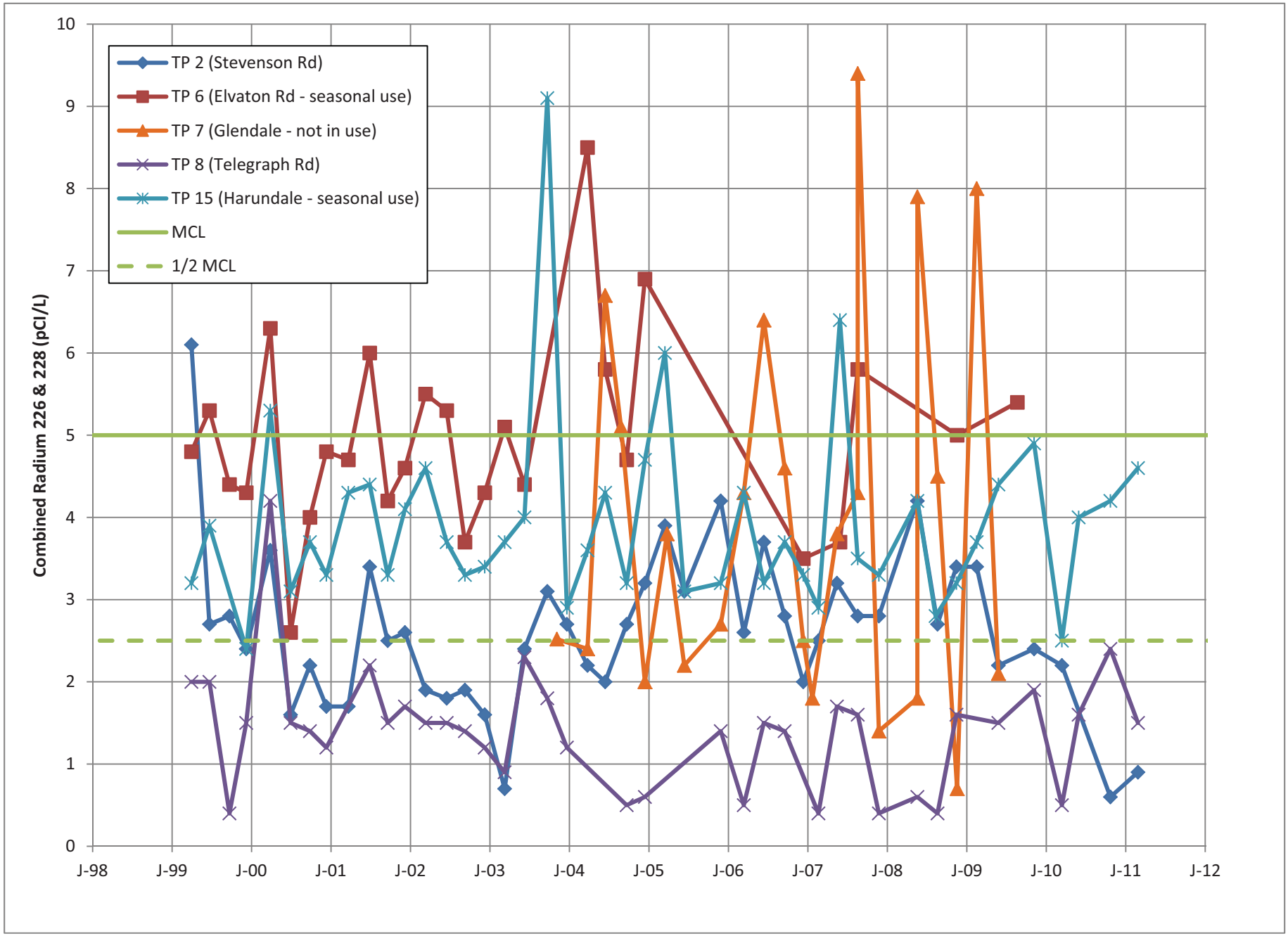

Figure 8 Combined Radium (226 and 228) Concentrations Reported for the Unconfined and Semi-Confined Sources of the Glen Burnie Public Water System

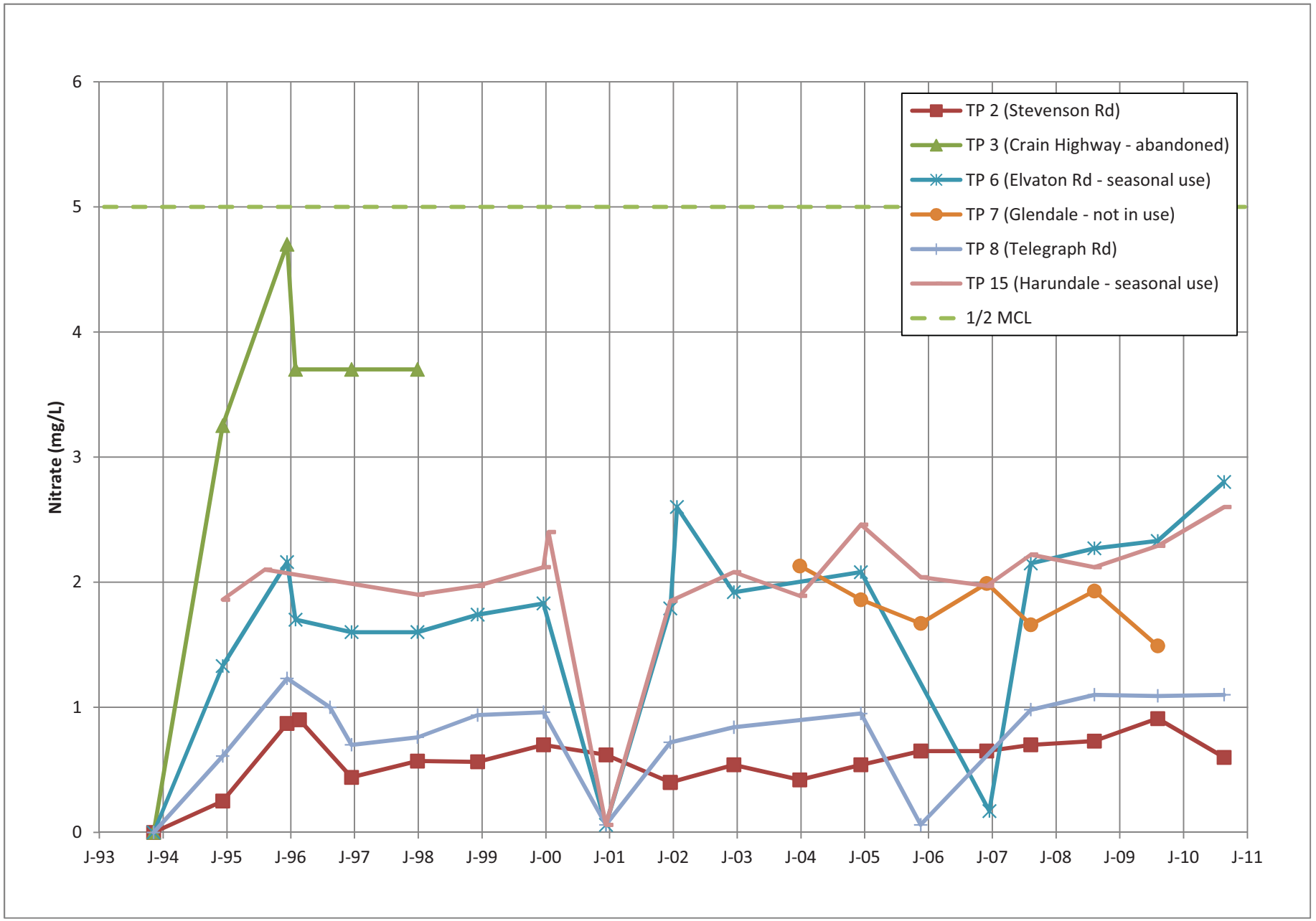

Figure 9 Nitrate Concentrations, Unconfined and Semi-Confined Sources of the Glen Burnie Public Water System

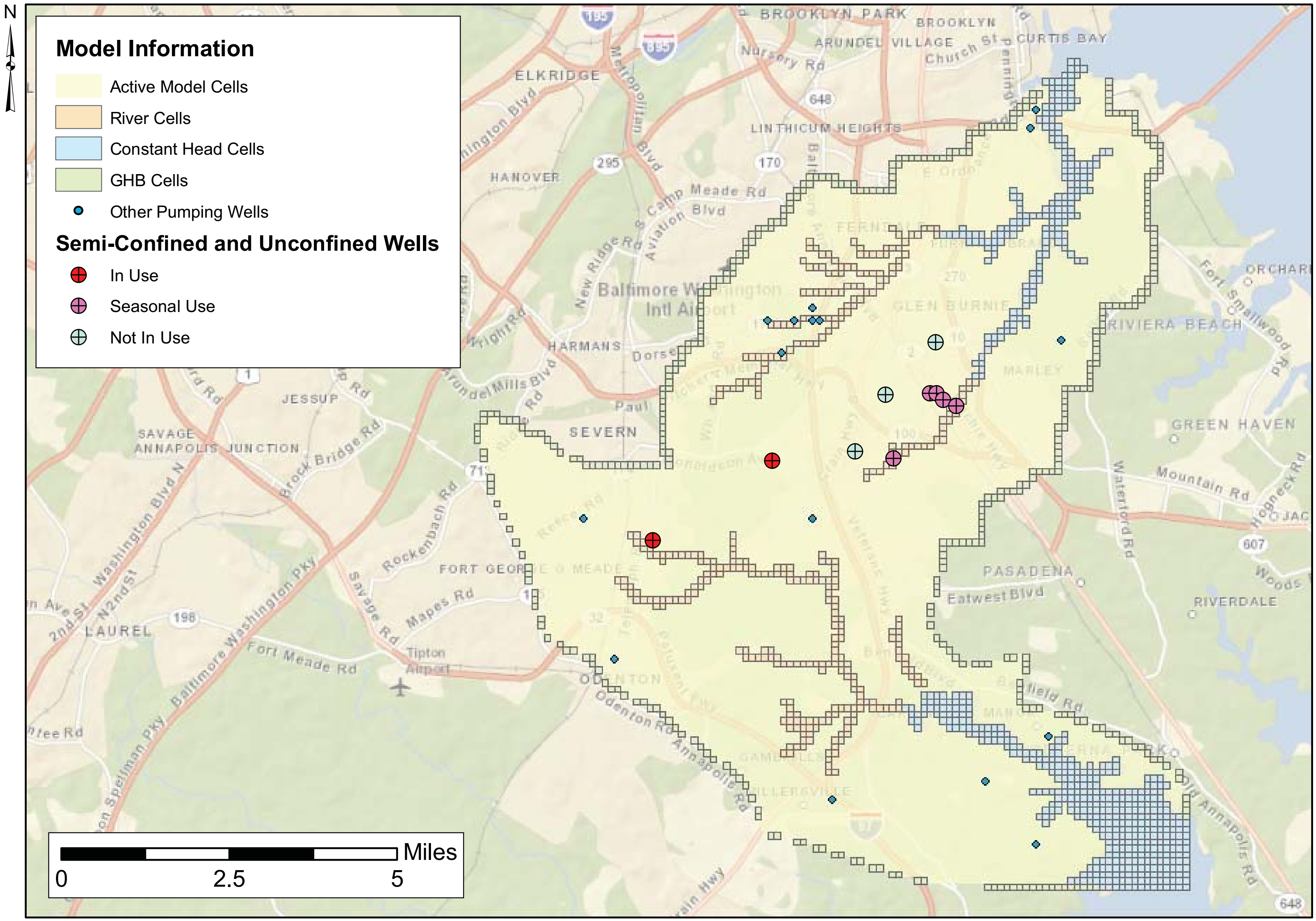

Figure 10 Layout of MODFLOW Model for Evaluating Source Water Assessment Areas

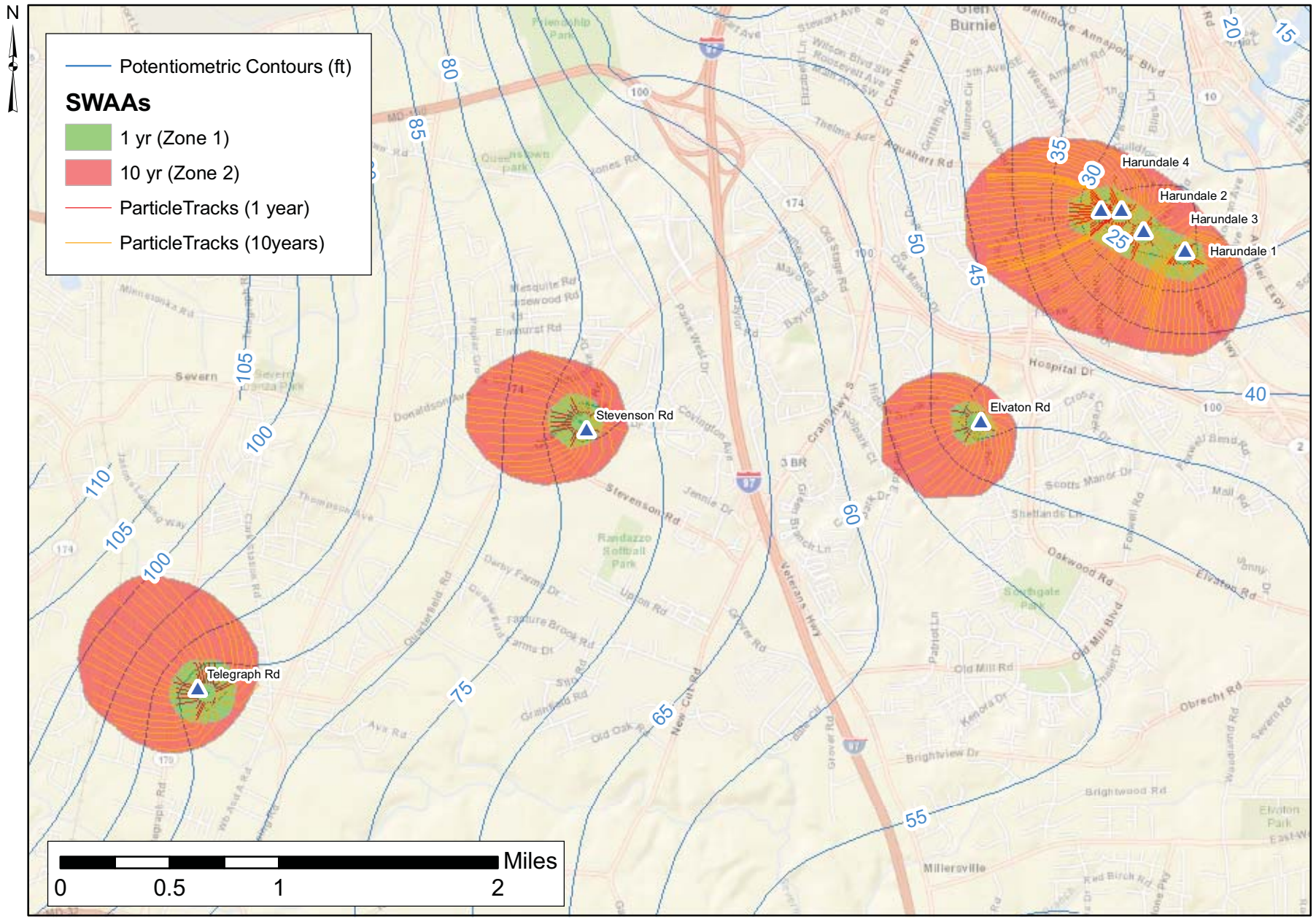

Figure 11 Simulated Potentiometric Surface and Source Water Assessment Areas for the Unconfined and Semi-Confined Sources of the Glen Burnie Public Water System

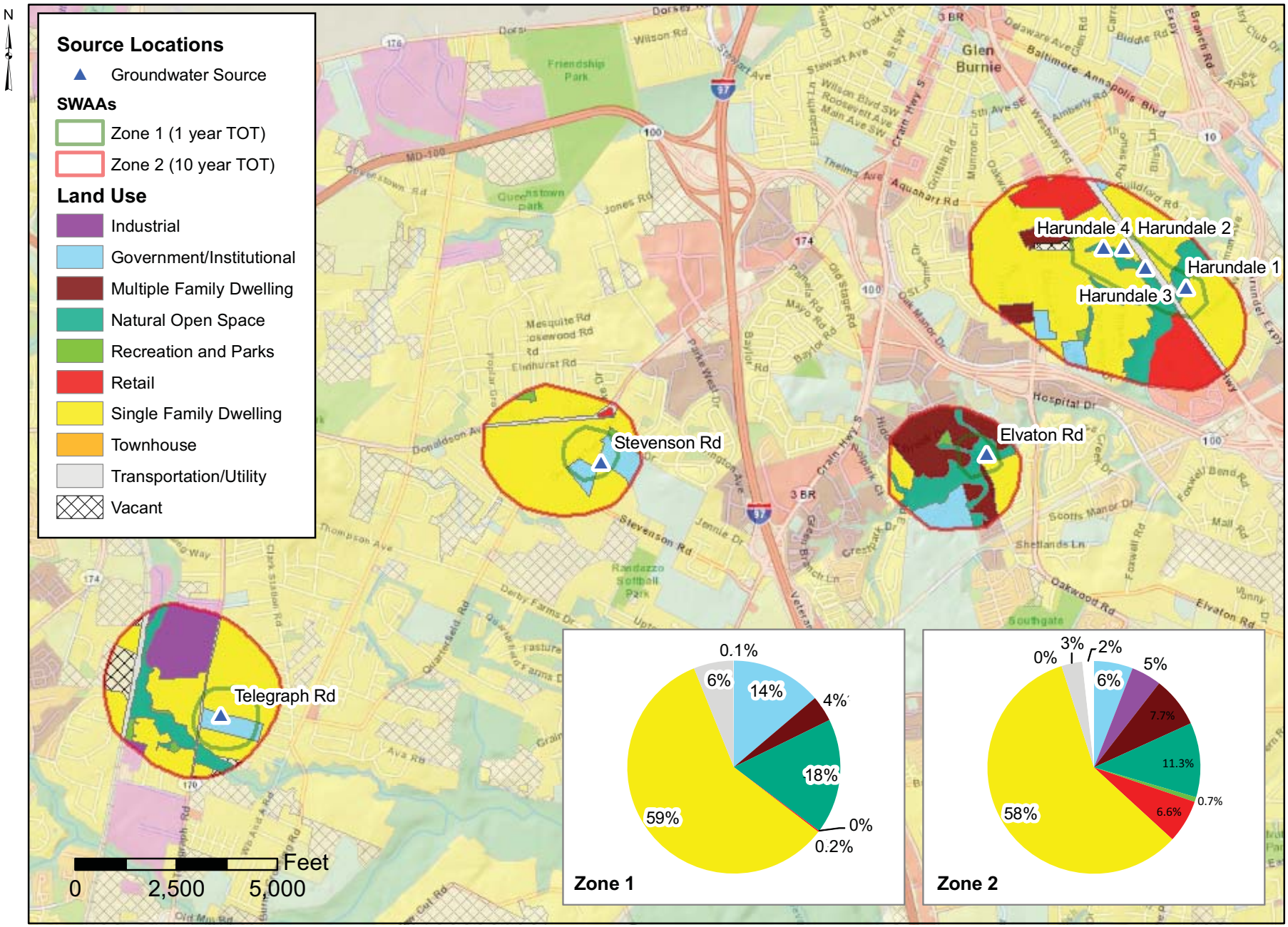

Figure 12 Land Use in the Source Water Assessment Areas for Unconfined and Semi-Confined Sources of the Glen Burnie Public Water System

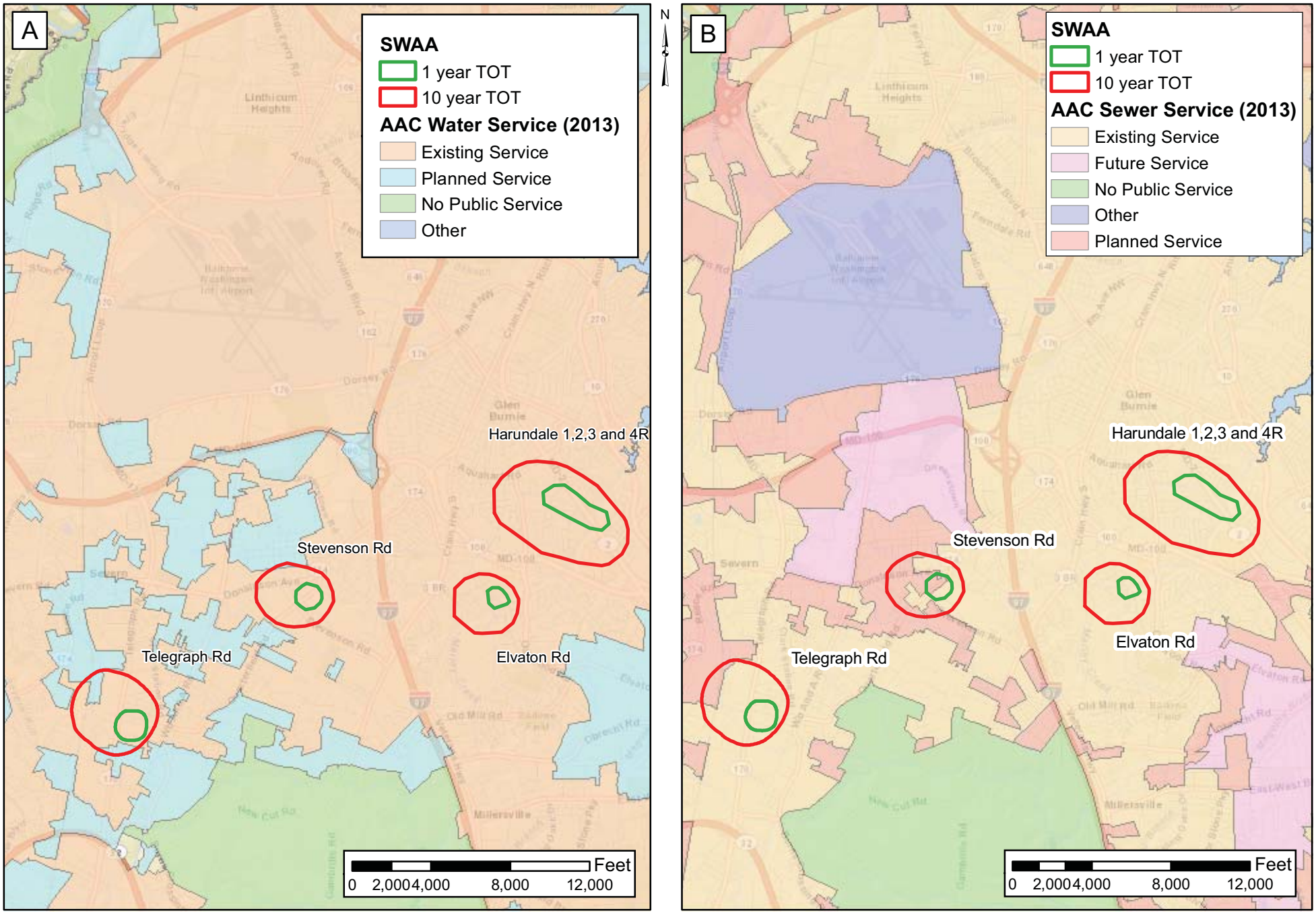

Figure 13 Water Service (A) and Sewer Service Areas (B) in the Vicinity of Glen Burnie

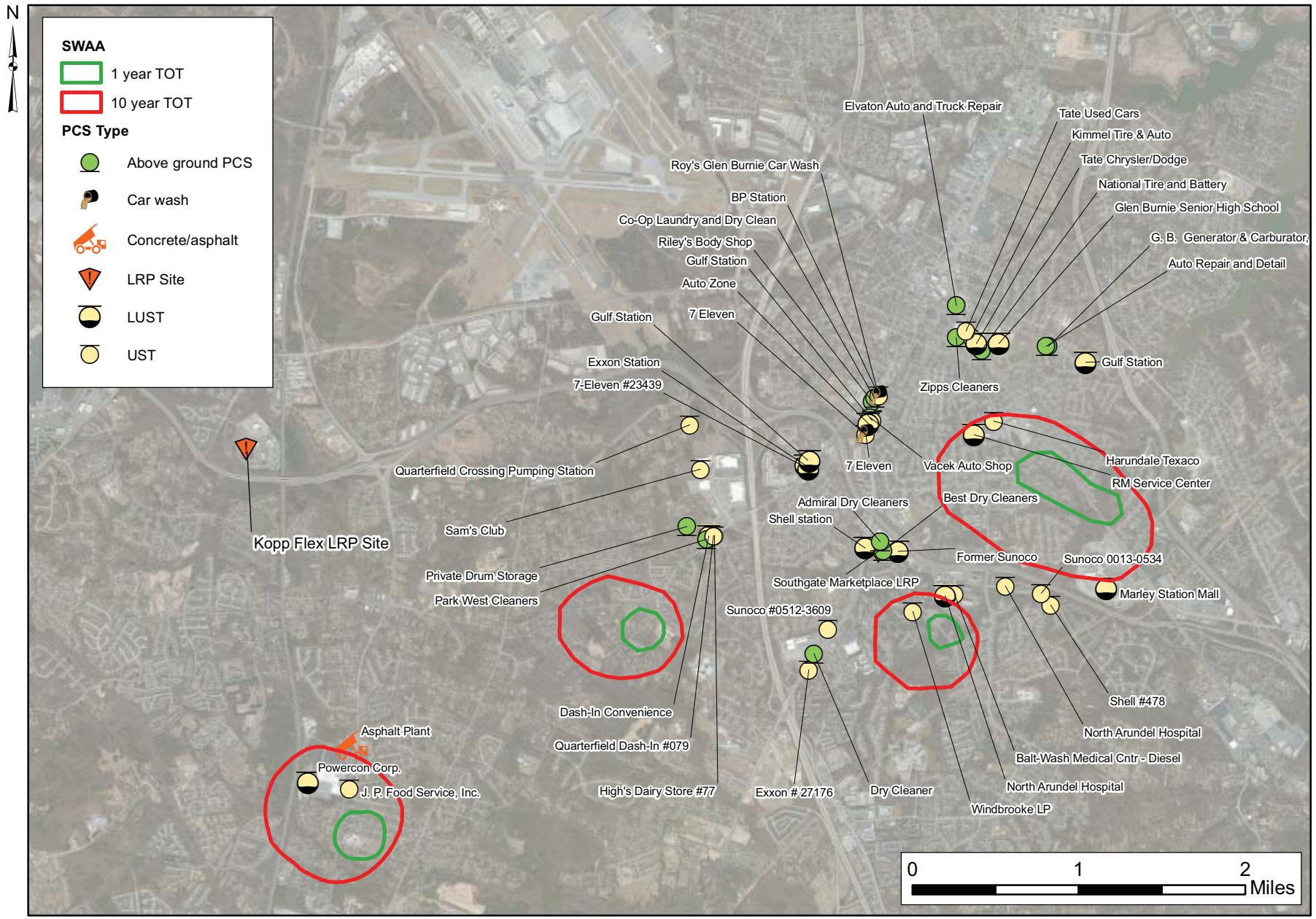

Figure 14 Potential Contaminant Sources in the Glen Burnie Area

TABLES

Table 1 Unconfined and Semi-Confined Sources of the Glen Burnie Public Water System

	SOURCES ADDRESSED IN THIS REPORT										Sources in 2003 SWAP Report?
	Source Type	Source ID	Plant ID	Source Name	Well Permit	Total Depth (ft)	Casing Depth (ft)	Completion Date	Screened Interval	Active?	
1	GW	3	2	Stevenson Road	AA810368	346	326	May-82	Patapsco Formation	Active	Yes
2	GW	8	6	Elvaton Road	AA691195	288	180	July-69	Patapsco Formation	Seasonal Use	Yes
3	GW	9	7	Glendale	AA690954	275	175	May-69	Patapsco Formation	Inactive	Yes
4	GW	10	8	Telegraph Road	AA810366	295	275	May-82	Patapsco Formation	Active	Yes
5	GW	14	15	Harundale 1	AA002803	123	98	June-48	Patapsco Formation	Seasonal Use	Yes
6	GW	15	15	Harundale 2	---	115	90	January-49	Patapsco Formation	Seasonal Use	Yes
7	GW	16	15	Harundale 3	AA019874	206	186	January-92	Patapsco Formation	Seasonal Use	Yes
8	GW	18	15	Harundale 4R	AA887363	220	172	April-92	Patapsco Formation	Seasonal Use	Yes
9	GW	47	3	Crain HWY 2-ASR	AA948021	264	195	August-02	Patapsco Formation	Inactive	---

Table 2 Water Appropriation Permits for Unconfined and Semi-Confined Sources of the Glen Burnie Public Water System

	WAPID	OWNER	SOURCES	Average Gallons per Day (AGPD)	Maximum Gallons per Day (MGPD)
1	AA1981G025	Anne Arundel County DPW	Stevenson Road	830,000	900,000
2	AA1981G026	Anne Arundel County DPW	Telegraph Road	1,000,000	1,100,000
3	AA1982G037	Anne Arundel County DPW	Harundale 1, 2, 3, 4R	2,200,000	2,600,000
4	AA1982G039	Anne Arundel County DPW	Elvaton Road	860,000	1,000,000
5	AA1982G043	Anne Arundel County DPW	Glendale	900,000	1,080,000
6	AA1982G044	Anne Arundel County DPW	Crain Highway #2 *	---	---
	TOTAL			**5,790,000**	

* Crain Highway Well under evaluation for ASR project, but injection not yet permitted; Exisiting WAP (AA1982G044 (05)) originally issued for Crain Highway Well #1 (now abandoned), most recently renewed in 2012

Table 3 Volatile Organic Compounds (VOCs) and Total Trihalomethanes (TTHM) Reported for Unconfined and Semi-Confined Sources of the Glen Burnie PWS

A. NON-TRIHALOMETHANES

Contaminant	Plant ID	Earliest Detect Date	Most Recent Detect Date	Number of Analyses	Count of Detections	Max Concentration (ug/L)
Methylene Chloride	7	06-Nov-03	06-Nov-03	23	1	0.7
Tetrachloroethylene	7	14-Sep-05	14-Sep-05	23	1	1.9
Tetrachloroethylene	15	19-Mar-01	16-Feb-11	164	40	3.2

B. INDIVIDUAL TRIHALOMETHANES

Contaminant	Plant ID	Earliest Detect Date	Most Recent Detect Date	Number of Analyses	Count of Detections	Max Concentration (ug/L)
Bromodichloromethane	1	23-Mar-06	23-Mar-06	1	1	0.7
Bromodichloromethane	6	26-Mar-08	26-Mar-08	2	1	0.9
Bromodichloromethane	7	13-Aug-08	13-Aug-08	23	1	9.2
Bromodichloromethane	15	21-Jun-01	21-Jun-01	164	1	2.6
Bromoform	7	13-Aug-08	13-Aug-08	23	1	0.5
Chloroform	1	23-Mar-06	23-Mar-06	1	1	1.7
Chloroform	2	31-Mar-10	31-Mar-10	2	1	0.6
Chloroform	6	26-Mar-08	26-Mar-08	2	1	1.1
Chloroform	7	13-Aug-08	13-Aug-08	23	1	40
Chloroform	15	21-Jun-01	21-Jun-01	164	1	7.3
Dibromochloromethane	6	26-Mar-08	26-Mar-08	2	1	0.8
Dibromochloromethane	7	13-Aug-08	13-Aug-08	23	1	2.5
Dibromochloromethane	15	21-Jun-01	21-Jun-01	160	1	1.6

C. TOTAL TRIHALOMETHANES

Contaminant	Plant ID	Number of Samples	Exceedances of One-Half MCL (40 ug/l)	Exceedances of MCL (80 ug/l)
Total Trihalomethanes	00 *	71	13	
Total Trihalomethanes	01	3	1	
Total Trihalomethanes	02	16		

* Disinfection byproduct results from distribution sytem not associated with a specific Treatment Plant

Table 4 Synthetic Organic Compounds (SOCs) Reported for Unconfined and Semi-Confined Sources of the Glen Burnie PWS

Contaminant	Plant ID	Earliest Detect Date	Most Recent Detect Date	Number of Analyses	Count of Detections	Max Concentration (ug/L)	MCL * (ug/L)
Pentachlorophenol	6	03/26/08	03/26/08	1	1	0.01	1
Di(2-Ethylhexyl) Phthalate	2	02/11/04	02/11/04	1	1	0.4	6
Di(2-Ethylhexyl) Phthalate	7	02/11/04	02/11/04	1	1	0.1	6
Di(2-Ethylhexyl) Phthalate	8	02/11/04	02/11/04	1	1	0.2	6
Di(2-Ethylhexyl) Phthalate	15	03/28/06	03/28/06	1	1	3.1	6

* Same as State of Maryland Groundwater Standards for Type I and Type II Aquifers

Table 5 Inorganic Compounds (IOCs) Reported for the Unconfined and Semi-Confined Sources of the Glen Burnie PWS

Contaminant	Number of Detections	Earliest Detect Date	Most Recent Detect Date	Min Concentration	Max Concentration	MCL	SMCL	Units
Alkalinity, Total	1	11/06/03	11/06/03	4	4			mg/L
Barium	14	12/16/02	08/11/09	0.009	0.037	2		mg/L
Beryllium	1	12/29/03	12/29/03	0.0005	0.0005	0.004		mg/L
Combined Radium (226 & 228)	145	03/22/01	03/02/11	0.4	9.4	5		pCi/L
Fluoride	16	12/17/01	08/25/10	0.057	1.75	4	2	mg/L
Gross Alpha	142	03/22/01	03/02/11	0.6	11.6	15		pCi/L
Gross Beta	1	11/06/03	11/06/03	1.6	1.6	50		pCi/L
Hardness, Total (as CaCO3)	1	11/06/03	11/06/03	10	10			mg/L
Nickel	8	12/16/02	08/11/09	0.003	0.016	0.1		mg/L
Nitrate	45	12/17/01	08/25/10	0.06	2.8	10		mg/L
Radium-226	155	03/22/01	03/02/11	0.1	4			pCi/L
Radium-228	131	03/22/01	03/02/11	0.8	5.6			pCi/L
Selenium	2	12/16/02	12/16/02	0.004	0.004	0.05		mg/L
Sodium	15	01/24/02	08/11/09	1.49	8.34			mg/L
Sulfate	5	12/16/02	08/10/09	1.13	4.69		250	mg/L

Table 6 Total and Fecal Coliform Results Reported for Unconfined and Semi-Confined Sources of the Glen Burnie PWS

Routine Samples				Repeat Samples			
Number of Samples Collected	**Number Positive for Total Coliform**	**Number Positive for Fecal Coliform**	**Number Indeterminate**	**Number of Samples Collected**	**Number Positive for Total Coliform**	**Number Positive for Fecal Coliform**	**Number Indeterminate**
19,282	3	0	0	16	1	0	0

Table 7 Land Use in the Source Water Assessment Areas for Unconfined and Semi-Confined Sources of the Glen Burnie PWS

1 YEAR TOT (Zone 1)	AREA (ACRES)					PERCENT AREA				
Land Use	**Elvaton Rd**	**Harundale 1,2,3 and 4R**	**Stevenson Rd**	**Telegraph Rd**	**TOTAL**	**Elvaton Rd**	**Harundale 1,2,3 and 4R**	**Stevenson Rd**	**Telegraph Rd**	**TOTAL**
Government/Institutional			11.2	14.2	25.4			37.2%	31.1%	13.8%
Multiple Family Dwelling	7.2	0.0			7.3	38.5%	0.0%			3.9%
Natural Open Space	8.9	23.3			32.2	47.4%	26.0%			17.5%
Recreation and Parks			0.0		0.0			0.0%		0.0%
Retail		0.4			0.4		0.4%			0.2%
Single Family Dwelling	2.7	55.9	18.9	30.2	107.7	14.1%	62.4%	62.8%	66.3%	58.5%
Transportation/Utility		9.9		1.2	11.1		11.0%		2.7%	6.0%
Vacant		0.1			0.1		0.1%			0.1%
TOTAL	18.8	89.7	30.2	45.6	184.2	100.0%	100.0%	100.0%	100.0%	100.0%

10 YEAR TOT (Zone 1)	AREA (ACRES)					PERCENT AREA				
Land Use	**Elvaton Rd**	**Harundale 1,2,3 and 4R**	**Stevenson Rd**	**Telegraph Rd**	**TOTAL**	**Elvaton Rd**	**Harundale 1,2,3 and 4R**	**Stevenson Rd**	**Telegraph Rd**	**TOTAL**
Government/Institutional	21.3	15.2	24.9	15.7	77.2	11.8%	2.6%	11.1%	4.9%	5.9%
Industrial				59.7	59.7				18.5%	4.6%
Multiple Family Dwelling	80.8	19.7			100.5	44.7%	3.4%			7.7%
Natural Open Space	45.7	65.1		37.1	147.9	25.2%	11.3%		11.5%	11.3%
Recreation and Parks	1.7	1.1	2.6	4.0	9.5	0.9%	0.2%	1.2%	1.2%	0.7%
Retail		84.3	1.2		85.5		14.6%	0.5%		6.6%
Single Family Dwelling	31.4	367.6	187.6	173.1	759.8	17.4%	63.6%	83.9%	53.8%	58.3%
Townhouse		0.0			0.0		0.0%			0.0%
Transportation/Utility		20.6	7.3	13.3	41.2		3.6%	3.3%	4.1%	3.2%
Vacant		4.0		19.0	22.9		0.7%		5.9%	1.8%
TOTAL	181.0	577.6	223.7	321.9	1,304.2	100.0%	100.0%	100.0%	100.0%	100.0%

Table 8 Potential Contaminant Sources in the Glen Burnie Area

No.	Potential Contaminant Source	Type
1	Admiral Dry Cleaners	Above ground PCS
2	Asphalt Plant, Telegraph Rd	Concrete/Asphalt Plant
3	Auto Repair and Detail	Above ground PCS
4	Best Dry Cleaners	Above ground PCS
5	Co-Op Laundry and Dry Clean	Above ground PCS
6	Dry Cleaner	Above ground PCS
7	Elvaton Auto and Truck Repair	Above ground PCS
8	G. B. Generator & Carburetor, Inc.	Above ground PCS
9	Kimmel Tire & Auto	Above ground PCS
10	National Tire and Battery	Above ground PCS
11	Park West Cleaners	Above ground PCS
12	Private Drum Storage	Above ground PCS
13	Riley's Body Shop	Above ground PCS
14	Vacek Auto Shop	Above ground PCS
15	Zipps Cleaners	Above ground PCS
16	7 Eleven	Car wash
17	Roy's Glen Burnie Car Wash	Car wash
18	Southgate Marketplace LRP	LRP Site
19	Kop-Flex Site	LRP Site
20	7-Eleven #23439	LUST
21	Auto Zone	LUST
22	Dash-In Convenience	LUST
23	Exxon Station	LUST
24	Former Sunoco	LUST
25	Glen Burnie Senior High School	LUST
26	Gulf Station	LUST
27	Gulf Station	LUST
28	Marley Station Mall	LUST
29	North Arundel Hospital	LUST
30	Powercon Corp.	LUST
31	RM Service Center	LUST
32	Shell station	LUST
33	Tate Chrysler/Dodge	LUST
34	7 Eleven	UST
35	Balt-Wash Medical Cntr - Diesel	UST
36	BP Station	UST
37	Exxon # 27176	UST
38	Gulf Station	UST
39	Gulf Station	UST
40	Harundale Texaco	UST
41	High's Dairy Store #77	UST
42	J. P. Food Service, Inc.	UST
43	North Arundel Hospital	UST
44	Quarterfield Crossing Pumping Station	UST
45	Quarterfield Dash-In #079	UST
46	Sam's Club	UST
47	Shell #478	UST
48	Sunoco #0512-3609	UST
49	Sunoco 0013-0534	UST
50	Tate Used Cars	UST
51	Windbrooke LP	UST

TABLE 9 Relevant Provisions of the Anne Arundel County Water Resources Element

Recommendations of Statewide Advisory Committees (cited in AAC WRP)	
	A regional, multi-aquifer groundwater flow model to assess water supply and impacts of future applications for withdrawals
	Additional monitoring of wells near large pumping centers to verify model predictability
	Developing standard methods of data collection, storage and transfer on domestic wells
	Evaluating the appropriateness of the 80% management level in aquifers in close proximity to their recharge areas
	Maryland must develop a more robust water resources program based on sound, comprehensive data. A statewide water supply plan should be developed that includes a strong outreach program
	Staffing, programmatic and information needs of the water supply management program must be adequately and reliably funded. A permit fee to fund the cost of administering the permitting system should be established. Hydrologic studies should be funded with a separate appropriation. In addition, funding should be provided to local governments for water resources planning and to expand the network of stream and ground-water monitoring for both water quantity and quality
	Specific legislative, regulatory and programmatic changes should be implemented including codifying the State's water allocation policies, requiring local jurisdictions to protect source waters, promoting collaborative local planning, facilitating regional planning and strengthening State and local programs for water conservation, water reuse, demand management, and individual wells. In addition, the use of individual wells in areas at high risk for well contamination should be discouraged, greater use should be made of the Water Management Strategy Areas, and administrative penalties for violations of water appropriation permits should be authorized
Other Goals Relevant to Source Water Protection (Groundwater)	
	Stormwater Regulations (implementation of MDE's Stormwater Manual, including 2009 updates focusing on Environmental Site Design); AAC Stormwater Manual
	Watershed Management Plans to address TMDLs for nutrients and bacteria
	Stream and Subwatershed Assessment and Ranking
	Targeted Nutrient Reduction Implementation Plans
	Septic Systems - Evaluation of On-site Sewate Disposal Systems (OSDS) manangement in areas zoned for public service
	- Partner with MDE and DNR to evaluate alternatives for new OSDS cluster treatment systems
	- Develop OSDS Environmental Fee Study and Ordinance
	- Develop OSDS Maintenance Ordinance
	- Make revisions to the General Development Plan: identify changes in areas of planned sewer service (additions and deletions); identify priorities; identify areas designated for limited sewer service for managing areas of existing OSDS targeted either for sewer extension or cluster systems

TABLE 10 Source Water Protection Funding Opportunities

Organization/ Funding Opportunity	Contact	Description	Website
MDA			
Conservation Reserve Enhancement Program (CREP)	Jim Stein (410) 571-6757	Offers financial assistance above the rates offered by the traditional Conservation Reserve Program. Program places land in conservation reserve or provides cost-share assistance for BMPs.	http://mda.maryland.gov/resource_conservation/Pages/crep.aspx
MDE			
Drinking Water Supply Assistance Program	Deborah Thomas (410)537-3722	Provides financial assistance for the acquisition, construction, rehabilitation and improvement of publicly owned water supply facilities to protect against health problems and meet federal SDWA requirements.	http://www.mde.maryland.gov/programs/water/qualityfinancing/saterqualityfinancehome/pages/programs/waterprograms/water_quality_finance/wqfa_ws.aspx
319 Nonpoint Source Program	Eric Ruby (410) 537-3685 (800) 633-6101	Provides financial assistance for the implementation of nonpoint source best management practices and program enhancements as a means of controlling the loads of pollutants entering the State's waterways.	http://www.mde.state.md.us/programs/Water/319NonPointSource/Pages/Programs/WaterPrograms/319nps/index.aspx
Bay Restoration Fund Enhanced Nutrient Removal	Rajiv Chawla (410)537-3770 (800) 633-6101	Provides up to 100 percent grant funding to upgrade wastewater treatment plants to enhanced nutrient removal (ENR) technologies.	http://www.mde.state.md.us/programs/Water/BayRestorationFund/Pages/water/cbwrf/enr.aspx
Maryland's Nitrogen-Reducing Septic Upgrade Program	Shan Abeywickrama 410-537-3921	Onsite Disposal Systems (OSDS) Fund: Provides up to 100 percent in grant funding for upgrades of existing systems to best available technology for nitrogen removal or for the marginal cost of using best available technology instead of conventional technology. Priority given to failing OSDS in Critical Areas	http://www.mde.state.md.us/PROGRAMS/WATER/BAYRESTORATIONFUND/ONSITEDISPOSALSYSTEMS/Pages/Water/cbwrf/index.aspx
Biological Nutrient Removal Cost-Share Program	Ms. Elaine Dietz (410) 537-3908 (800) 633-6101	Provides grants to local municipalities and agencies for upgrading WWTPs with biological nitrification/denitrification facilities to achieve a goal of annual average effluent concentration of 8 mg/l total nitrogen.	http://www.mde.state.md.us/programs/Water/QualityFinancing/SaterQualityFinanceHome/Pages/programs/waterprograms/water_quality_finance/wqfa_bnr.aspx
Linked Deposit Water Quality Revolving Loan Fund (WQRLF) and Drinking Water Revolving Loan Fund (DWRLF)	Mr. Jag Khuman (410) 537-3119 (800) 633-6101	Provides a source of low-interest financing for certain water quality and drinking water capital projects. Below market interest rates are passed on to borrowers by participating commercial lenders with investment agreements with MDE	http://www.mde.state.md.us/programs/Water/QualityFinancing/LinkedDeposit/Pages/programs/waterprograms/water_quality_finance/link_deposit/index.aspx
Sewerage Facilities Supplemental Assistance Program	Ms. Heather Fleming (410) 537-3327 (800) 633-6101	Provides financial assistance to local governmental entities in the form of grants, supplementing the Water Quality Loan funds, where affordability is a problem and to correct public health or water quality problems	http://www.mde.state.md.us/programs/Water/QualityFinancing/SaterQualityFinanceHome/Pages/programs/waterprograms/water_quality_finance/wqfa_supplemental.aspx
State Revolving Loan Fund/ Water Quality Financing	Mr. Jag Khuman (410) 537-3119 (800) 633-6101	Provides a source of low interest financing to encourage private landowners, and water system owners to implement capital improvements that will protect or improve the quality of Maryland's water resources and provide safe drinking water.	http://www.mde.state.md.us/programs/Water/QualityFinancing/Pages/Programs/WaterPrograms/water_quality_finance/index.aspx
Water Supply Program/ Drinking Water Supply Assistance Program	Ms. Debbie Thomas (410) 537-3722 (800) 633-6101	Provides financial assistance to local governments or to water supply systems for wellhead protection projects and direct loans to local governments or to water supply systems for land acquisition for source water protection.	http://www.mde.state.md.us/programs/Water/QualityFinancing/SaterQualityFinanceHome/Pages/programs/waterprograms/water_quality_finance/wqfa_ws.aspx
UST Loan Program/ Linked Deposit WQRLF & DWRLF	Mr. Greg Sonberg (410) 537-3412 (800) 633-6101	A program through the Water Management Administration, known as Linked Deposit, may provide owners of underground oil storage tanks (UST) a way to replace those tanks.	http://www.mde.state.md.us/programs/Water/QualityFinancing/LinkedDeposit/Pages/programs/waterprograms/water_quality_finance/link_deposit/index.aspx
UST Reimbursement Program (Oil Contaminated Site Environmental Cleanup Fund)/ The Oil Control Program	Mr. Christopher Ralston (410) 537-3443 (800) 633-6101	Provides financial assistance to owners or operators of USTs by reimbursing them for costs incurred as a result of an oil-contaminated site environmental cleanup project.	http://www.mde.state.md.us/programs/Land/OilControl/OilControlProgram/Pages/programs/landprograms/oil_control/pollutionmanagement/index.aspx
Environmental Benefits Districts	Lisa Nissley (410) 537-3812 (800) 633-6101	Offers financial, technical, and other appropriate resources to benefit targeted communities. This is a new initiative developed by MDE to foster sound environmental practices, healthy and safe communities, and proactive economic development for all Marylanders.	http://www.mde.state.md.us/programs/crossmedia/EnvironmentalJustice/EJImplementationinMaryland/Pages/programs/multimediaprograms/environmental_justice/implementation/details.aspx#ebd
USDA			
Conservation Reserve Program (CRP)	Judy Lynch (410) 535-1521 ext. 4	Contact specific for Anne Arundel County	http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp-sp
Conservation Innovation Grant (CIG) Program	Gregorio Cruz (703) 235-8065	Provides grants for the development and adoption of innovative conservation approaches and technologies. Provides more options for environmental enhancement and compliance with agricultural regulations.	http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044413.pdf
USEPA			
Assessment and Watershed Protection Program Grants (CFDA 66.480)	Federal Service Desk (866) 606-8220	Provides financial assistance for studies relating to water pollution, specifically for watershed management actions and policies.	https://www.cfda.gov/index?s=program&mode=form&tab=step1&id=8f560648f1725cee11f88ee3c25452ea
Environmental Education Regional Grants	Federal Service Desk (866) 606-8220	Provides financial assistance for environmental education projects that increase public awareness.	http://www.epa.gov/education/grants/index.html
Pollution Prevention Grants Program (CFDA 66.708)	Federal Service Desk (866) 606-8220	Provides financial assistance for pollution prevention technical assistance and projects for businesses.	https://cfda.symplicity.com/index?s=program&mode=form&tab=step1&id=15438a8058b068197cc298e0234f8695

TABLE 11 Glen Burnie SWPP - Implementation Matrix

Threat	Recommended Action	Estimated Cost *	Funding Sources	Schedule
Releases of Contaminants	Contingency Planning	<$10,000	General Revenues	within 1 year
	Transfer on-Site Septic to Regional System	---	General Revenues	ongoing
Inappropriate Land Use	Wellhead Protection Ordinance (WHPO)	TBD	General Revenues or Tax/fee dedicated to WHP	TBD
	Digital Information/Mapping Resources	---	General Revenues	within 30 days
	Periodic Updates of SWPP	$25,000 - $50,000	General Revenues	every 6 years
	Land Acquisition and/or Easement	site-specific	General Revenues Grants/Loans - see Table 10	As opportunities arise
Need for Public Education and Interaction	Public Education through DPW	<$10,000	General Revenues In-Kind Support	ongoing

* Cost Estimates are based upon current implementation, and do not account for changes in costs over time

APPENDIX A

Example
Wellhead Protection Ordinance[1]

For Anne Arundel County[2]
September, 2013

Based on the
Maryland Model Wellhead Protection Ordinance
February 1997,
Revised August 2005
Revised August 2007

Maryland Department of the Environment
Water Management Administration
Water Supply Program

[1] This text has not been reviewed, approved, or otherwise endorsed by attorneys, planners or other parties responsible for enacting legislation for Anne Arundel County. It is provided as a framework and suggestion, only.
[2] This draft is based upon conditions in the Glen Burnie of Anne Arundel County, and would need to be evaluated with respect the entire county prior to implementation.

Table of Contents

Section 1.0 PURPOSE AND INTENT

WHEREAS, the ground water underlying the community water supply wellhead protection areas is a major source of Anne Arundel County's existing and future water supply; and

WHEREAS, a safe and adequate source of drinking water is of great benefit to the health and well being of Anne Arundel County; and

WHEREAS, the aquifer systems supplying the community water supply wellhead protection areas, with its ground water supply, is integrally connected with numerous surface waters and streams; and

WHEREAS, accidental spills and discharges of toxic and hazardous materials can threaten the quality of such water supplies, posing public health and safety hazards; and

WHEREAS, unless preventive measures are adopted to control the discharge and storage of toxic and hazardous materials within the community water supply wellhead protection areas, further spills and discharges of such materials will predictably occur, and with greater frequency and degree of hazard by reason of increasing land development, population, and vehicular traffic within the wellhead protection areas; and

WHEREAS, agricultural and residential development can result in increased nitrogen loading to the ground water from septic systems, fertilizer application and livestock wastes; and

WHEREAS, proper siting, installation, operation, and maintenance of septic systems, agricultural operations, feedlots and animal wastes areas are necessary to prevent contamination of the ground water from excessive nitrogen and pathogenic organisms; and

WHEREAS, the purpose of this ordinance is to protect the public health, safety, and welfare through the preservation of the ground water resources of community public water supplies to ensure a future supply of safe and healthful drinking water. The designation of the wellhead protection districts, and careful regulation of development activities within these districts, can reduce the potential for ground and surface water contamination.

Section 2.0 DEFINITIONS

A. **AQUIFER** means any formation of soil, sand, rock, gravel, limestone, sandstone, or other material, or any crevice from which underground water is or may be produced.

B. **BEST MANAGEMENT PRACTICES (BMPs)** means a conservation or pollution control practice that manages wastes, agricultural chemicals, or hazardous materials so as to minimize movement into surface or ground waters of the State.

C. **CONTAINMENT DEVICE** shall be defined as a device that is designed to contain an unauthorized release, retain it for cleanup, and prevent released materials from penetrating into the ground.

D. **EPA** refers to the United States Environmental Protection Agency.

E. **EPA STORMWATER NPDES PERMIT** shall be defined as a permit meeting the requirements of the National Pollutant Discharge Elimination System Permit Application Regulations for Storm Water Discharges issued by EPA on November 16, 1990.

F. **HAZARDOUS MATERIALS** means any substance that: (1) conveys toxic, lethal, or other injurious effects or which causes sublethal alterations to plant, animal, or aquatic life; or (2) may be injurious to human beings. Hazardous materials include any matter identified as a "hazardous waste" by the Environmental Protection Agency or a "controlled hazardous substance" by the Maryland Department of the Environment.

G. **MDE** refers to the Maryland Department of the Environment.

H. **NUTRIENT/MANURE MANAGEMENT PLAN** shall be defined as a plan prepared by a certified nutrient management consultant to manage the amount, placement, timing, and application of animal waste, fertilizer, sewage sludge, and other plant nutrients in order to prevent pollution and to maintain productivity of the soil.

I. **ON-SITE FLOOR DRAINS** shall be defined as drains which are not connected to municipal sewer or stormwater systems and which discharge directly to the ground or septic system.

J. **OWNER** shall be defined as a property owner or his duly authorized agent or attorney, a purchaser, devisee, fiduciary, and any other person having vested or contingent interest in the property of question.

K. **PERSON** shall be defined as any natural person, individual, public or private corporation, firm, association, joint venture, partnership, municipality, government agency, political subdivision, public officer, owner, lessee, tenant, or any other entity whatsoever or any combination of such, jointly or severally.

L. **PESTICIDE** shall be defined as any substance or mixture of substances intended for: (1) preventing, destroying, repelling, or mitigating any pest; (2) use as a plant regulator, defoliant, or desiccant; or (3) use as a spray adjuvant such as a wetting agent or adhesive.

M. **RULES AND REGULATIONS OF MDE** shall be defined as official publications of MDE with standards and requirements for protection of ground water resources.

N. **UNDERGROUND INJECTION WELL** shall be defined as a bored, drilled, driven or dug well whose depth is greater than the largest surface dimension, through which fluids enter the subsurface; or, an improved sinkhole; or, a subsurface fluid distribution system.

O. **UNDERGROUND STORAGE TANK** means an underground storage tank, connected piping, underground ancillary equipment, and containment system, if any.

P. **WELLHEAD PROTECTION DISTRICT** means that land area overlying the aquifer which contributes water to a public water supply well under the permitted withdrawal rate (average annual) and average annual recharge conditions that can be anticipated based on historical data. It is bounded and may be influenced by the ground water divides which result from pumping the well and by the contact of the aquifer with less permeable geologic boundaries. In all cases, the Wellhead Protection District shall extend upgradient to its point of intersection with prevailing hydrogeologic boundaries (a ground water flow divide, a contact with geologic formations, or a recharge boundary), or be limited by time-of-travel. The Wellhead Protection District shall be reviewed and approved by MDE.

The Wellhead Protection District may include two (2) zones of protection, with Zone 1 being the most restrictive. Zone 1 is based on a 1-year Time of Travel (TOT), as determined by the methodology for Coastal Plain aquifers in the MDE's Source Water Protection Plan (1999). Zone 2 is based on the 10-year TOT as similarly calculated.

Q. **YARDING AREAS** shall be defined as a pen or other outdoor area used for the feeding and care of livestock or poultry.

Section 3.0 AUTHORITY

Section 3.1 Enabling Statute

WHEREAS, Anne Arundel County has duly adopted within the Comprehensive Plan, after public notice and hearing, a Sensitive Areas Plan element in accordance with §3.05 of Article 66B of the Annotated Code of Maryland; and

WHEREAS, § 3.05 of Article 66B requires protection of streams and their buffers, 100-year floodplains, habitats of threatened and endangered species (habitat), and steep slopes; and

WHEREAS, § 3.05 (a)(2) of Article 66B authorizes protection of additional types of sensitive areas; and

WHEREAS, Anne Arundel County the has determined through the Sensitive Areas element of the Comprehensive Plan that, in addition to streams and their buffers, 100-year floodplains, habitats of threatened and endangered species, and steep slopes, wellhead protection areas are in need of special protection; and

WHEREAS, § 4.01 of Article 66B empowers Anne Arundel County with the authority to regulate and restrict land use for the purpose of promoting the health, safety and general welfare of the community; and

WHEREAS, Section 1428 of the Federal Safe Drinking Water Act Amendments of 1986 requires that each state develop a wellhead protection program to protect public water supplies from contamination from contamination; and

WHEREAS, the Maryland Department of the Environment (MDE) has developed a wellhead protection program, approved by EPA, which identifies that local governments have

responsibility for developing programs, including regulations and management controls, to protect public water supplies from contamination.

Section 4.0 APPLICABILITY

A. This Ordinance applies to all land uses and activities located or proposed within the area delineated as the Wellhead Protection District in Anne Arundel County on a map available for inspection at the office of the Anne Arundel County and as defined in the definitions section of the ordinance. The Wellhead Protection District consists of Zone 1, and Zone 2 as described in 5.0 below.

B. This Ordinance is supplementary to other laws and regulations. Where this Ordinance or any portion thereof imposes a greater restriction than is imposed by other regulations, the provisions of this Ordinance shall control.

Section 5.0 EXTENT AND DESIGNATIONS

A. The Wellhead Protection District includes differing zones of protection as recommended by MDE.

1. Zone 1 is based on a 1-year Time of Travel (TOT), as determined by the methodology for Coastal Plain aquifers in the MDE's Source Water Protection Plan (1999), and as delineated in the Source Water Protection Plan for the Glen Burnie PWS (2013) and its subsequent updates. MDE has indicated its approval of this area as being consistent with the requirements of Section 1428 of the Safe Drinking Water Act by letter dated _____.

2. Zone 2 is based on a 10-year Time of Travel (TOT), as determined by the methodology for Coastal Plain aquifers in the MDE's Source Water Protection Plan (1999), and as delineated in the Source Water Protection Plan for the Glen Burnie PWS (2013) and its subsequent updates. MDE has indicated its approval of this area as being consistent with the requirements of Section 1428 of the Safe Drinking Water Act by letter dated _____.

B. The maps delineating the Wellhead Protection District and Zone(s) (1&2) are entitled (title and date) and are incorporated herein and made a part of this Ordinance. The maps shall be on file and maintained by _____. Accurate copies of these maps shall be made available for review by the public.

C. In determining how properties within the Wellhead Protection District depicted on the (title and date of map) are affected by the requirements of this ordinance the following rules shall apply:

1. Properties located wholly within one zone as reflected on (title and date of map) shall be governed by the restrictions applicable to that Zone.

2. Properties having parts lying within more than one zone as reflected on the (title and date of map) shall be governed by the restrictions applicable in each zone.

3. Where the boundary line between two zones passes through a building, the entire building shall be considered to be in that zone in which more than fifty (50) percent of the floor space of the building is situated.

D. The boundary of the Wellhead Protection District or individual zones within the District may be modified should additional information or analysis be provided that shows that the current boundary lines no longer appropriately reflects the criterion which they purport to represent. Such evaluations will be made at a minimum every six years, coincident with preparation of the City's Comprehensive Plan and Water Resources Element.

Procedures for modification of such boundaries shall be as follows:

1. The applicant wishing a change in boundary shall provide the evidence to the Zoning Commissioner. The applicant shall petition the Zoning Commissioner for a special hearing/District Reclassification and be required to present detailed hydrogeologic and hydrologic information to the Board of Appeals indicating where in fact the new boundary line should be drawn. The applicant shall provide (No. of copies) copies of all reports and maps to the Zoning Commissioner for a technical review of geologic and hydrologic, and any other relevant information. Maps shall be submitted on the same scale or more detailed as the official Wellhead Protection District Maps.

2. The Zoning Commissioner shall seek competent technical advice of such a change request. The (name of community) wellhead protection planning team shall be given a copy of the information given to the zoning commissioner and be granted adequate time to comment on the proposed change.

3. The burden of proof shall be on the applicant to show that the current boundaries do not represent the criterion which they purport to represent.

4. If after receiving written advice from Anne Arundel County planning team and/or other technical advisors, and the Zoning Commissioner believes that the proposed change has merit, all property owners potentially affected by the changes shall be sent notices indicating the proposed change. An opportunity for public comment of sixty (60) days after notices are sent shall be provided.

5. After close of the comment period the Zoning Commissioner shall make his decision.

6. Any maps so revised shall be incorporated and made part of this Ordinance and kept on file and available to the public for review by (name of appropriate agency).

Section 6.0 USE REGULATIONS

Section 6.1 Permitted Uses

The following uses shall be permitted:

A. Conservation of soil, water, plants, and wildlife;

B. Outdoor recreation, nature study, boating, fishing, and hunting where otherwise legally permitted;

C. Foot, bicycle, and/or horse paths, and bridges;

D. Normal operation and maintenance of existing water bodies and dams, splash boards, and other water control, supply and conservation devices;

E. Maintenance, repair, and enlargement of any existing structure, subject to Section 6.2 prohibited uses;

F. Residential development, subject to Section 6.2 prohibited uses;

G. Farming, gardening, nursery, conservation, forestry, harvesting, and grazing, subject to Section 6.2 prohibited uses; and

H. Construction, maintenance, repair, and enlargement of drinking water supply related facilities such as, but not limited to, wells, pipelines, aqueducts, and tunnels. Underground storage tanks related to these activities are not categorically permitted.

Section 6.2 Prohibited Uses

The following uses are prohibited or conditional within the designated protection zone(s):

			Zone 1	Zone 2
A.		Bulk Storage of Hazardous Materials, except the following[2]	X	Cu
	1.	Materials needing for normal household use, outdoor maintenance, and heating of a structure;		
	2.	Waste oil retention facilities required by statute, rule, or regulation;		
	3.	Materials needed for emergency generators; or		
	4.	Materials used in Water Treatment Plants.		
B.		Dry Cleaning Establishments, Coin or Commercial Laundries	X	Cu
C.		Garage, Service Station	X	Cu
D.		Heavy Manufacturing Uses	X	X
E.		Junk Yard	X	X
F.		Yarding Area	X	Cu[3]
G.		Manure Piles, Animals Waste Pits, Lagoons, and Sewage Sludge Storage Facilities	X	Cu
H.		Metal Plating Establishments	X	X
I.		On-site Wastewater Disposal	X	Cu[4]
J.		Open Burning Sites and Dumps	X	X
K.		Quarries and Mining Operations	X	X

L.		Storage of Deicing Chemicals	X	Cu
M.		Disposal of Fuels or Hazardous Materials	X	X
N.		Sanitary Landfills and Rubble Fills	X	X
O.		Bulk Storage and Mixing of Pesticides and Fertilizers[5]	X	Cu
P.		Underground Injection Wells	X	Cu[6]
Q.		Underground Storage Tanks	X	Cu
R.		Uses which involve, as a principal activity, the manufacture, storage, use, transport, or disposal of hazardous materials	X	X
S.		Uses which involve hazardous materials in quantities greater than those associated with normal household use [8]	X[7]	Cu
T.		Underground pipelines [9] carrying hazardous materials	X	Cu
U.		Development with greater than 50% impervious surfaces	Cu	Cu

Key: X = Not Allowed, Cu = Conditional Use

[2]Secondary containment and release detection standards for in-ground tanks and above ground tanks found later in this manual apply to the exceptions permitted in Zone 1 of the wellhead protection district.

[3]Counties/municipalities may require nutrient management plans through local regulation or other non-zoning by law/ordinance. Local requirements must be consistent with MDA/SCD standards.

[4] Counties/municipalities should consider requiring commercial and residential developments within this Zone to be serviced by public sewer. For all lots subdivided which propose on-site wastewater disposal, the intention is to ensure that the nitrate-levels do not exceed 10 mg/l. In some instances on-site systems that maximize nitrogen removal may required. Process wastewater that contain hazardous materials above drinking water standards or otherwise to harm to the water supply should be prohibited from on-site disposal.

[5]New standards and guidelines adopted by Maryland Department of Agriculture should be referenced as a condition for special exception.

[6]Process wastewater that contain hazardous materials above drinking water standards or otherwise cause harm to the water supply should be prohibited from on-site disposal.

[7]This prohibition does not apply to uses permitted in Section 6.2.A.

[8]Normal household use does not imply that it is acceptable to dispose of hazardous material through the home's plumbing system.

[9] Counties and local governments may be pre-empted from regulating the location of pipelines used in interstate commerce.

Section 6.3 Conditional Uses

Activities that are defined as conditional uses will not be allowed within the Wellhead Protection District unless the property owner can show the use will not harm the ground water and is able to meet the conditions described in 6.3.B and 6.7 of this ordinance.

A. The landowner or representative shall submit to Anne Arundel County an application for a Conditional Use. The application shall include:

1. A list of all hazardous materials which are to be stored, handled, used, or produced in the activity being proposed.

2. A description of the quantities and containers for the storage, handling, use, or production of hazardous materials by the proposed activity.

3. A site plan illustrating the location of all operations involving hazardous materials, spill containment structures and showing all points of potential discharge to ground water including dry wells, infiltration ponds, septic tanks and drainfields.

4. Documentation of approval by MDE of any industrial waste treatment or disposal system or any wastewater treatment system over 5,000 gallons per day (gpd) capacity.

5. Documentation of MDE permit or approval for any discharge via an underground injection well.

6. A description and estimate of the average and maximum number of poultry livestock animals that will be yarded within the Wellhead Protection District. Evidence that a nutrient management plan for nitrogen has been completed for all livestock or poultry wastes to be generated by the activity. This plan must incorporate adequate waste holding facilities and show any application sites within the wellhead protection district.

7. Plans showing secondary containment, for all underground and above ground tanks and lines containing hazardous material.

8. A description of the best management practices which will be followed during the construction of the facility to ensure that hazardous materials are not released to the ground water.

9. An emergency plan indicating the procedures which will be followed in the event of a spill of a hazardous material to control and collect the spilled material to prevent the substance from reaching the ground water.

10. A hydrologic assessment for properties with greater than 50% planned impervious surfaces (building footprints, sidewalks, and transportation surfaces) to determine the ground water recharge rate after site development is completed. The assessment will also estimate the ground water recharge rate prior to development.

B. Anne Arundel County shall obtain advice from all appropriate local agencies to assess whether the wellhead protection area will be protected from contaminants which pose an adverse effect on the health or comfort of persons. In making their determination, Anne Arundel County shall give consideration to the simplicity, reliability, and feasibility of the control measures proposed and the degree of threat to drinking water quality which would result if the control measures failed. Anne Arundel shall then issue a written decision. In order for the area to be approved, it must be shown that the use:

1. Will protect the water supply from contaminants used on the property which pose an adverse effect on the health or comfort of persons;

2. Will not cause the average ground water quality on the property to violate drinking water standards promulgated by MDE and the EPA; or

3. Will maintain recharge of water to the water supply aquifer consistent with rates prior to development. A request may not be approved until all comments provided by

local agencies have been addressed by the applicant to the satisfaction of Anne Arundel County.

C. Anne Arundel County may deny the Conditional Use if it is determined that the Conditional Use would not meet the requirements outlined in 6.3.B. above. Anne Arundel County's decision shall be made in writing to the applicant.

Section 6.4 Nonconforming Uses

Non-conforming uses lawfully in existence within the Wellhead Protection District may continue to exist in the form in which they existed at the time on this Ordinance is adopted. Changes in title or right to possession shall not effect continuation of an existing use.

In the event a non-conforming use poses a direct hazard to the public water supply, Anne Arundel County may take any action permitted by law to abate the hazard.

Section 6.5 Variances

Variances to the provisions of this ordinance may be granted by Anne Arundel County, following a public hearing, provided that a strict interpretation of the Ordinance deprives such property of privileges or safety enjoyed by other similarly situated property within the Wellhead Protection District. Applications for Variances must be presented to the Anne Arundel County.

Section 6.6 Exemptions

The following activities are exempt from regulation under this ordinance as defined below:

1. Transportation of Hazardous Material- The transportation of any Hazardous Material through the Wellhead Protection District shall be exempt from the provisions of this ordinance.

2. Application of Pesticides- The application of pesticides in recreation, agriculture, pest control, and aquatic weed control activities shall be exempt from the provisions of this ordinance provided that:

a. The application is in strict conformity with the use requirement as set forth in the substances EPA registries. A pesticide can only be used according to its labeling and according to pertinent federal and state laws.

b. The application of pesticides shall be noted in the records of an applicator certified by the Maryland Department of Agriculture. Records shall be kept of the date and amount of these substances applied at each location and said records shall be available for inspection.

3. Underground Storage of Oil(s)- The underground storage of oil(s) used for heating fuel shall be exempt from the provisions of this ordinance if the tank used for storage is located within an enclosed structure (i.e., secondary containment or any currently approvable containment technology) sufficient to contain leakage of oil from the environment and to provide routine access for visual inspection (e.g., cement-floored basement), and sheltered to prevent the intrusion of precipitation. Any tank used for the underground storage of oil that is

out of service for more than one year shall be removed. Liquid residue shall be removed and all connecting piping securely capped or plugged.

4. Aboveground Storage of Oil(s)- The aboveground storage of oil(s) used for heating fuel shall be exempt from the provisions of this ordinance provided that the tank used for storage is: 1) located on an impervious pad or container of sufficient volume to capture and contain spills and leakage of oil from entering the environment, 2) sheltered to prevent the intrusion of precipitation and, 3) located in a manner that allows for routine visual inspection. Aboveground storage of oil shall be located as far away from the public water supply wells as possible.

Section 6.7 Performance Plan Standards

All activities that are designated conditional uses shall meet the following design and operation guidelines. The intent of this section is to encourage the use of Best Management Practices (BMPs) for all potentially hazardous activities in Zones 1 and 2.

A. Containment of hazardous materials. Leak-proof trays under containers, floor curbing, or other containment systems to provide secondary liquid containment shall be installed. The containment shall be of adequate size to handle all spills, leaks, overflows, and precipitation until appropriate action can be taken. The specific design and selection of materials shall be sufficient to contain any hazardous material at the location and prevent escape to the environment. These requirements shall apply to all areas of use, production, and handling, to all storage areas, to loading and off-loading areas, and to aboveground and underground storage areas. Because State and federal governments already regulate hazardous materials nothing in this ordinance shall be applied in a way to prevent a person from complying with State and federal requirements.

B. All underground tanks(s) and piping systems shall meet the requirements of COMAR 26.10.05.03.C 1-4 for secondary containment, double wall tanks, liners, vaults and underground piping.

C. Dry cleaning establishments shall not discharge to the ground or subsurface any wastewater that was in contact with the organic solvents used in dry cleaning process. As specified in A. above, secondary containment is required for areas when dry cleaning solvent is stored, used and transferred.

D. Infiltration of stormwater runoff that has come in contact with the pavement surfaces shall not be permitted at gasoline service stations. Waste from service stations' work areas is not permitted to be discharged to the ground or subsurface.

E. All sewage sludge and animal waste holding facilities shall be constructed so as not to allow the waste material to leach into the ground water. All in-ground facilities shall use low permeability liners constructed to meet one of the standards specified below:

a. one foot of clay with a permeability less than 10^{-7} cm/sec, or

b. two feet of clay with a permeability less than 10^{-6} cm/sec or

c. two feet of compacted soil with a permeability less than 10^{-5} cm/sec, and a manmade liner, 30 mil thick, and permeability less than 10^{-7} cm/sec.

F. Agricultural operations with yarding areas shall follow nutrient management plans for nitrogen. Waste application rates for all sites within the wellhead protection district are to be

designed to not exceed not exceed crop requirements and therefore minimize nitrate discharge to ground water.

G. All facilities with wastewater disposal greater than 5,000 gpd shall have a State discharge permit. All developments with on-site disposal shall be designed so that the average NO_3-N concentration of the water recharging the surficial ground water aquifer under the property shall not exceed 10 milligrams per liter.

H. All de-icing chemicals (salt piles and sand/salt mixes) must be stored under roof and protected from precipitation by a permanent cover. Runoff from mixing and loading areas may not be discharged to the subsurface.

I. All facilities with bulk storage of pesticides must show evidence of compliance with Maryland Department of Agriculture requirements.

J. All tanks of liquid fertilizers must have secondary containment of at least 110% of the largest tank within the contained area. All dry fertilizer storage must be under a permanent cover and protected from rainfall.

K. All facilities with underground injection wells must show evidence of compliance with all applicable MDE permits, consent orders, or other State actions, regarding the underground disposal of wastes.

L. All underground pipelines carrying hazardous materials shall be equipped with operable secondary release detection equipment and be protected against corrosion.

M. All excess hazardous materials from the construction of any facility shall not be released to the environment and shall be removed from the property, unless such materials are incorporated into a contained hazardous materials storage area.

N. At all facilities practicing stormwater infiltration the following design standards shall apply:

1. Stormwater management facilities including drainage swales, detention ponds, and retention ponds shall be designed in a manner to provide optimal protection of the ground water resources. Uses of grass swales, open shoulder roads and grass filter strips shall be considered as first options in plan development.

2. At least four feet of soil material is required between the top of bedrock surface or high water table (whichever is higher) and the bottom of any stormwater infiltration pond or system.

3. Stormwater infiltration shall be prohibited in areas receiving runoff from handling and mixing areas of hazardous materials.

4. At least 80% of the predevelopment recharge rate shall be preserved following development. The design shall be made to ensure that this rate can be maintained over the life of the facility.

O. Reporting of Spills. Any spill of a hazardous material shall be reported by the facility owner by telephone to the water supplier, within two (2) hours of discovery of the spill. Clean-up shall commence immediately upon discovery of the spill. A written report detailing the steps taken to contain and clean up the spill and preventing a recurrence shall be submitted to the water supplier within five (5) working days of the spill.

P. Monitoring for Hazardous Materials in Ground Water. If required by the Anne Arundel County, ground water monitoring well(s) shall be installed at the expense of the facility owner or operator in accordance with an approved ground water monitoring plan. The permittee shall be responsible for developing an approved ground water monitoring system. Samples shall be analyzed by a State-certified laboratory and the results reported to Anne Arundel County

Q. Alterations and Expansion. Anne Arundel County shall be notified in writing prior to the expansion, alteration, or modification of any activity that is subject to a Conditional Use. Approval by Anne Arundel County is required before the activity subject to a Conditional Use can begin. The landowner or representative shall submit an explanation of the change in activity and the information as required by this ordinance above.

R. Facilities required by Federal and/or State Law to maintain a Spill Prevention, Control, and Countermeasure Plan (SPCC; e.g. those facilities storing more than 1,320 gallons of oil or petroleum-based liquid above ground, or 42,000 gallons of oil underground, per the Clean Water Act of 1990) will be required to provide copies of these plans with Anne Arundel County, and to provide updates to the City when any substantive changes are made, when land use changes, or when the property changes ownership.

Section 7.0 ADMINISTRATION REQUIREMENTS

Section 7.1 Subdivision and Land Development Review

All subdivision proposals and other proposed new development plans within the Wellhead Protection District shall be reviewed by for compliance with the provisions of this ordinance. It shall be the responsibility of Anne Arundel County to recommend approval, disapproval, or approval with modifications of the proposed subdivision or development plan.

Section 7.2 Notice of Violation

Whenever it is determined that there is a violation of this ordinance, A Notice of Violation shall be issued. The Notice of Violation shall:

1. Specify the violation or violations in writing.
2. Specify the length of time available to correct the violation.
3. Clearly state any penalties associated with the subject violation.
4. Provide a description of any rights of appeal.

Section 7.3 Stop Work Orders

The Anne Arundel County is authorized to issue cease and desist orders whenever it becomes aware of violations of this ordinance.

Section 7.4 Penalties

All costs incurred by the Anne Arundel County, including engineering and attorney's fees for enforcing this ordinance shall be paid by the owner who violated the provisions of this ordinance. A penalty of up to $1,000 may be levied for any violation of this ordinance.

Section 8.0 FEES

All fees for review of Subdivision and Land Development Plans shall be established by resolution of the appropriate local governing body. Fees established shall be reviewed annually and adjusted as required. The fees shall include reasonable costs involved with the implementation of this ordinance and may include Administrative and professional staff review costs.