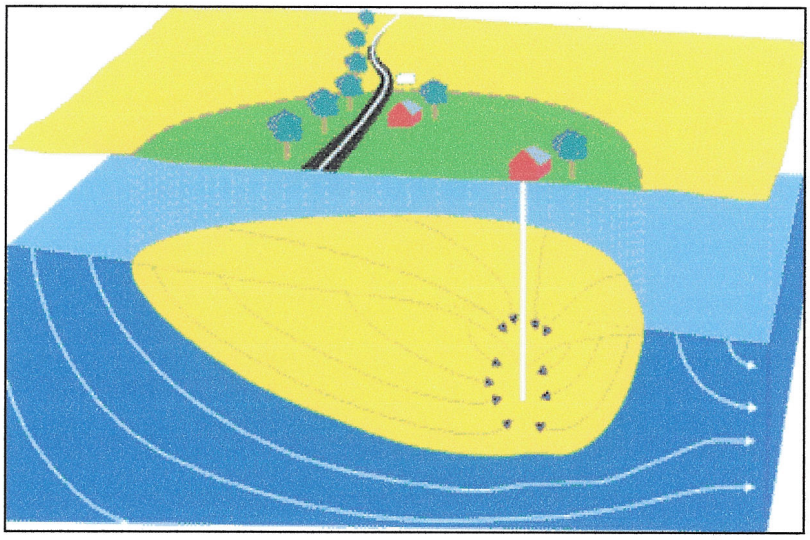
SOURCE WATER ASSESSMENT
for
MARQUIP WARD UNITED AND GLEN ARM MAINTENANCE FACILITY
BALTIMORE COUNTY, MD



Prepared By
Water Management Administration
Water Supply Program
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MDE

Robert L. Ehrlich, Jr.
Governor

Kendl P. Philbrick
Secretary

Michael S. Steele
Lt. Governor

Jonas A. Jacobson
Deputy Secretary

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INTRODUCTION

The Water Supply Program has conducted a source water assessment for Marquip Ward United, Inc (MWUI) and Glen Arm Maintenance Facility (GAMF) water systems in north central Baltimore County (figure 1). Since both these facilities are in the same vicinity and have similar water uses they were assessed together. Each of these water systems is considered a nontransient noncommunity (NTNC) water system, which is defined as a public water system that regularly serves at least 25 of the same individuals over six months per year. The MWUI water system serves 40 persons and the GAMF water system serves 35 persons. The GAMF population served also includes the Ulla Popken building.

In August 2002 MWUI purchased the facility from United Machinery Corporation. Since the purchase the manufacturing operations have been reduced along with reduction in the work force from about 300 to 40. There is possibility that this manufacturing plant may completely shutdown in the near future. The GAMF site was owned by Grumman Aerospace Corporation till 1998, when Baltimore County purchased the building on the west site for county maintenance work. The Maryland Environmental Service (MES) operates the water and wastewater treatment plants. The eastern building is owned by Schneider properties and houses Ulla Popken, which is ladies clothes distribution center.

WELL INFORMATION

Well information was obtained from the Water Supply Program's database, site visits, well completion reports, sanitary survey inspection reports and published reports. MWUI is served water by three wells (Nos. 1, 2 and 3) which are treated at two plants. Well No. 1 is treated at plant 1 while Well Nos. 2 and 3 are treated at plant 2. Well No. 2 is in a pit while the other two have casings that are 1.5 feet above grade. GAMF is served by three wells (Nos. 3, 6 and 7) which are also treated at two plants. Well No. 3 is served by plant 1, while Well Nos. 6 and 7 are treated at plant 2. Well No. 3 is above ground in the rear of the parking enclosed in a concrete casing. Well Nos. 6 and 7 are in a field and each have casing about 1 ft above grade. A review of well data and sanitary surveys of the two water systems indicates that all the MWUI's Well Nos. 1 and 3 and GAMF Well Nos. 6 and 7 were drilled after 1973, when the State's well construction regulations went into effect, and should be in compliance with current well construction standards. No information on MWUI's Well No. 2 is available. GWUI's Well No. 3 was drilled in 1955 and review of the well completion report shows that it was grouted to 21 feet. In addition, in 1993 following an MDE inspection and request, the casing for this well was raised above ground and protected by a concrete casing. Well information for the two water systems is shown in Tables 1a and 1b. below.

SOURCE ID	SOURCE NAME	PERMIT NO	TOTAL DEPTH (ft)	CASING DEPTH (ft)	YEAR DRILLED	AQUIFER
01	Well No. 1	BA810487	525	72	1982	Cockeysville Marble
02	Well No. 2	N/A	N/A	N/A	N/A	Cockeysville Marble
02	Well No. 3	BA732480	202	57	1975	Cockeysville Marble

Table 1a. Well Information for Marquip Ward United Inc.

SOURCE ID	SOURCE NAME	PERMIT NO	TOTAL DEPTH (ft)	CASING DEPTH (ft)	YEAR DRILLED	AQUIFER
01	Well No. 3	BA019446	79	70	1955	Cockeysville Marble
02	Well No. 6	BA811777	200	90	1983	Cockeysville Marble
03	Well No. 7	BA812071	100	56	1983	Cockeysville Marble

Table 1b. Well Information for Glen Arm Maintenance Facility

MWUI has a Water Appropriation Permit that allows it to use an average of 10,0000 gallons per day (gpd) and 12,000gpd in the month of maximum use. Based on reported pumpage for the past three years, the facility has used an average of 800 gpd. GAMF has a Water Appropriation Permit that allows it to use an average of 12,200 gpd and 20,000 gpd in the month of maximum use. Based on reported pumpage for the past three years the facility has used an average of 5,813 gpd.

HYDROGEOLOGY

MWUI and GAMF are located within the Piedmont physiographic province which is characterized by gently rolling hills and valleys. The bedrock underlying the Piedmont is some of the oldest in the State and consists of Precambrian and Paleozoic metamorphic and igneous rocks. All the aquifers in the Piedmont are unconfined fractured-rock aquifers. Ground water systems in crystalline rock tend to be localized and flow is within topographic divides towards the nearest perennial streams. (Bolton, 1998). In this type of setting, the underlying crystalline rocks have negligible primary porosity and permeability and ground water is stored in and moves through fractures in the rocks. Ground water flow rates depend upon the openness of the fractures and their degree of interconnection. Unconsolidated overburden (saprolite) above the crystalline rock frequently has much greater primary porosity and permeability than the rock has, allowing additional ground water to be stored (Duigon, 1994). Ground water flow in carbonate rock is dominated by solution enlarged fractures and bedding planes. Soil cover and overburden is generally thin or non-existent, due to dissolution of the minerals that make up the rock, causing ground water to infiltrate rapidly from the surface to the water table. Usually the most productive wells are found in this type of aquifer due to flow through conduits formed by solution enlarged fractures.

The Cockeysville Marble is the aquifer of use by both water systems. It is a completely crystalline marble, ranging from a poorly cemented, coarsely crystalline

calcite to a fine-grained dense dolomite. The calcareous and dolomite phase are interbedded (Dingman, et al, 1956). Cockeysville Marble, a carbonate aquifer, contains solution-enlarged fractures in some locations.

SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WHPA) is considered to be the source water assessment area for the system. The source water assessment area for public water systems with an average appropriation amount of greater than 10,000 gpd and drawing from fractured-rock aquifers is the watershed area that contributes to the well. This area is modified by geological boundaries, ground water divides and by annual average recharge needed to supply the well (MD SWAP, 1999). The delineated WHPA represents the areas which contribute ground water to the wells for both systems. The total area for the WHPA is 158 acres (fig. which is more that sufficient to support the daily permitted averages for both systems even under drought conditions.

POTENTIAL SOURCES OF CONTAMINATION

Potential sources of contamination are classified as either point or non-point sources. Examples of point sources of contamination are leaking underground storage tanks, landfills, ground water discharge permits, large scale feeding operations and Superfund sites. These sites are generally associated with commercial or industrial facilities that use chemical substances that may, if inappropriately handled, contaminate ground water via discrete point location. Non-point sources of contamination are associated with certain types of land use practices such as the use of pesticides, application of fertilizers or animal wastes, or septic systems that may lead to ground water contamination over a larger area.

Point Sources

A review of MDE contaminant databases as well as a field survey revealed several point sources of contamination in the WHPA (fig 2). Both MWUI and GAMF are listed as Controlled Hazardous Substance (CHS) Generators since they handle or handled hazardous substances in their operations. GAMF also may have several petroleum storage tanks (PST) for gasoline. In addition there is an automobile (AUTO) garage repair shop and one other CHS Generator in the WHPA. Table 2 lists the facilities identified and their potential types of contaminants. Potential contaminants are grouped as Volatile Organic Compounds (VOCs), Metals (M) and Heavy Metals (HM).

ID	Type	Site Name	Address	Potential Contaminant	Comments
F	CHS	Sensor Concepts	5240 Glen Arm Rd	VOC	Located just outside of WHPA
B	CHS	Glen Arm Maintenance Facility	12200 Long Green Rd	VOC, M	
C	PST	Glen Arm Maintenance Facility	12200 Long Green Rd	VOC HM	Unknown no. of tanks
D	AUTO	Wooten's Garage	12128 Long Green Rd	VOC, HM	
E	CHS	Glen Arm Lumber	1200 Long Green Rd	VOC	
F	CHS	Sensor Concepts	5240 Glen Arm Rd	VOC	Located just outside of WHPA

Table 2. Potential Contaminant Sources within the WHPA (see figure 2 for locations).

Non-Point Sources

The Maryland Department of Planning's 2002 digital land use map for Baltimore County was used to determine the predominant types of land use in the WHPAs (figure 3). Table 3 shows the land use categories within the WHPA. The largest portion of the WHPA is forested land, followed by pasture and industrial land.

LAND USE CATEGORIES	TOTAL AREA (acres)	PERCENTAGE OF WHPA
Low Density Residential	18.79	11.9
Commercial	7.10	4.5
Industrial	30.90	19.6
Cropland	16.22	10.3
Pasture	32.49	20.6
Forest	52.40	33.1
Total	157.90	100.00

Table 3. Land Use Summary for the WHPA

Agricultural land (cropland and pasture) is commonly associated with nitrate loading of ground water. Cropland represents a potential source of SOCs depending on use of pesticides and herbicides. Industrial properties may be sources of VOCs due to handling of hazardous substances in their plant manufacturing processes. Commercial properties may be a source of nitrates and SOCs if fertilizers and pesticides are not used carefully for landscaping activities. Residential areas also may be sources of nitrates and SOCs if fertilizers and pesticides are not used carefully for lawns and gardens

A review of the Maryland Department of Planning's 2002 Baltimore County Sewer Map indicates that there is no planned sewer service for the entire WHPA and its vicinity. Both MWUI and GAMF have wastewater treatment plants for treatment and disposal of wastes. Both facilities have surface water discharge permits for discharging the treated wastes into Long Creek. Residential properties and farms in the WHPA and adjacent to it use on-site septic systems for waste disposal.

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database and system files for Safe Drinking Water Act contaminants. The State's SWAP defines a threshold for reporting water quality data as 50% of the Maximum Contaminant Level (MCL). If a monitoring result is at or greater than 50% of a MCL, this assessment will describe the sources of such a contaminant and, if possible, locate the specific sources which may be the cause of the elevated contaminant level. All data reported is from the finished (treated) water unless otherwise noted. The MWUI has no treatment for its water supply. adjustment for The GAMF water system has ph adjustment for corrosion control and hypochlorination for disinfection for treatment of its water supply.

A review of the monitoring data since 1993 for MWUI and GAMF College indicates that both systems meet the current drinking water standards. The water quality sampling results are summarized in Table 4a and 4b.

	Nitrate		SOCs		VOCs		IOCs (except nitrate)	
PLANT NO	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL
01	26	5	7	1	8	0	8	0
02	27	0	8	1	9	0	10	0

Table 4a. Summary of Water Quality Samples for the Marquip Ward United Water Supply.

	Nitrate		SOCs		VOCs		IOCs (except nitrate)	
PLANT NO	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL
01	31	2	3	0	8	0	6	0
02	21	3	3	1	8	0	5	0

Table 4b. Summary of Water Quality Samples for the Glen Arm Maintenance Facility Water Supply.

Inorganic Compounds (IOCs)

Nitrate was the only IOC detected above 50% of the MCL in both the MWUI and GAMF water supplies. The MCL for nitrate is 10 ppm and tables 5a and 5b display the nitrate results above 50% of the MCL for the systems. All the nitrate levels above 50% of the MCL of MWUI were detected at plant 1

(Well1). There was a one-time detection above the MCL at 12.9 mg/l in a sample collected on August 29, 2000.

PWSID	PLANT ID	CONTAMINANT NAME	MCL (mg/l)	SAMPLE DATE	RESULT (mg/l)
1030040	01	NITRATE	10	22-Jun-95	5.5
1030040	01	NITRATE	10	30-Dec-97	5
1030040	01	NITRATE	10	11-Mar-98	5.1
1030040	01	NITRATE	10	29-Aug-00	12.9
1030040	01	NITRATE	10	12-Sep-00	5.9

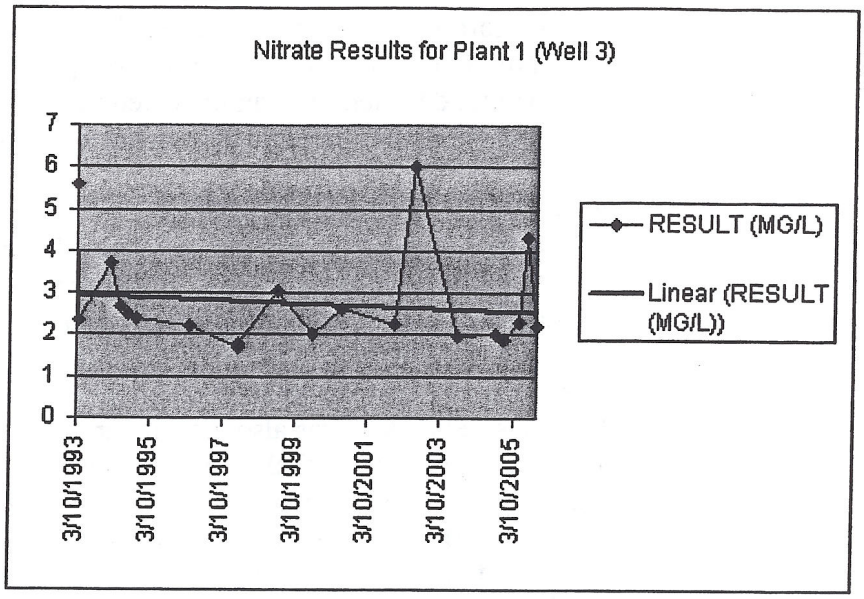
Table 5a. IOC detections above 50% of the MCL in Marquip Ward United's water supply

PWSID	PLANT ID	CONTAMINANT NAME	MCL (mg/l)	SAMPLE DATE	RESULT (mg/l)
1030052	01	NITRATE	10	10-Mar-93	5.60
1030052	01	NITRATE	10	26-Jun-02	6.00
1030052	02	NITRATE	10	26-Jun-02	5.80
1030052	02	NITRATE	10	16-Dec-04	5.07
1030052	02	NITRATE	10	20-Sep-05	6.45

Table 5b. IOC detections above 50% of the MCL in Glen Arm Maintenance Facility's water supply

Nitrate has been detected at both plants serving the GAMF at levels above 50% of the MCL. A nitrate trend analysis conducted on all the samples from the two plants indicates that nitrate levels are decreasing in the plant 1 (Well 3) water supply and increasing in the plant 2 (Wells 6 and 7) water supply. Table 6 shows the data used for the trend analysis.

PLANT	SAMPLE DATE	RESULT (MG/L)
1	10-Mar-93	5.6
1	5-Apr-93	2.33
1	8-Feb-94	3.7
1	17-May-94	2.7
1	2-Aug-94	2.5
1	1-Nov-94	2.4
1	1-Apr-96	2.2
1	22-Aug-97	1.7
1	22-Aug-97	1.8
1	16-Sep-98	3.04
1	16-Sep-98	3.04
1	1-Sep-99	2.04
1	15-Sep-99	2.04
1	6-Jul-00	2.64
1	6-Jul-00	2.64
1	6-Jul-00	2.64
1	21-Dec-01	2.25
1	26-Jun-02	6
1	10-Sep-03	1.95
1	23-Sep-04	2
1	16-Dec-04	1.9
1	17-May-05	2.28
1	27-Jul-05	4.3
1	9-Nov-05	2.21



PLANT	SAMPLE DATE	RESULT (mg/l)
2	16-Sep-98	1.87
2	1-Sep-99	2.79
2	1-Sep-99	2.79
2	6-Jul-00	2.25
2	6-Jul-00	2.25
2	21-Dec-01	4.55
2	26-Jun-02	5.8
2	28-Aug-02	4.37
2	10-Sep-03	4.04
2	23-Sep-04	2.56
2	28-Sep-04	3.28
2	16-Dec-04	5.07
2	28-Jan-05	4.95
2	17-May-05	3.28
2	27-Jul-05	4.8
2	20-Sep-05	6.45
2	9-Nov-05	4.79

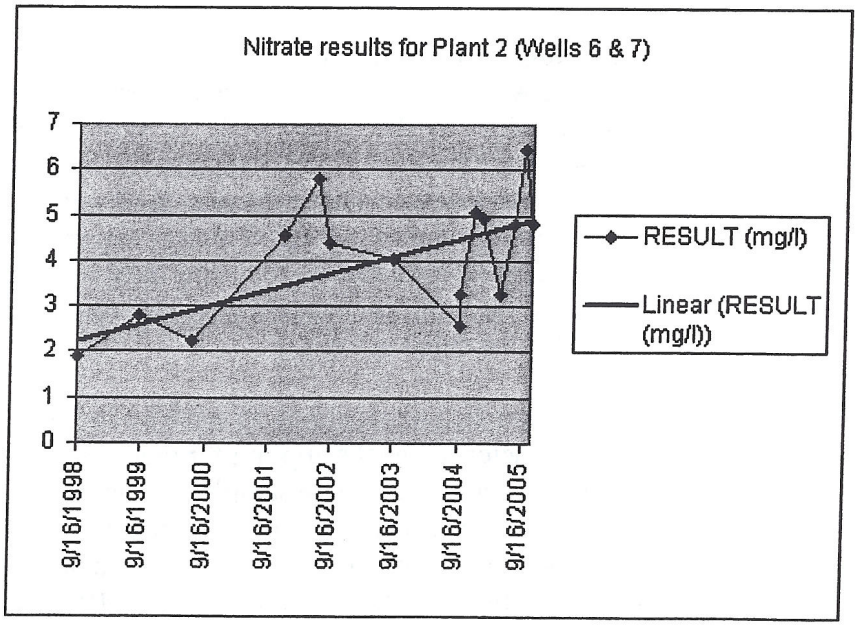


Table 6. Nitrate trend for Glen Arm Maintenance Facility's water supply.

Volatile Organic Compounds (VOCs)

No VOCs above 50% of the MCL have been detected in either MWUI or GAMF's water supply. The only VOCs detected in GAMF's water supply were very low levels of trihalomethanes (THMs). THMs are disinfection byproducts that are formed as a result of the reaction between chlorine used for disinfection and natural organic matter in the water supply. In addition very low level of toluene was detected in a sample taken in February 1992. Subsequent samples have shown no detects of toluene in the water supply.

Synthetic Organic Compounds (SOCs)

Di(ethylhexyl)phthalate was the only SOC that was detected above 50% of the MCL in the MWUI water supply. It was reported at 14.4 ppb in a sample collected on June 19, 2002 from plant 1 and at 17.6 ppb in a sample collected the same date from plant 2. The MCL for phthalate is 6 ppb. All previous samples and subsequent samples in 2005 reported less than 50% of the MCL of phthalates. Phthalate was also detected in the laboratory blank collected that same day. Hence the phthalate detection is not believed to represent the water quality. Other SOCs detected one time at levels well below an MCL were di(ethylhexyl) adipate and oxamyl. Adipate was also found in the laboratory blank is not believed to represent the water quality. Oxamyl which has an MCL of 200 ppb was detected at 5 ppb (6/19/02). A sample collected in 2005 reported no detectable oxamyl.

No SOCs above 50% of an MCL were detected in the GAMF water supply. The only SOCs detected were di(ethylhexyl)phthalate and oxamyl. The phthalate was also found in the laboratory blank and is not believed to represent the water quality. Oxamyl was detected at 5 ppb on June 26, 2002

Microbiological Contaminants

Ground water under the influence of surface water (GWUDI) testing was conducted for all the supply wells for MWUI and GAMF in late 2003 and early 2004. Since these wells are completed in carbonate rock they are considered at high risk to surface water influence. Raw water sampling is required after at least 0.5 inches of rainfall. GWUDI testing requires collection and analysis of raw water samples for bacteria (total and fecal coliform), pH, temperature and turbidity. No coliform bacteria were detected in any of the raw water samples collected for either system.

All nontransient noncommunity systems are required to conduct quarterly routine bacteriological sampling for their water supply as required by the Safe Drinking Water Act. These samples are generally collected from finished (treated) water, which may not be indicative of the source water conditions. There were only two total coliform bacteria detections out of the forty bacteriological samples collected for the MWUI water supply. No detections were found in the repeat samples. There were no total coliform bacteria

detections out of the 31 bacteriological samples collected for the GAMF water supply.

SUSCEPTIBILITY ANALYSIS

The wells supplying MWUI and GAMF obtain water from an unconfined fractured-rock aquifer. Wells in unconfined aquifers are generally vulnerable to any activity on the land surface that occurs within the WHPA. Therefore, managing this area to minimize the risk to the supply and continued routine monitoring of contaminants is essential in assuring a safe drinking water supply. The susceptibility of the wells to contamination is determined for each group of contaminants based on the following criteria: (1) available water quality data, (2) presence of potential contaminant sources in the WHPA, (3) aquifer characteristics, (4) well integrity, and (5) the likelihood of change to the natural conditions.

Vulnerability will vary based on the specific rock type comprising the aquifer. Wells that draw water from carbonate formations are generally more vulnerable to activity on the land surface due to thin soil cover and development of karst features. In the Piedmont region, if a well is constructed properly with the casing extended to competent rock and with sufficient grout, the saprolite serves as a natural filter and protective barrier for microbial contaminants. However, in carbonate formations, the saprolite may not provide sufficient natural filtration because dissolution of minerals comprising the bedrock often leaves little overburden above the bedrock. The susceptibility of the two water supplies to the various types of contaminants is summarized in Table 7a and 7b.

Inorganic Compounds (IOCs)

Nitrate was the only IOC detected above 50% of the MCL in both MWUI and GAFM's water supplies. A review of the nitrate data for MWUI shows no increasing or decreasing trends in nitrate levels. For GAMF, the nitrate data shows that nitrate levels at plant 1 (Well 3) are decreasing whereas nitrate levels at plant 2 (Wells 6 & 7) are increasing. Sources of nitrate can generally be traced to land use. Fertilizer applied to agricultural fields (cropland and pasture), and the residential properties for landscaping, are source of nitrate loading in ground water. The entire WHPA is in an area not planned for public sewer, but both facilities have a wastewater treatment plants for waste disposal to surface water, but other properties have onsite septic systems for waste disposal. Onsite septic systems in the WHPA are also sources of nitrate in ground water.

Based on above discussion both Marquis Ward United, Inc. and Glen Arm Maintenance Facility water systems **are** susceptible to nitrate but not to other inorganic compounds.

Volatile Organic Compounds (VOCs)

No VOCs above 50% of an MCL have been detected in either MWUI or GAMF water supplies since 1993. There are several potential sources of VOC

contamination in the WHPA (figure 2), but a review of the water quality data indicates that these sources have not had an impact on the water supplies. Given the upgradient position of the petroleum storage tank (figure 2) to the GAMF Well Nos. 6 and 7 and the vulnerable nature of the aquifer, the Glen Arm Maintenance Facility **is** determined to be susceptible to VOC contamination. The Marquip Ward United, Inc. water systems **is not** susceptible to VOC contamination as there no upgradient VOC sources for these wells.

Synthetic Organic Compounds (SOCs)

The most recent sample results for SOCs at both facilities show all reported detections are below 50% of any MCL. Previous reported detections of di(ethylhexyl)phthalate are not reliable due to concurrent measurement in laboratory blank samples. Land uses in the WHPA may be potential sources of SOCs (figure 2). Application of pesticides on the facility properties, residential properties and cropland can be potential nonpoint sources of SOCs. As these compounds have not been report at levels of significance whatever use is occurring has not resulted in the water supply being affected.

Based on the above discussion, both Marquip Ward United and Glen Arm Maintenance Facility water systems **are not** susceptible to SOC contamination.

Microbiological Contaminants

Based on raw water bacteriological data the wells supplying MWUI and GAMF were determined not to be GWUDI. In addition, routine bacteriological sampling results for both systems have not shown any presence of total coliform bacteria in GAMF's water supply since 1993 and since 2001 in MWUI's water supply. MWUI's Well No. 2 is in a pit and may be subject to flooding.

Based on the above discussion Marquip Ward United and Glen Arm Maintenance Facility's wells **are not** susceptible to microbiological contaminants, except for Marquip Ward United 's Well No.2 **maybe** susceptible to microbiological contaminants.

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

Table 7a. Susceptibility Summary for Marquis Ward United Inc.'s water supply.

*except for maybe Well No. 2 due to flooding

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

Table 7b. Susceptibility Summary for Glen Arm Maintenance Facility's water supply.

MANAGEMENT OF THE WHPA

Contaminant Source Inventory/Well Inspection

- The system owners should review the potential sources of contaminants within the WHPA and update them if necessary, including a consideration of historical uses.

- Marquis Ward Untied Inc.'s Well No 2 is in a pit and may be subject to flooding. It is recommended that flood-proof well caps be installed for this well to prevent surface water from getting into the wells. Well No. 1 is located near the entrance way to the parking lot and the well casing has been damaged in the past by vehicular traffic. Bollards should be placed around it to prevent damage to the casing again.
- Periodic inspections and a regular maintenance program for the supply wells will ensure their integrity and protect the aquifer from contamination.
- Baltimore County should consider fully enclosing (vaulting) its petroleum storage tanks and piping (if they are underground) to prevent a release to ground water. If these tanks are above ground they should have sufficient containment to prevent overflow of product on to the surface.

Cooperative Efforts with Other Agencies

- Work closely with Baltimore County Department of Environmental Protection and Resource Management to identify any unused wells in the WHPA and to ensure that they are abandoned and sealed in compliance with the State's well construction standards.

Monitoring

- Continue to monitor for all Safe Drinking Water Act contaminants as required by MDE.

Changes in Use

- Any increase in pumpage or addition of new wells to the system may require revision of the WHPA. The system is required to contact the Water Supply Program when an increase pumpage is applied for or when new wells are being considered.

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OTHER SOURCES OF DATA

Water Appropriation and Use Permits: BA1956G003 and BA1969G004
Public Water Supply Inspection Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles: White Marsh
USGS Topographic 7.5-Minute Towson and White Marsh Quadrangles
Maryland Department of Planning 2002 Baltimore County Land Use Map
Maryland Department of Planning 2002 Baltimore County Sewer Map

FIGURES

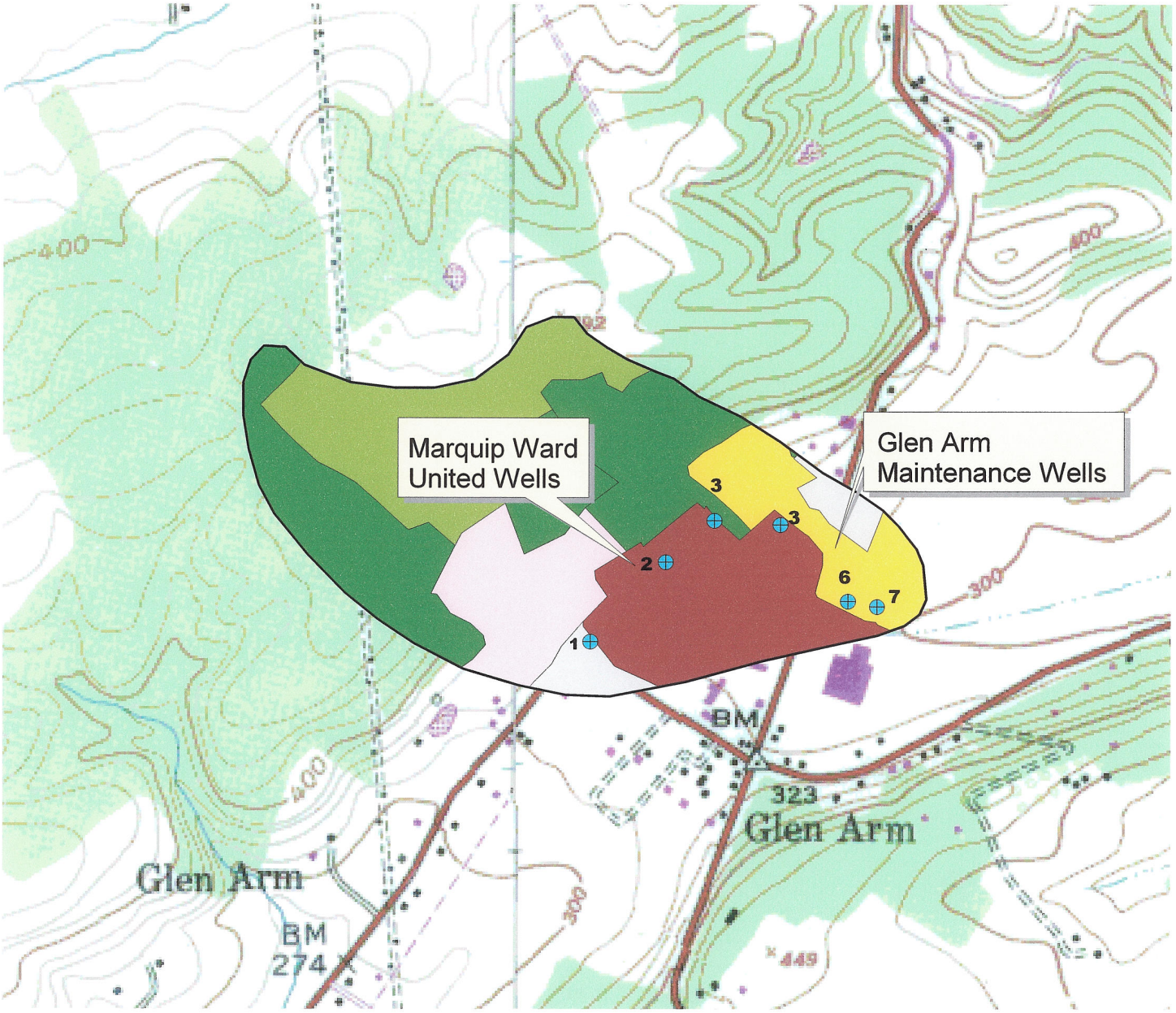

Figure 3. Land Use in the Wellhead Protection Area for Marquip Ward United & Glen Arm Maintenance Facility

Base Map: USGS 7.5 Minute Topo Quadrangles - Towson & White Marsh
Sourc: MD Dept of Planning Land Use Map (2002)