Final

Source Water Assessment

for the

Swan Harbor Dell Mobile Home Park Water System

Harford County, Maryland

Prepared for:

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

Prepared by:

EA Engineering, Science, Technology, Inc.
15 Loveton Circle
Sparks, Maryland 21152
(410) 771-4950

May 2003

Project No. 61726.01

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5/30/03

Mike Hertz, P.G.
Task Manager

5/30/03

Kevin Sharpe, P.G.
Project Manager

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LIST OF ACRONYMS AND ABBREVIATIONS

BMP	Best Management Practice
CCL	Contaminant Candidate List
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CHS	Controlled Hazardous Substances
COMAR	Code of Maryland Regulations
CREP	Conservation Reserve Program
DWEL	Drinking Water Equivalent Level
ft	Foot/Feet
gpd	Gallon(s) Per Day
gpm	Gallon(s) Per Minute
GPS	Global Positioning System
GWUDI	Ground Water Under Direct Influence
IOC	Inorganic Compound
L	Liter(s)
LUST	Leaking Underground Storage Tank
MCL	Maximum Contaminant Level
MDE	Maryland Department of the Environment
mg	Milligram(s)
ml	Milliliter(s)
MGS	Maryland Geological Survey
MHP	Mobile Home Park
mrem	Millirem(s)
MTBE	Methyl-tert-butyl-ether
NaOH	Caustic Soda
Org	Organisms
PCE	Tetrachloroethylene
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethylene
pCi	Picocurie(s)
PWSID	Public Water System Identification

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

SDWA	Safe Drinking Water Act
SDWR	Secondary Drinking Water Regulations
SOC	Synthetic Organic Compound
SWAP	Source Water Assessment Plan
SWPA	Source Water Protection Area
TCE	Trichloroethylene
µg	Microgram(s)
USEPA	U.S. Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WHPA	Wellhead Protection Area

EXECUTIVE SUMMARY

EA Engineering, Science, and Technology was tasked to perform a Source Water Assessment for the Swan Harbor Dell Mobile Home Park (MHP)water system in Harford County, Maryland. This water system is identified as Public Water System Identification (PWSID) 0120215 by the Maryland Department of the Environment (MDE). EA has performed this study under Purchase Order No. U00P3200205, as authorized by MDE.

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

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

The source of the Swan Harbor Dell MHP's water supply is from fractured Metagabbro and Amphibolite, which is an unconfined crystalline rock aquifer. The Source Water Protection Area (SWPA) for the three ground-water supply wells was delineated using the watershed delineation method for fractured bedrock wells. The area of the SWPA is based on land topography, the nearby streams, and a calculation of the total ground-water contributing areas during a drought. The SWPA is approximately 163 acres.

Potential point and non-point sources of contamination within the assessment area were identified based on site visits, a review of MDE's databases, and a review of sewer service area and land use maps. Septic systems, railroad tracks, potential polychlorinated biphenyl (PCB) containing transformers, two inactive wells, and an automobile repair area were observed within the SWPA. In addition, a Leaking Underground Storage Tank (LUST) site is adjacent to the SWPA. Well information and water quality data were also reviewed.

The susceptibility analysis for the Swan Harbor Dell MHP water supply is based on a review of the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. It was determined that the Swan Harbor Dell MHP water supply is highly susceptible to volatile organic compounds and nitrates; moderately susceptible to synthetic organic compounds, radon-222, and microbiological contaminants; and has a low susceptibility to other regulated inorganic compounds and other radionuclides.

Recommendations to protect the ground-water supply include creating a SWPA protection team, resident awareness, and communication with county officials about future planning and land use.

1. INTRODUCTION

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

The Swan Harbor Dell MHP water system serves the community within the mobile home park in Harford County. The water treatment plant and the supply wells for the system are located within Swan Harbor Dell MHP. The Swan Harbor Dell MHP water system serves a population of 300 with 130 connections. The water is supplied by three wells (Figure 1).

1.1 GROUND-WATER SUPPLY SYSTEM INFORMATION

A review of the well data and sanitary surveys of the system indicates that well numbers 1, 3, and 5 were drilled in 1985, in accordance with the State's current well construction standards, which were implemented in 1973. The wells have an average yield of 40,000 gallons per day (gpd). Two unused wells exist at the property; however, it is unknown if the wells (HA009611 and another unidentified well) have been properly abandoned. Each of the active supply wells was completed above grade and housed within wooden or concrete sheds. Each active well was observed to be secure and in good repair. Table 1 contains a summary of the well construction data.

TABLE 1. WELL INFORMATION

Source ID	Source Name	Permit No.	Total Depth (ft)	Casing Depth (ft)	Aquifer
01	Well 1	HA811937	450	56	Metagabbro and Amphibolite
02	Well 3	HA811911	515	50	Metagabbro and Amphibolite
03	Well 5	HA812099	300	52	Metagabbro and Amphibolite

According to the MDE Public Water Supply Inspection Report for the water system dated October 2002, the operators of the water system are Thomas Kahoe and Daniel Ragan of Maryland Environmental Services.

Residents reported a sulfur odor in the water supply in September 2002. The collection of emergency samples was requested on 10 September 2002 for chlorine, pH, iron, and hydrogen sulfide by MDE. However, according to the Water Supply Complaint Record of 3 October 2002, the results of the analysis were within acceptable ranges.

Currently, the raw ground water is treated with caustic soda (NaOH) for corrosion control and sodium hypochlorite (bleach) for disinfection.

1.2 HYDROGEOLOGY

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

The ground water used by the Swan Harbor Dell MHP is from production wells drilled into the Metagabbro and Amphibolite formation. The Metagabbro and Amphibolite formation is described as "weakly to strongly lineated metagabbro and epidote amphibolite" [Maryland Geologic Survey (MGS) 1968].

The source of the ground water in Harford County is from precipitation in the form of rainfall or snowmelt. The availability of ground water in the crystalline rock of the area depends on the nature and distribution of secondary openings resulting from fracturing and weathering. The yield of a well in crystalline rock depends of the amount of fracture openings penetrated by the well. The well yield range of 560 wells in the Piedmont province range from 0.1 to 200 gallons per minute (gpm) with 30 percent of the wells having well yields greater than 10 gpm (Otton et al. 1988).

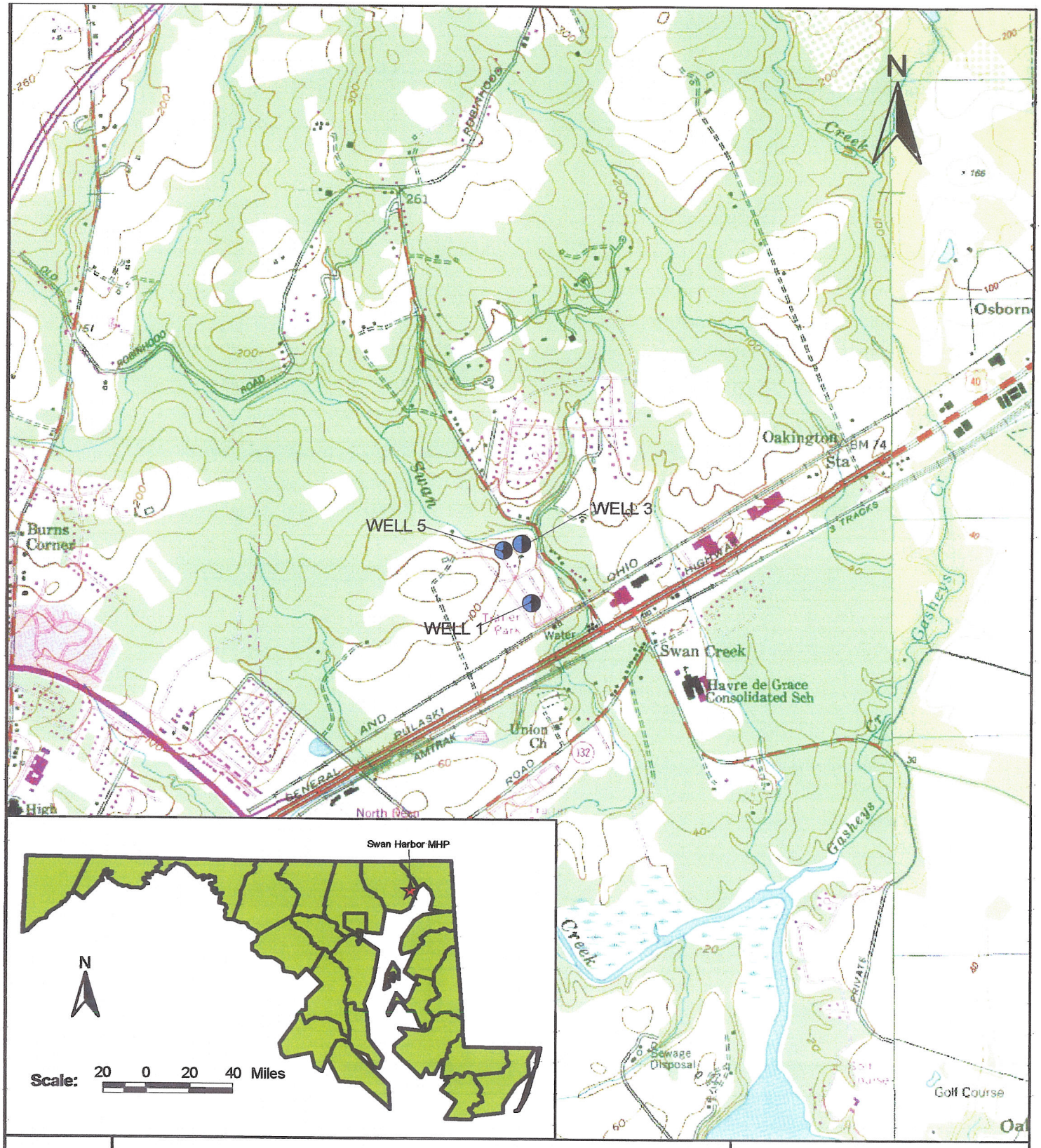


Figure 1. Swan Harbor Dell MHP Location Map of Supply Wells

Source Water Assessment Program
2003

Legend:

MHP Wells

Scale:

1000 0 1000 2000 Feet

Source: United States Geologic Survey. 1953 (1985). *7.5-minute Series Map for Aberdeen, Maryland.*

United States Geologic Survey. 1992. *7.5-minute Series Map for Havre de Grace, Maryland.*

2. DELINEATION OF THE AREA CONTRIBUTING WATER TO SOURCE

For ground-water systems, a Wellhead Protection Area (WHPA) is considered to be the source water protection area (SWPA) for the system. Consistent with the recommended delineation in the Maryland SWAP (MDE 1999), the watershed drainage area that contributes ground water to the supply wells methodology was used.

This original delineation shape was then modified by accounting for surface water bodies, topography, significant land features, and by using a conservative calculation of total ground-water recharge during a drought. For conservative purposes, a drought condition recharge value of 400 gpd per acre (or approximately 5.4 inches per year) was used to estimate the total ground-water contribution area required to supply the wells.

For Swan Harbor Dell MHP, the current Water Appropriation Permit issued by the MDE Water Rights Division is for an average of 40,000 gpd for the total of the three wells. To determine the total ground-water contribution area during a drought, the following equation was used:

Recharge Area (acre) = Average Use (gpd)/Drought Condition Recharge (gpd/acre)

From the equation above, the total ground-water contributing area during a drought is approximately 100 acres. The delineated SWPA is approximately 163 acres (Figure 2), and is therefore adequate to meet the average daily ground-water usage during a drought.

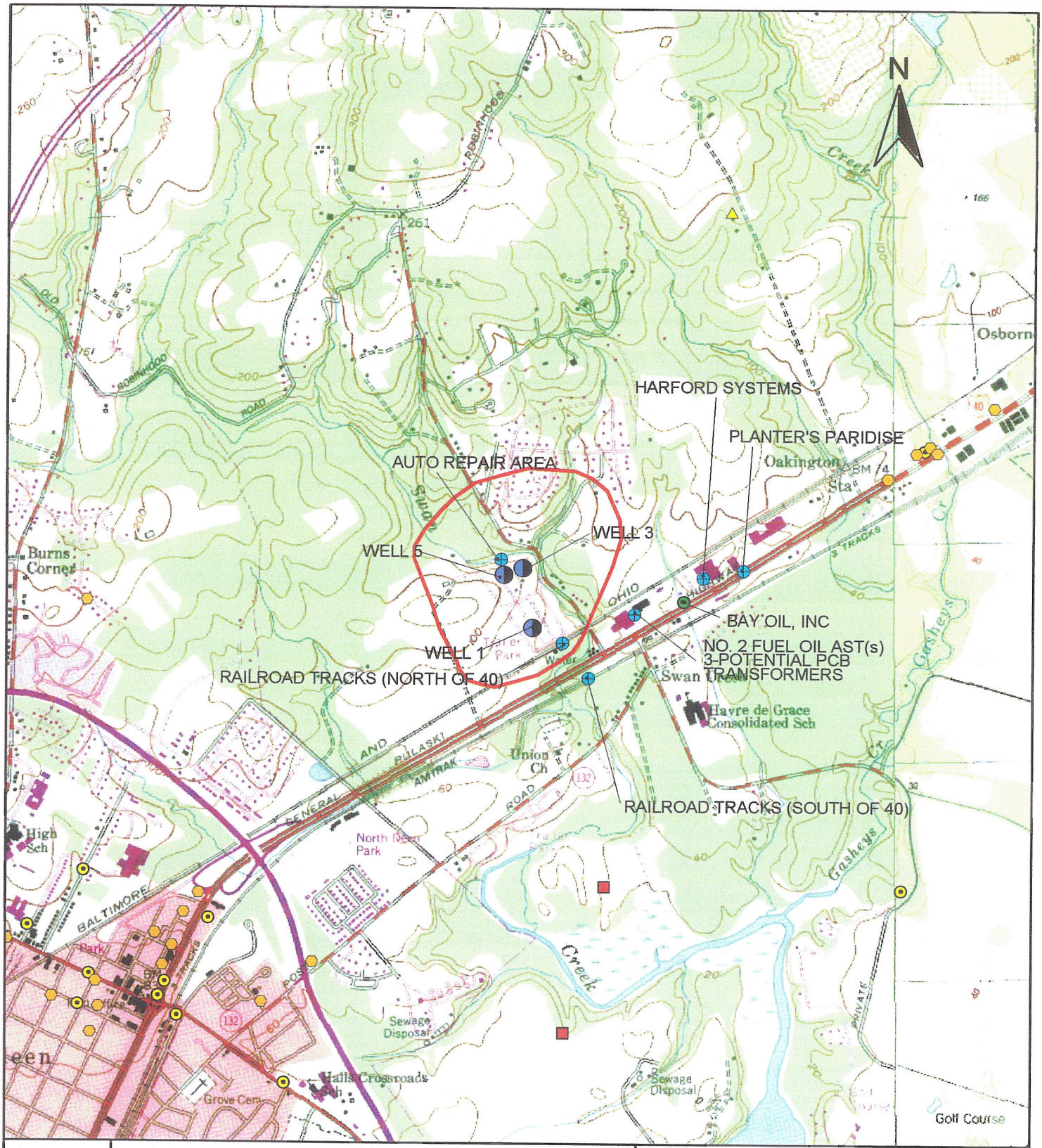


Figure 2. Swan Harbor Dell MHP Source Water Protection Area Map with Potential Sources of Contamination

Source Water Assessment Program
2003

Legend:

- MHP Wells
- SWPA Boundary
- LUST
- Miscellaneous
- CHS Generator
- UST
- CERCLA
- Groundwater Discharge Permit

Source: United States Geologic Survey. 1953 (1985).*7.5-minute Series Map for Aberdeen, Maryland.*
United States Geologic Survey. 1992.*7.5-minute Series Map for Havre de Grace, Maryland.*

Scale:

1000 0 1000 2000 Feet

3. INVENTORY OF POTENTIAL CONTAMINANTS WITHIN THE DELINEATED AREA

A field survey was performed on 5 November 2002 to confirm potential sources of contamination identified in MDE databases around the ground-water wells. These databases include the Comprehensive Environmental Response, Compensation, and Liability Act Information System the (CERCLIS), (which includes National Priority List (Superfund) sites, Maryland Registered Underground Storage Tank (UST) sites, Maryland Leaking Underground Storage Tank (LUST) sites, landfills, pesticide dealers, ground-water discharge permits, Colonial Tanks, and Controlled Hazard Substances (CHS) generator sites.

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

3.1 POINT SOURCES

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

Harford Systems is located adjacent to the SWPA. Potential polychlorinated biphenyls (PCB) oil-containing tranformers were observed at this property. Prior to 1977, many transformers and electrical equipment contained PCB as an insulator. It is possible that the equipment may contain PCB. If the equipment leaks, the PCB oil could eventually leach through the soil overburden into the ground-water aquifer.

Railroad tracks exist south of the development within the SWPA. Railroad track soils have been known to contain elevated levels of metals due to historic fill contained within the soils. It is possible that metals and spill products mobilized by rainwater infiltration could eventually leach through the soil overburden into the ground-water aquifer.

A small, designated automobile repair area exists south of the creek on the northern boundary of the property. Improper disposal of motor oil or solvents in this area by residents could potentially result in the impact of the ground-water aquifer with petroleum or chlorinated hydrocarbons.

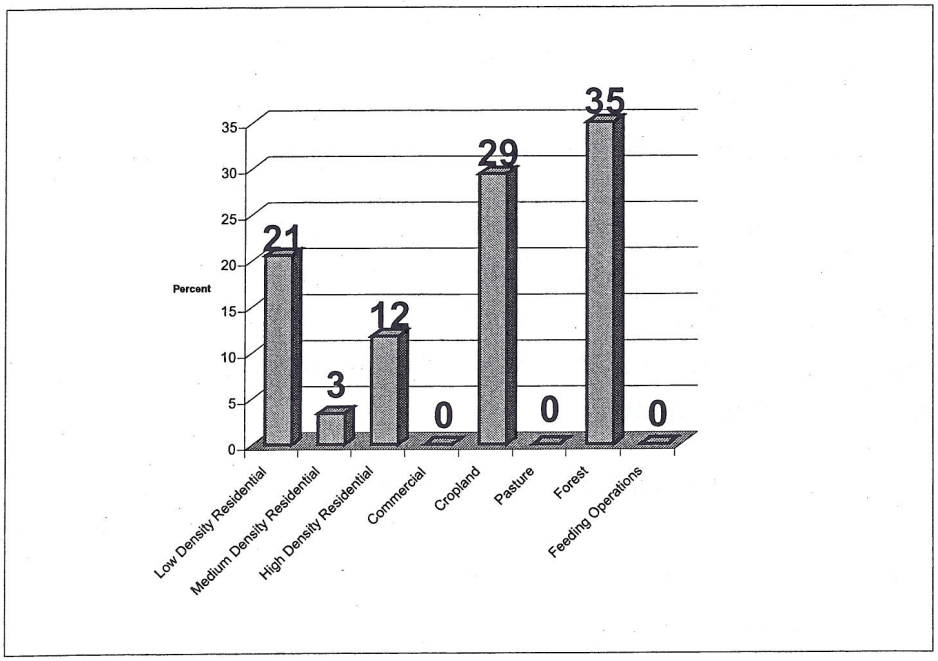
Two inactive wells exist at the property and it is unknown if the wells have been properly abandoned. Improperly abandoned wells can become pathways for contaminants to directly enter the ground-water aquifer.

Bay Oil, a listed leaking underground storage tank site, exists just outside the SWPA to the southeast. Dependent on the nature and extent of release at this property, the local ground-water could be impacted by petroleum hydrocarbons.

3.2 NON-POINT SOURCES

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

PERCENTAGE OF EACH LAND USE TYPE



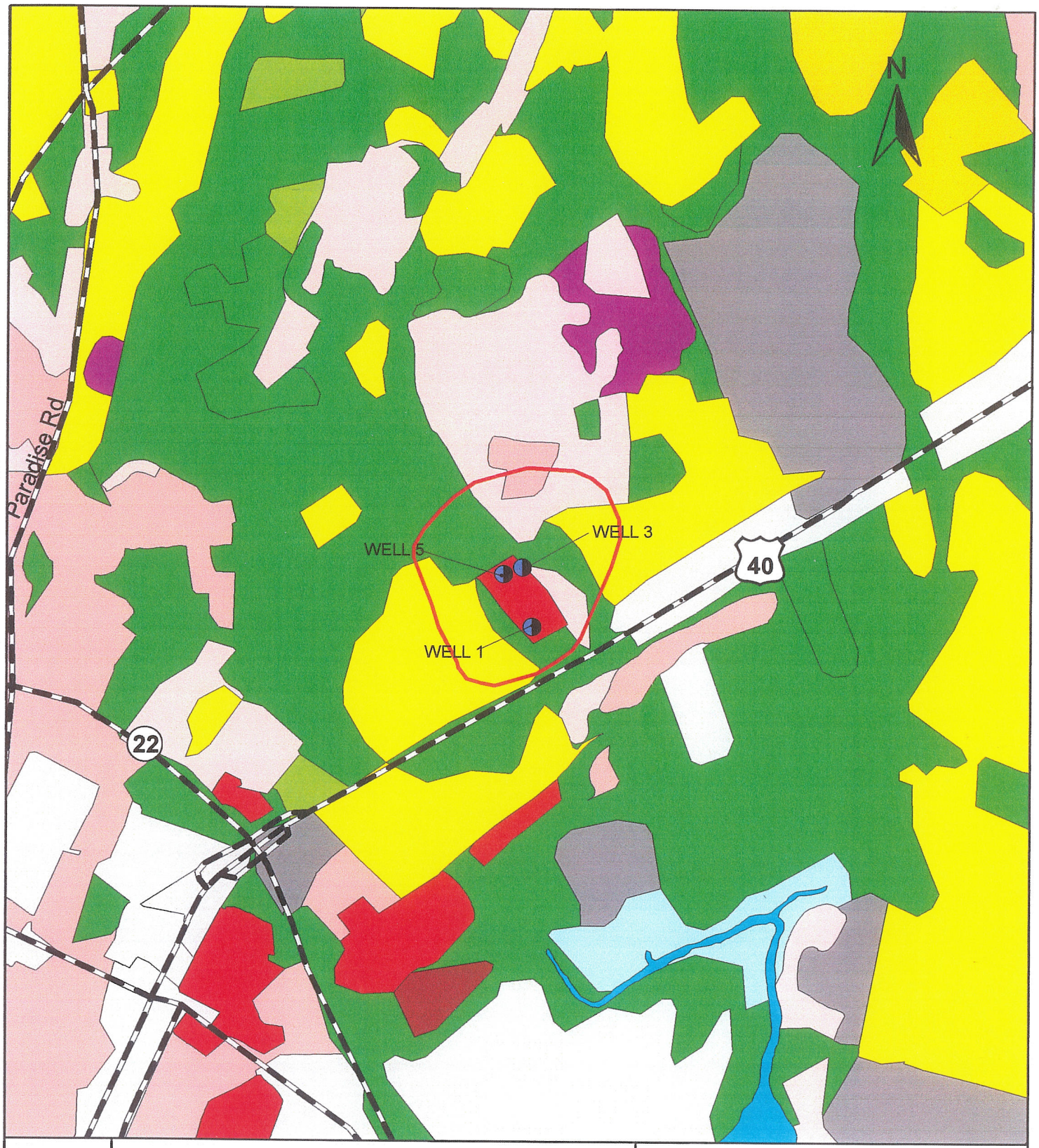


Figure 3. Swan Harbor Dell MHP Land Use Map of the Source Water Protection Area

Source Water Assessment Program
2003

Scale: 1000 0 1000 2000 Feet

Source: Maryland Office of Planning, 2000.

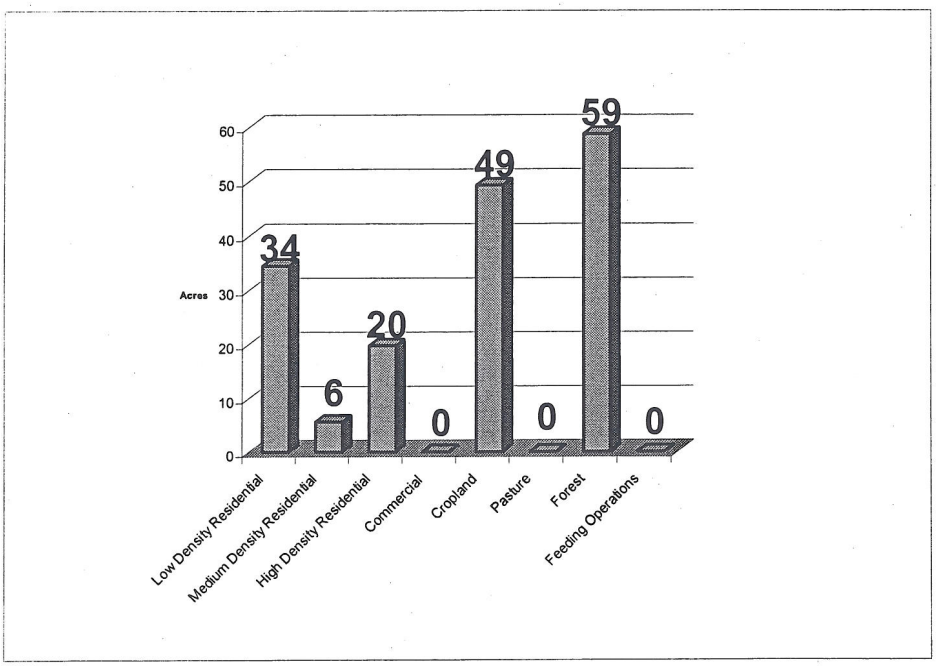
Legend:

- MHP Wells
- SWPA Boundary
- Major Roads

Land Use

- Low Density Residential
- Medium Density Residential
- High Density Residential
- Commercial
- Industrial
- Open Urban Land
- Cropland
- Pasture
- Orchards
- Forest
- Water
- Wetlands
- Feeding Operations

ACREAGE OF EACH LAND USE TYPE



From an interpretation of the graphs above, residential areas (60 acres) and cropland (49 acres) account for a majority of the SWPA (168 acres). The use of fertilizers and pesticides in croplands and on residential lawns is common. Therefore, there is potential for the migration of potential contaminants into the ground water from land use activities.

Using the 1993 Maryland Office of Planning's Harford County sewerage coverage, potential non-point sources from other septic system users in the SWPA were assessed (Figure 4). By overlaying the SWPA on the sewerage coverage layer in ArcView GIS, it was determined that approximately 78 percent of the SWPA does not have public sewer service, approximately 1 percent is either on public sewer service or is under construction, and approximately 21 percent is programmed for service within 5 years.

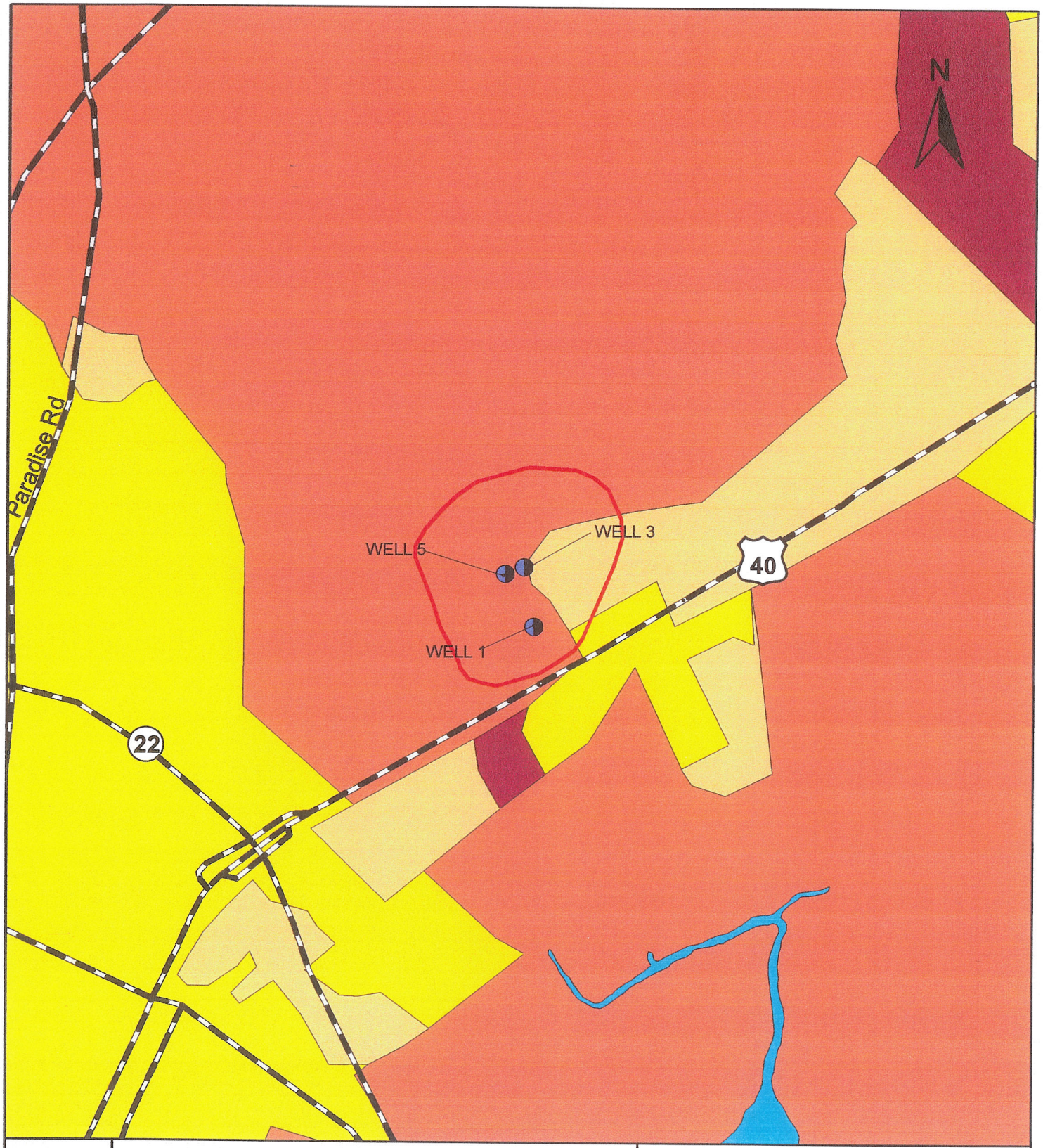


Figure 4. Swan Harbor Dell MHP Sewer Service Map of the Source Water Protection Area

Source Water Assessment Program
2003

Legend:

MHP Wells
SWPA Boundary
Major Roads

Sewer
No planned service area
Existing service area
Area programmed for service within 5 years
Area programmed for service within 6 to 10 years

Scale: 1000 0 1000 2000 Feet

Source: Maryland Office of Planning, 1993.

4. REVIEW OF WATER QUALITY DATA

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

A review of the water quality data from 1991 to 2002 has been performed for Swan Harbor Dell MHP's finished water samples. All detected compounds from the ground-water sample analytes are shown in Appendix A.

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

4.1 GENERAL WATER QUALITY PARAMETERS

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

4.2 VOLATILE ORGANIC COMPOUNDS

Only one volatile organic compound (VOC), trichloroethylene (TCE), was reported above 50 percent of the MCL (2.5 µg/L) in one of the ground-water samples collected. A summary of all TCE concentrations in the ground-water samples collected is shown in Table 2.

TABLE 2. SUMMARY OF TCE ANALYSIS

Plant ID	Sample Date	Contaminant	Result	units
01	13-Feb-91	Trichloroethylene	ND	µg/L
02	13-Feb-91	Trichloroethylene	2	µg/L
00	29-May-91	Trichloroethylene	2	µg/L
01	29-May-91	Trichloroethylene	ND	µg/L
01	18-Jul-91	Trichloroethylene	ND	µg/L
00	24-Jul-91	Trichloroethylene	2	µg/L
01	24-Jul-91	Trichloroethylene	ND	µg/L
01	18-Nov-91	Trichloroethylene	ND	µg/L
01	08-Jan-92	Trichloroethylene	ND	µg/L
00	12-May-92	Trichloroethylene	2	µg/L
01	12-May-92	Trichloroethylene	ND	µg/L
00	04-Aug-92	Trichloroethylene	1	µg/L
01	04-Aug-92	Trichloroethylene	ND	µg/L
00	06-Oct-92	Trichloroethylene	ND	µg/L
01	06-Oct-92	Trichloroethylene	ND	µg/L
00	22-Dec-92	Trichloroethylene	ND	µg/L
01	22-Dec-92	Trichloroethylene	2	µg/L
01	10-Mar-93	Trichloroethylene	ND	µg/L
02	19-Apr-94	Trichloroethylene	1.4	µg/L
01	10-May-94	Trichloroethylene	ND	µg/L
02	02-Aug-94	Trichloroethylene	0.7	µg/L
01	18-Oct-94	Trichloroethylene	1.4	µg/L
01	11-Dec-95	Trichloroethylene	ND	µg/L
02	11-Dec-96	Trichloroethylene	ND	µg/L
02	03-Oct-97	Trichloroethylene	0.8	µg/L
02	26-Aug-98	Trichloroethylene	0.8	µg/L
02	18-Feb-99	Trichloroethylene	1.4	µg/L
02	18-Feb-99	Trichloroethylene	1	µg/L
01	27-Sep-99	Trichloroethylene	1.3	µg/L
01	30-Oct-00	Trichloroethylene	1.5	µg/L
02	21-Feb-01	Trichloroethylene	1.2	µg/L
02	21-Feb-01	Trichloroethylene	1.8	µg/L
01	26-Mar-01	Trichloroethylene	1.4	µg/L
02	12-Dec-01	Trichloroethylene	1.7	µg/L
01	21-May-02	Trichloroethylene	2.6	µg/L

ND = Not Detected.
Shaded values are greater than 50 percent of the MCL.

TCE is a primary drinking water standard parameter. TCE can occur in ground water as a result of discharge from dry cleaners, metal degreasing, or other manufacturing or chemical industries.

Low-level concentrations of 1,1,1-trichloroethane and tetracholoroethylene (PCE) were reported in the water samples. These compounds are also common contaminants in dry cleaning and degreasing activities. The concentrations of 1,1,1-trichloroethane ranged from 1 to 7 µg/L. The concentrations of PCE ranged from 0.5 to 2.3 µg/L. The current MCL for 1,1,1-trichloroethane is 20 µg/L. The current MCL for PCE is 5 µg/L.

The disinfection by-products bromodichloromethane, chloroform, bromoform, and dibromochloromethane (commonly known as trihalomethanes) were also reported in the water samples and ranged in concentration from 0.3 to 0.8 µg/L. Effective 1 January 2004, the MCL for total trihalomethanes will be 80 µg/L.

Low levels of methyl-tert-butyl-ether (MTBE) was reported in ground-water samples collected and ranged from 0.6 to 0.9 µg/L. Methyl-tert-butyl-ether (MTBE) is presently on the USEPA Contaminant Candidate List (CCL) for evaluation of whether placement on the Primary Drinking Water Standards list is warranted. Due to its presence on the CCL, MTBE currently has no MCL; however, USEPA has an advisory level of 20 to 40 µg/L for the compound. MTBE is commonly found in gasoline as a oxygenate additive.

No other VOCs have been detected in the ground-water samples collected.

4.3 SYNTHETIC ORGANIC COMPOUNDS

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

One water sample collected in October 2000 was reported to contain 0.61 µg/L of 2,4-D, a herbicide commonly used on row crops. The current MCL for 2,4-D is 70 µg/L.

One water sample collected in May 2001 was reported to contain 0.1 µg/L of benzo(a)pyrene. The current MCL for benzo(a)pyrene is 0.2 µg/L.

Three water samples were reported to contain di(2-ethylhexyl)phthalate. The reported concentrations ranged from 0.6 to 1.0 µg/L. Di(2-ethylhexyl)phthalate is a common laboratory cross-contaminant and has a current MCL of 6 µg/L.

One water sample collected in October 2000 was reported to contain 0.05 µg/L of pentachlorophenol. Pentachlorophenol in ground water is generally associated with discharge from wood preserving factories or from leaching of wood that has been preserved. It has a current MCL of 1 µg/L.

4.4 INORGANIC COMPOUNDS

Only one inorganic compound, nitrate, was reported above 50 percent of the MCL of 10 mg/L in one of the ground-water samples collected. A summary of all detected nitrate concentrations in the ground-water samples collected is shown in Table 3.

TABLE 3. SUMMARY OF NITRATE ANALYSIS

Plant ID	Sample Date	Contaminant	Result	Unit
01	10-Mar-93	Nitrate	3.6	mg/L
02	10-Mar-93	Nitrate	3.6	mg/L
01	20-Nov-95	Nitrate	3.4	mg/L
02	20-Nov-95	Nitrate	4	mg/L
01	10-Dec-96	Nitrate	7.14	mg/L
02	18-Dec-96	Nitrate	4.46	mg/L
02	03-Oct-97	Nitrate	4.3	mg/L
02	16-Jul-98	Nitrate	3.5	mg/L
01	21-Sep-99	Nitrate	3.8	mg/L
01	29-Sep-99	Nitrate	3.88	mg/L
02	29-Sep-99	Nitrate	3.35	mg/L
02	30-Oct-00	Nitrate	3.5	mg/L
01	13-Dec-00	Nitrate	3.43	mg/L
02	13-Dec-00	Nitrate	2.59	mg/L
02	13-Dec-00	Nitrate	4.3	mg/L
01	14-Jun-01	Nitrate	2.27	mg/L
02	14-Jun-01	Nitrate	3.96	mg/L
02	14-Jun-01	Nitrate	2.43	mg/L
01	12-Dec-01	Nitrate	ND	mg/L
02	12-Dec-01	Nitrate	1.08	mg/L
01	21-May-02	Nitrate	3.9	mg/L

ND = Not Detected.
Shaded values are greater than 50 percent of the MCL.

Nitrate is a primary drinking water standard parameter. Elevated levels of nitrates may occur due to the influx of agricultural animal waste, agricultural chemicals or fertilizers, and/or septic system effluent into the drinking water.

4.5 MICROBIOLOGICAL CONTAMINANTS

No total or fecal coliform has been detected in samples of the water system's finished water from January 1997 to August 2002.

To assess the potential of Ground Water Under the Direct Influence (GWUDI) of surface water, ground-water sampling records (during dry and storm conditions) in MDE databases were assessed and information from Public Water Supply Reports were reviewed.

Surface water that directly recharges the aquifer through major fractures in rock does not pass through the soil overburden that both filters and contains beneficial microorganisms that break down potential contaminants. If significant variances in the ground-water results from dry and storm conditions are observed, it is possible that the ground water is under the direct influence of surface water. Two GWUDI samples collected on 22 and 23 March 2002 from Well 3 were both reported to contain 1 org/100 ml of total coliforms. One of the two samples was also reported to contain 1 org/100 ml of fecal coliform.

The assessment of ground-water sampling results by MDE is still pending on whether the supply system at Swan Harbor Dell MHP is GWUDI.

4.6 RADIONUCLIDES

Radon-222 was reported above the more conservative proposed MCL of 300 picocuries per liter (pCi/L) in two of the water samples collected on 30 October 2000 as shown in Table 4.

TABLE 4. SUMMARY OF RADON-222 ANALYSIS

Plant ID	Sample Date	Contaminant	Result	Unit
01	30-Oct-00	Radon-222	325	pCi/L
02	30-Oct-00	Radon-222	430	pCi/L

Shaded values are greater than the more conservative proposed MCL.

The MCL used for comparing detections of Radon-222 was 300 (pCi/L). This MCL is a proposed MCL established by USEPA since there is no current MCL for this contaminant (USEPA 1999). However, if a state has a program to address the more significant risk from radon in indoor air, then 4,000 pCi/L can be used as an alternate MCL. For the purpose of this investigation, the more conservative number was utilized.

Gross alpha and beta particles were also reported in the 30 October 2000 water samples at concentrations (2 piC/L and 6 piC/L) below the current MCLs of 15 and 50 piC/L.

5. SUSCEPTIBILITY ANALYSIS

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

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

The aquifer that supplies Swan Harbor Dell MHP's drinking water is an unconfined aquifer.

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

5.1 VOLATILE ORGANIC COMPOUNDS

Prior to 1996, TCE (a common industrial degreaser) was reported infrequently in water samples analyzed. However, since 1997, TCE has been reported regularly. The highest concentration of TCE reported to date is 2.6 µg/L, which is greater than 50 percent of the MCL.

PCE, which is often used as a dry cleaning chemical and industrial degreaser, has been reported in three water samples below 50 percent of the MCL. TCE, which has also been reported in the water samples, can be formed from the degradation of PCE in ground water.

No facilities were observed or reported within the SWPA that may have used PCE or TCE. However, there may have been a historical surface release or spill within the SWPA or an accidental release into septic systems which were not designed to treat and degrade solvents.

The low levels of MTBE reported (less than 1 µg/L) are most likely the result of a gasoline release into the subsurface. Because of the chemical properties of MTBE, it moves faster and farther than other gasoline constituents such as benzene or xylenes.

The reported concentrations may be the leading edge of the dissolved phase plume of gasoline constituents with MCLs. A known LUST site (Bay Oil) has been reported and observed adjacent

to the SWPA to the east. An auto repair area has also been identified within the SWPA. Any unreported and unintentional release of gasoline could impact the ground water with VOCs including MTBE.

Based on the water quality data reviewed and the observed and reported facilities that may cause VOC contamination in the SWPA, the water supply at Swan Harbor Dell MHP is highly susceptible to VOCs.

5.2 SYNTHETIC ORGANIC COMPOUNDS

No concentrations of SOCs have been reported above 50 percent of the MCL.

The reported concentrations of di(2-ethylhexyl)phthalate are most likely the result of laboratory cross-contamination.

The possible use of fertilizers, herbicides, and pesticides on lawns of residential areas (36 percent of the SWPA) and croplands (29 percent of the SWPA) can be considered a potential non-point source for SOCs. A low level concentration (0.61 µg/L) of the herbicide 2,4-D was reported in one water sample analyzed from October 2000.

While SOCs have a high affinity to sorb to soil particles and are not likely to infiltrate into the ground-water aquifer, a number of SOCs including 2,4-D, pentachlorophenol, and benzo(a)pyrene have been reported.

Based on the water quality data reviewed and the reported concentrations of SOCs, the water supply at Swan Harbor Dell MHP is moderately susceptible to SOCs.

5.3 INORGANIC COMPOUNDS

Nitrate was reported in a December 1996 water sample at a concentration (7.14 mg/L) greater than 50 percent of the MCL of 10 mg/L. Nitrate concentrations have been reported generally between 2 and 4 mg/L in the water samples collected. No other inorganic compounds (IOCs) were reported above 50 percent of the MCL.

The concentrations of nitrate reported in the water samples may be from non-point sources such as septic fields and agricultural areas. Approximately 29 percent of the SWPA is agricultural. Excessive use of manure as a fertilizer on agricultural areas is a potential source of nitrate to the ground water. Approximately 78 percent of the SWPA is not served by public sanitary sewer systems and therefore most likely uses subsurface septic systems. Nitrate is also present in septic system wastewater.

Based on the water quality review, and an evaluation of the land use areas in the SWPA, the water supply at Swan Harbor Dell MHP is highly susceptible to nitrate pollution and has a low susceptibility to other regulated IOCs.

5.4 RADIONUCLIDES

Concentrations of radon-222 of 325 and 430 µg/L, which are greater than the more conservative proposed MCL of 300 pCi/L, were reported in the two water samples collected in October 2000.

Gross alpha and beta particle concentrations in the October 2000 water sample were reported well below the current MCLs.

While the presence of gross alpha particles, gross beta particles, and radon-222 are generally attributed to decay of naturally occurring minerals like uranium in the metamorphic rock aquifer (Bolton 1996), the concentrations of radon-222 are higher than the more conservative proposed MCL. However, this proposed rule is not enforceable and MDE is waiting for the USEPA's final rule to determine how radon will be regulated for public water systems (USEPA 1999).

Based on the water quality review, the water supply at Swan Harbor Dell MHP is moderately susceptible to radion-222, and has a low susceptibility to other radionuclides.

5.5 MICROBIOLOGICAL CONTAMINANTS

No coliform bacterium has been detected in the finished water samples since the collection began in 1997.

At this time, the assessment of ground-water sampling results by MDE is still pending on whether the supply system at Swan Harbor Dell MHP is GWUDI. However, 1 org/100 ml of total coliform was reported from GWUDI sampling performed on 22 and 23 March 2002 from Well Number 3. One of the two samples was also reported to contain 1 org/100 ml of fecal coliform.

Two unused wells (HA009611 and HACF166) were observed. Unused wells that are not properly maintained can become a direct pathway for surface water with naturally occurring coliform bacteria to infiltrate into the aquifer. However, it is unknown if the wells have been properly abandoned.

From documentation reviewed, the supply wells were constructed after 1973, the year that proper well construction standards were required. All the wellheads were observed to be in good repair.

Based on the water quality review, the recent GWUDI results, and the presence of two unused wells, the water supply at Swan Harbor Dell MHP is moderately susceptible to microbiological contaminants.

6. RECOMMENDATIONS FOR PROTECTING THE WATER SUPPLY

With the information contained in this report, Swan Harbor Dell MHP has a basis for better understanding of the risks to its drinking water supply. Being aware of the SWPA, knowing potential contaminant sources, evaluating current and future development, working with agricultural producers and soil conservation agencies, and effective outreach and education are examples of management practices that will help protect the water supply.

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

6.1 PROTECTION TEAM

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

6.2 PUBLIC AWARENESS AND OUTREACH

The management of the mobile home park should consider discussing with property owners and businesses located within the SWPA the activities that may have impacts to the ground water and its quality.

The management of the mobile home park should also consider sending pamphlets, flyers, or bill stuffers to its residents to educate them about the SWPA. An example pamphlet, "Gardening in a Wellhead Protection Area," is available from MDE. The residents should also be encouraged to notify the mobile home park management of any significant spills from gasoline or any other potentially hazardous substances.

Placing signs at the SWPA boundaries is an effective way to make the public aware of protecting their source of water supply, and to help in the event of spill notification and response.

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

6.3 PLANNING/NEW DEVELOPMENT

The management of the mobile home park should also inform the Harford County Health and Planning Departments of any concerns to future development or zoning changes for properties that are within the SWPA.

6.4 MONITORING

The management of the mobile home park should continue to monitor the ground water for all SWDA contaminants as required by MDE. Due to the frequency of detections of low-level VOCs (specifically TCE), and nitrate in the water, the management of the mobile home park should monitor the reported concentrations closely.

Due to the frequent reported detections of VOCs, specifically TCE, the management of the mobile home park may want to consider installing a VOC removal system, such as granular activated carbon.

Additional sampling for radon-222 should be performed to monitor and document levels until the USEPA determines how to regulate the radionuclides in public water supplies.

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

The management of the mobile home park should also contact the MDE Oil Control Program for the environmental compliance status of Bay Oil, which is adjacent to the SWPA.

6.5 CONTINGENCY PLAN

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

6.6 CHANGES IN USES

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

6.7 CONTAMINANT SOURCE INVENTORY UPDATES/INSPECTIONS

The management of the mobile home park should conduct its own survey of the SWPA to ensure that there are no additional potential sources of contamination. The management of the mobile home park should notify the MDE Water Supply Program of any historical solvent users near the mobile home park such as dry cleaners and any other industries that may have been a cause of the low level VOC detections in the ground water.

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

Two unused wells were observed on onsite. Unused wells that are no longer connected to the distribution system should be abandoned and sealed as per COMAR 26.04.04.11. Wells that are unused and not maintained can provide a pathway for contaminants, specifically total coliforms, to the aquifer.

6.8 COOPERATIVE EFFORTS WITH OTHER AGENCIES

The management of the mobile home park may request the assistance of the University of Maryland Agricultural Extension Service, Soil Conservation Service to work with the nearby farmers to adopt Best Management Practices (BMPs) for cropland located within the SWPA.

The nearby farmers can also participate in the New Conservation Reserve Program (CREP) applicable to the cropland located within the SWPA. Government funding is available to qualified farmers equal to the cost and financial benefit of farming the area. The Natural Resources Conservation Service is responsible for determining the relative environmental benefits of each acre offered for participation.

7. REFERENCES

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

1. Bolton, David W. 1996. *Network Description and Initial Water-Quality Data From a Statewide Ground-Water Quality Network in Maryland.* Maryland Geological Survey Report of Investigations No. 60.

2. Maryland Geologic Survey (MGS). 1968. *Cecil County Geologic Map adapted from Maryland Geological Survey's Geologic Map of Maryland.*

3. United States Environmental Protection Agency (USEPA). 2001. *A Small Systems Guide to the Total Coliform Rule.* Office of Water. EPA 816-R-01-017A. June.

4. United States Environmental Protection Agency (USEPA). 1999. *Proposed Radon in Drinking Water Rule.* Office of Water. EPA 815-F-99-006. October.

5. Maryland Department of the Environment (MDE), Water Supply Program, 1999. *Maryland's Source Water Assessment Plan*, 36. pp.

6. Nutter, Larry J. Ground-Water Resources of Harford County, Maryland. 1977. Maryland Department of Natural Resources, Maryland Geologic Survey, Geologic Survey of the United States Department of the Interior and Harford County Department of Planning and Zoning. Bulletin No. 32.

SOURCES OF DATA

Water Appropriation and Use Database.
Public Water Supply Inspection Reports
Monitoring Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Maryland Office of Planning 2000 Harford County Land Use Map
Maryland Office of Planning 1993 Harford County Land Use Map
USGS Topographic 7.5 minute Quadrangle Map – 1992 Havre de Grace, Maryland Quad
USGS Topographic 7.5 minute Quadrangle Map – 1953 (1985) Aberdeen, Maryland Quad

Appendix A

Detected Compounds in Ground-Water Samples

SUMMARY OF DETECTED COMPOUNDS IN SWAN HARBOR DELL MHP WATER SAMPLES				
Plant ID	**Sample Date**	**Contaminant Name**	**Result**	**Unit**
Volatile Organic Compounds				
01	13-Feb-91	1,1,1-TRICHLOROETHANE	4	ug/L
01	29-May-91	1,1,1-TRICHLOROETHANE	5	ug/L
01	18-Jul-91	1,1,1-TRICHLOROETHANE	7	ug/L
01	24-Jul-91	1,1,1-TRICHLOROETHANE	4	ug/L
01	12-May-92	1,1,1-TRICHLOROETHANE	4	ug/L
01	04-Aug-92	1,1,1-TRICHLOROETHANE	4	ug/L
01	06-Oct-92	1,1,1-TRICHLOROETHANE	3	ug/L
00	22-Dec-92	1,1,1-TRICHLOROETHANE	1	ug/L
01	10-Mar-93	1,1,1-TRICHLOROETHANE	4.6	ug/L
01	11-Dec-95	1,1,1-TRICHLOROETHANE	1.7	ug/L
01	29-May-91	1,1-DICHLOROETHYLENE	1	ug/L
01	04-Aug-92	1,1-DICHLOROETHYLENE	1	ug/L
01	22-Dec-92	1,1-DICHLOROETHYLENE	1	ug/L
01	10-Mar-93	1,1-DICHLOROETHYLENE	0.9	ug/L
02	03-Oct-97	BROMODICHLOROMETHANE	0.3	ug/L
02	03-Oct-97	BROMOFORM	0.3	ug/L
01	11-Dec-95	CHLOROFORM	0.4	ug/L
02	03-Oct-97	CHLOROFORM	0.3	ug/L
02	18-Feb-99	CHLOROFORM	0.8	ug/L
01	27-Sep-99	CHLOROFORM	0.5	ug/L
02	03-Oct-97	DIBROMOCHLOROMETHANE	0.6	ug/L
02	26-Aug-98	METHYL-TERT-BUTYL-ETHER	0.8	ug/L
02	18-Feb-99	METHYL-TERT-BUTYL-ETHER	0.8	ug/L
01	30-Oct-00	METHYL-TERT-BUTYL-ETHER	0.6	ug/L
02	21-Feb-01	METHYL-TERT-BUTYL-ETHER	0.9	ug/L
01	26-Mar-01	METHYL-TERT-BUTYL-ETHER	0.7	ug/L
01	30-Oct-00	TETRACHLOROETHYLENE	0.8	ug/L
02	21-Feb-01	TETRACHLOROETHYLENE	2	ug/L
02	12-Dec-01	TETRACHLOROETHYLENE	2.3	ug/L
01	21-May-02	TETRACHLOROETHYLENE	0.5	ug/L
02	13-Feb-91	TRICHLOROETHYLENE	2	ug/L
00	29-May-91	TRICHLOROETHYLENE	2	ug/L
00	24-Jul-91	TRICHLOROETHYLENE	2	ug/L
00	12-May-92	TRICHLOROETHYLENE	2	ug/L
00	04-Aug-92	TRICHLOROETHYLENE	1	ug/L
01	22-Dec-92	TRICHLOROETHYLENE	2	ug/L
02	19-Apr-94	TRICHLOROETHYLENE	1.4	ug/L
02	02-Aug-94	TRICHLOROETHYLENE	0.7	ug/L
01	18-Oct-94	TRICHLOROETHYLENE	1.4	ug/L
02	03-Oct-97	TRICHLOROETHYLENE	0.8	ug/L
02	26-Aug-98	TRICHLOROETHYLENE	0.8	ug/L
02	18-Feb-99	TRICHLOROETHYLENE	1.4	ug/L
02	18-Feb-99	TRICHLOROETHYLENE	1	ug/L
01	27-Sep-99	TRICHLOROETHYLENE	1.3	ug/L

SUMMARY OF DETECTED COMPOUNDS IN SWAN HARBOR DELL WATER SAMPLES				
Plant ID	**Sample Date**	**Contaminant Name**	**Result**	**Unit**
Volatile Organic Compounds				
01	30-Oct-00	TRICHLOROETHYLENE	1.5	ug/L
02	21-Feb-01	TRICHLOROETHYLENE	1.8	ug/L
02	21-Feb-01	TRICHLOROETHYLENE	1.2	ug/L
01	26-Mar-01	TRICHLOROETHYLENE	1.4	ug/L
02	12-Dec-01	TRICHLOROETHYLENE	1.7	ug/L
01	21-May-02	TRICHLOROETHYLENE	2.6	ug/L
Synthetic Organic Compounds				
01	30-Oct-00	2,4-D	0.61	ug/L
01	21-May-02	BENZO(a)PYRENE	0.1	ug/L
02	16-Jul-98	DI(2-ETHYLHEXYL) PHTHALATE	0.6	ug/L
01	30-Oct-00	DI(2-ETHYLHEXYL) PHTHALATE	0.6	ug/L
01	21-May-02	DI(2-ETHYLHEXYL) PHTHALATE	1	ug/L
01	30-Oct-00	PENTACHLOROPHENOL	0.05	ug/L
Inorganic Compounds				
02	22-Mar-94	BARIUM	0.013	mg/L
02	16-Jul-98	FLUORIDE	0.1	mg/L
01	10-Mar-93	NITRATE	3.6	mg/L
01	20-Nov-95	NITRATE	3.4	mg/L
02	20-Nov-95	NITRATE	4	mg/L
01	10-Dec-96	NITRATE	7.14	mg/L
02	18-Dec-96	NITRATE	4.46	mg/L
02	03-Oct-97	NITRATE	4.3	mg/L
02	16-Jul-98	NITRATE	3.5	mg/L
01	21-Sep-99	NITRATE	3.8	mg/L
01	29-Sep-99	NITRATE	3.88	mg/L
02	29-Sep-99	NITRATE	3.35	mg/L
02	30-Oct-00	NITRATE	3.5	mg/L
01	13-Dec-00	NITRATE	3.43	mg/L
02	13-Dec-00	NITRATE	2.59	mg/L
02	13-Dec-00	NITRATE	4.3	mg/L
01	14-Jun-01	NITRATE	2.27	mg/L
02	14-Jun-01	NITRATE	3.96	mg/L
02	14-Jun-01	NITRATE	2.43	mg/L
02	12-Dec-01	NITRATE	1.08	mg/L
01	21-May-02	NITRATE	3.9	mg/L
02	16-Jul-98	SODIUM	40.3	mg/L
01	21-Sep-99	SODIUM	1.8	mg/L
02	30-Oct-00	SODIUM	47.1	mg/L
01	21-May-02	SODIUM	81.2	mg/L
01	20-Nov-95	SULFATE	8.1	mg/L
02	20-Nov-95	SULFATE	7.7	mg/L
02	16-Jul-98	SULFATE	12.7	mg/L
02	30-Oct-00	SULFATE	12.2	mg/L
01	21-May-02	SULFATE	11.2	mg/L

SUMMARY OF DETECTED COMPOUNDS IN SWAN HARBOR DELL WATER SAMPLES				
Plant ID	**Sample Date**	**Contaminant Name**	**Result**	**Unit**
General Water Quality Parameters				
01	10-Dec-96	pH	7.9	s.u.
02	18-Dec-96	pH	7.1	s.u.
Radionuclides				
01	30-Oct-00	GROSS ALPHA	2	pCi/L
01	30-Oct-00	GROSS BETA	6	pCi/L
02	30-Oct-00	RADON-222	325	pCi/L
01	30-Oct-00	RADON-222	430	pCi/L
GWUDI Sampling				
02	22-Mar-00	TOTAL COLIFORM	1	org/100ml
02	22-Mar-00	FECAL COLIFORM	1	org/100ml
02	23-Mar-00	TOTAL COLIFORM	1	org/100ml

s.u. – standard units.