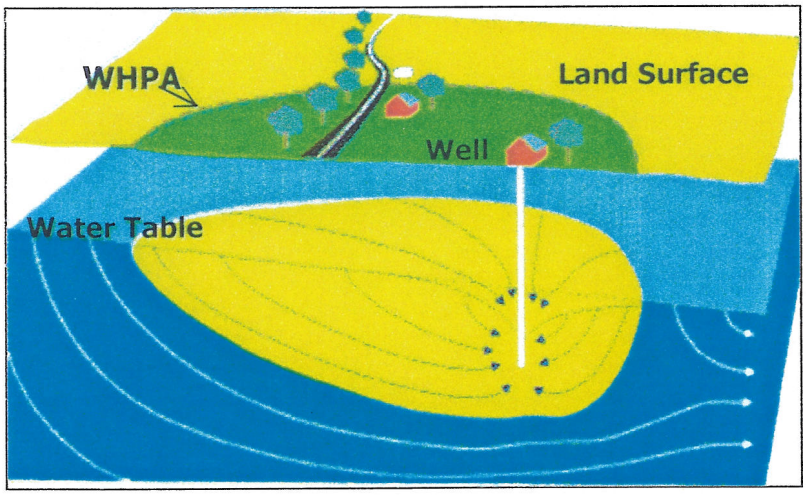
SOURCE WATER ASSESSMENT

FOR THE TOWN OF HAMPSTEAD

CARROLL COUNTY, MD



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MDE

SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for the Town of Hampstead. The required components of this report as described in Maryland's Source Water Assessment Plan (SWAP) are: 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Hampstead's water supply is an unconfined fractured rock aquifer, known as the Prettyboy Schist. The system currently uses fourteen wells to obtain its drinking water. The Source Water Assessment Area was delineated by the Carroll County Bureau of Water Resources Management using U.S. EPA approved methods specifically designed for each source.

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

The susceptibility analysis for Hampstead's 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 all of Hampstead's wells are susceptible to contamination by nitrates, volatile organic compounds, synthetic organic compounds, and radionuclides, but not to other inorganic compounds. It was also determined that Hampstead's wells are not susceptible to protozoans but Well Nos. 19, 21, 23 and 24 are susceptible to total coliform.

INTRODUCTION

The Town of Hampstead is located about 8 miles northeast of Westminster in Carroll County (figure 1). The Town owns and operates its water supply system that serves a population of 4847. Currently, the water is supplied by fourteen wells located in various parts of the Town (figure 1). The water is pumped from the wells and treated at nine pump houses located in the vicinity of the wells.

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. A review of well data and sanitary surveys of Hampstead's water system indicates that Well Nos. 11 and 12 were drilled prior to 1973, when the State's well construction regulations went into effect, and may not meet current construction standards. All the other wells were drilled after 1973 and should meet construction standards for grouting and casing. Two older wells (Nos. 7 and 8) were abandoned as per State construction standards. Well Nos. 18 was taken out of service because it was determined to be under the influence of surface water. Well No. 30 is not in service due to its vicinity to Well Nos. 28 and 29 and interference effects with them. A new well (No. 31) will be placed into service shortly when construction of pumphouse (No. 15) is completed. The Town is also negotiating the use a well currently owned by the Oakmont Green Golf Club. Table 1 contains a summary of the well construction data.

PLANT ID	PUMP HOUSE NO	SOURCE NAME	PERMIT NO	TOTAL DEPTH (ft)	CASING DEPTH (ft)	YEAR DRILLED
02	5	Well No 11 (N Main)	CL680426	300	75	1968
02	5	Well No 12 (N Main)	CL690151	425	65	1968
03	6	Well No 13 (Rt 88)	CL732800	205	44	1975
04	7	Well No 15 (Rt 88)	CL737438	225	73	1978
05	8	Well No 19 (Greenmount)	CL811395	200	21	1984
06	9	Well No 20 (Hospital)	N/A	N/A	N/A	1987
06	9	Well No 21 (Hospital)	CL814666	122	22	1987
07	10	Well No 22 (Roberts Field)	CL814671	132	46	1987
07	10	Well No 23 (Roberts Field)	CL814674	102	23	1988
08	11	Well No 24 (Small Crossings)	CL813908	174	38	1986
08	11	Well No 25 (Small Crossings)	CL813231	149	40	1986
09	12	Well No 26 (Roberts Field)	CL815662	161	60	1988
10	13	Well No 27 (Roberts Field)	CL815653	161	30	1988
11	14	Well No 28 (Corbin)	CL813232	123	28	1986
11	14	Well No 29 (Corbin)	CL815651	223	26	1986
11	14	Well No 30 (Corbin)	CL815652	115	44	1986
12	15	Well No 31 (Westwood)	CL880252	243	28	1990

Table 1. Hampstead Well Information.

The yields of the wells being currently used range from 31 gallons per minute (gpm) to 75 gpm. Hampstead has a three Water Appropriation Permits that allow the Town to use an average of 509,800 gallons per day (gpd) and 733,300 gpd in the month of maximum use. Based on the 2001 reported pumpage, the Town used an average of 398,800 gpd and 436,000 gpd in June, which was the month of maximum use.

HYDROGEOLOGY

The Hampstead area lies in the Piedmont physiographic province and is located on a major watershed divide which generally follows Route 30 through Town, between the Gunpowder River and Patapsco River basins (R.E. Wright, 1988). The Hampstead area is underlain by the Prettyboy Schist, which formerly has been mapped as the Upper Pelitic Schist of the Wissahickon Formation. The Water Appropriation Permits indicate the Upper Pelitic Schist as the aquifer which supplies water to the Town. The Prettyboy Schist is an unconfined, fractured rock aquifer composed of fine to medium-grained, green gray albite-chlorite-muscovite-quartz schist with minor intercalated greenish-gray to pale tan chlorite-muscovite quartzite (Muller, 1991).

Weathering of the schist results in clayey overburden material known as saprolite, below which is fractured bedrock. In the Hampstead area saprolite thickness ranges from 0 feet to over 100 feet in the valleys. In this type of aquifer, most of the ground water is stored in the saprolite and ground water flow is through fractures in the rock. Ground water systems in crystalline rock tend to be localized and flow is within topographic divides towards the nearest perennial streams. (Bolton, 1998).

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 WHPA for Hampstead's water supply was delineated by the Carroll County Bureau of Water Resource Management as part of the County Water Resources Ordinance development (R. E. Wright, 1989). Hydrogeologic mapping was the method used for the delineation. This is the methodology recommended for fractured rock aquifers in the EPA approved Maryland's Source Water Assessment Plan (1999).

The Hampstead WHPA consists of six smaller WHPAs (figure 2). These WHPAs are based on the watersheds in which the wells are located. The delineated WHPAs represent the areas which contribute ground water to the wells. These areas are based on "capture areas" as estimated from available field testing data, hydrologic flow systems, and ground water availability estimates, in combination with the hydrogeological characteristics of the aquifer (R. E. Wright, 1989). The total area of the Hampstead WHPA is 1,830 acres.

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. The WSP conducted a joint field survey of the WHPA in January 2001 with the Town's Water Superintendent Roger Steger, Water Operator Kevin Hann and County Hydrogeologist Tom Devilbiss.

Point Sources

A review of MDE and Carroll County contaminant databases as well as the field survey revealed several point sources of contamination in and adjacent to the WHPA. Figure 2 identifies Underground Storage Tanks (USTs) sites, Ground Water Discharge Permit (GWD) sites, Junkyards (JUNK), Registered Hazardous Waste Generators (CHS), Superfund sites (CERCLA), and Pesticide Dealers (PD). In addition, facilities like auto body and repair shops (MISC) that handle and use chemicals are also shown in figure 2. Table 2 lists the facilities identified and their potential types of contaminants. The contaminants are based on generalized categories and often the potential contaminant depends on the specific chemicals and processes being used or which had been used at the facility. The potential contaminants are not limited to those listed. Potential contaminants are grouped as Volatile Organic Compounds (VOC), Synthetic Organic Compounds (SOC), Inorganic Compounds (IOC), Heavy Metals (HM), Metals (M), Nitrate/Nitrite (NN), and Microbiological Pathogens (MP).

Several of the facilities with USTs (these are * in table 2)) have had their tanks replaced with newer ones due to leaks or non-compliance with current State tank regulations. Other facilities that had USTs have had them permanently removed (eg Ward Sunoco) due to leaks or other non-compliance issues. Newer tanks are less likely to leak due to new construction standards, however leaks may be possible in underground piping. Because they are located in the subsurface, leaks often go undetected unless a water supply is impacted. Hampstead Exxon had a leaking UST that impacted Well No. 15 which was shut off for sometime. The site was remediated and case closed once it was determined that the level of VOC contamination was no longer a threat to public health.

ID	Type	Site Name	Address	Potential Contaminant	Status
1	GWD	C. J. Miller	3514 Basler Rd	VOC	Permit Inactive
2	UST	North Carroll Middle School*	2401 Hanover Pike	VOC	1 tank
3	CERCLA	North Carroll Shopping Plaza	Route 30 and Brodbeck Rd	VOC	No further action
4	CHS	C & C Cleaners	2320 Hanover Pike	VOC	Inactive
5	GWD	North Carroll Shopping Plaza	Route 30 and Brodbeck Rd	NN, MP	Active Permit
6	MISC	Mr. Tire	2330 Hanover Pike	VOC	Active
7	CHS	Auto Unlimited	2031 Hanover Pike	VOC, HM	Active
8	MISC	Walsh's Fuel Supply	1600 Hanover Pike	VOC	Active
9	CHS	Cox's Ford, Inc.	1621 Hanover Pike	VOC, HM	Active
10	MISC	Reese's Garage	1525 Hanover Pike	VOC, HM	
11	CHS	Ridge Engineering, Inc.	3987 Hampstead-Mexico Rd	VOC, HM	Active
12	UST	Ridge Engineering, Inc.	3987 Hampstead-Mexico Rd	VOC	1 tank
13	UST	Maryland Fresh Eggs*	3986 Hampstead-Mexico Rd	VOC	1 tank in use , 1 tank removed (1993)
14	UST	North Carroll High School	3801 Hampstead-Mexico Rd	VOC	1 tank
15	CHS	North Carroll High School	3801 Hampstead-Mexico Rd	VOC, M, SOC	Active
16	MISC	Matthews Tire Co.	1219 Main Street	VOC	Active
17	UST	Jiffy Mart/Shell*	1155 Main Street	VOC	5 tanks
18	PD	Southern States	4020 Shiloh Rd	SOC	Main activity at other site
19	CHS	Stambaugh Chevrolet	1111 Main Street	VOC, HM	Active
20	UST	Highfield Apartments	3825 Shiloh Rd	VOC	1 tank
21	UST	Highfield Apartments	3825 Shiloh Rd	VOC	1 tank
22	UST	Hampstead Elementary	3737 Shiloh Rd	VOC	1 tank
23	CHS	Dr. Deogracias Faustino	4111 Lower Beckleyville Rd	VOC, HM, R	Active
24	MISC	Millender's Garage	844 South Main St	VOC, HM	Active
25	UST	Hampstead Exxon*	822 South Main St	VOC	3 tanks
26	MISC	Hampstead Performance Ctr	818 Main St	VOC, HM	Active
27	CHS	Black and Decker	626 Hanover Pike	VOC	Active
28	CERCLA	Black and Decker	626 Hanover Pike	VOC	Under Remediation
29	UST	Spring Garden Elementary	700 Boxwood Dr	VOC	1 tank
30	PD	Southern States	550 Hanover Pike	SOC	Active
31	CHS	Joseph A. Banks	500 Hanover Pike	VOC	Active
32	JUNK	Brodbeck Garage	Brodbeck Rd &Hanover Pike	VOC, HM, M	Active
33	CHS	J. F. Eline & Sons, Inc.	934 South Main St	VOC, SOC, MP	Active

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

The two CERCLA sites are close to the Town's WHPA boundary. The Black and Decker site maintains an ongoing pump and treat system for removal for trichloroethylene (TCE) and tetrachloroethylene (PCE) from the ground water. Because of the concern that the contamination plume may migrate east, Well Nos. 22 and 23 were kept offline from 1990 to 2000. The wells have now been permitted for use at a pumping rate that will not cause any changes in the hydrogeological conditions at the contamination site. Ground water at the North Carroll Plaza was contaminated by PCE and TCE due to improper disposal of chemicals. A remediation treatment was installed for the PCE which was the main contaminant found in high concentrations. The PCE was removed to levels below drinking water standards and the site was given a No Further Action status in 2001. The site, which had its own water supply, is now connected to the Town of Hampstead water system and the previous water supply wells have been abandoned.

Non-Point Sources

The Maryland Office of Planning's 2000 digital land use map for Carroll County was used to determine the predominant types of land use in the WHPA (figure 3). A large portion of the WHPA is made of residential land (43%) followed by cropland (28%). It must be noted that some of the cropland shown on the 2000 map is now school property (Hampstead Middle School).

LAND USE CATEGORIES	TOTAL AREA (acres)	PERCENTAGE OF WHPA
Low Density Residential	190.54	10.41
Medium Density Residential	521.72	28.51
High Density Residential	78.52	4.29
Commercial/Institutional	216.89	11.85
Industrial	7.79	0.45
Open Urban Land	127.74	6.98
Cropland	504.43	27.56
Pasture	35.02	1.91
Forest	143.49	7.84
Feeding Operations	3.65	0.20
Total	1,829.79	100.00

Table 3. Land Use Summary for the Hampstead WHPA.

Agricultural land (cropland, pasture and feeding operations) is commonly associated with nitrate loading of ground water. Cropland and pasture represent a potential source of SOCs depending on fertilizing practices and use of pesticides. In addition, pasture and feeding operations may be potential sources of microbiological pathogens due to animal wastes. Residential areas may be a source of nitrates and SOCs if fertilizers and pesticides are not used carefully for lawns and gardens. Commercial areas are associated with facilities that may have point sources of contamination as described above.

The Maryland Office of Planning's 1995 Carroll County Sewer Map, shows that 44% of the Hampstead WHPA is not planned for sewer service (figure 4). Table 4 summarizes the sewer service categories in the WHPA. It must be noted that the categories showing future services now have service, since the map is based on 1995 data.

SEWER SEVICE AREA	TOTAL AREA (acres)	PERCENTAGE OF WHPA
No Planned Service	805.81	44.04
Existing Service	765.31	41.82
Service within 2 to 6 years	172.55	9.43
Service within 6 years	86.12	4.71
Total	1,829.79	100

Table 4. Sewer Service Area Summary for the Hampstead WHPA.

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 are the cause of the elevated contaminant level. All data reported is from the finished (treated) water unless otherwise noted. The Hampstead water system currently has 10 points of entry or plants all of which have ph adjustment and hypochorination (post) for treatment. The purpose of the treatment is for corrosion control and disinfection, respectively.

A review of the monitoring data since 1993for Hampstead's water indicates that the water supply meets the current drinking water standards. The water quality sampling results are summarized in Table 5. It must be noted that the radionuclide numbers used in this table include detections of radon-222 using proposed MCLs.

PLANT ID	PUMP HOUSE NO	Nitrate		SOCs		VOCs		IOCs (except nitrate)		Radionuclides	
		No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL
02	5	32	32	12	0	12	0	4	0	4	4
03	6	32	31	2	0	5	0	3	0	3	2
04	7	30	29	3	0	10	0	3	0	3	2
05	8	22	21	2	0	5	0	2	0	2	2
06	9	38	38	12	1	34	7	4	0	3	2
07	10	7	7	0	0	19	0	0	0	0	0
08	11	54	54	2	0	8	0	4	0	3	3
09	12	32	32	2	1	7	0	3	0	4	3
10	13	24	24	3	1	9	0	3	0	2	1
11	14	31	30	10	0	13	0	5	0	7	4

Table 5. Summary of Water Quality Samples for Hampstead's Water Supply

Inorganic Compounds (IOCs)

The only IOC detected above 50% of the MCL was nitrate. The MCL for nitrate is 10 ppm. The nitrate detections above 50% of the MCL in Hampstead's water supply are shown in Tables 6a - 6j. The trend of the nitrate values is discussed in the susceptibility analysis section. Nitrate levels above the MCL are shown in bold.

PLANT ID	SAMPLE DATE	RESULT (ppm)
02	13-Dec-93	9.3
02	11-Mar-94	8.9
02	29-Nov-94	7.72
02	30-Nov-94	8.9
02	24-May-95	7.3
02	8-Aug-95	8.6
02	8-Sep-95	9.4
02	2-Jan-96	8.7
02	28-Mar-96	8.9
02	18-Sep-96	9.2
02	9-Dec-96	8.4
02	13-Mar-97	9
02	19-Jun-97	8.1
02	10-Sep-97	8.2
02	5-Dec-97	8
02	30-Mar-98	7.8
02	25-Jun-98	7.9
02	21-Sep-98	8.1
02	19-Oct-98	8.2
02	7-Dec-98	8.5
02	17-Mar-99	7.5
02	14-Jun-99	8.1
02	7-Sep-99	7.4
02	6-Dec-99	7.2
02	15-Mar-00	7.8
02	6-Jun-00	7.4
02	20-Jun-00	7.3
02	21-Sep-00	7.3
02	7-Dec-00	8.2
02	12-Mar-01	7.5
02	12-Jun-01	7.7
02	24-Sep-01	7.7

Table 6a. Nitrate results above 50% of the MCL for Hampstead Plant 2 (Well Nos. 11 and 12).

PLANT ID	SAMPLE DATE	RESULT (ppm)
03	13-Dec-93	7.3
03	30-Nov-94	6.98
03	30-Jan-95	6.9
03	24-May-95	7
03	**8-Sep-95**	**10.3**
03	18-Oct-95	8.5
03	2-Jan-96	9.4
03	28-Mar-96	6.9
03	3-Jun-96	6.4
03	18-Sep-96	6.6
03	9-Dec-96	6.2
03	13-Mar-97	6.8
03	19-Jun-97	6.2
03	10-Sep-97	6.3
03	5-Dec-97	6.1
03	30-Mar-98	6
03	25-Jun-98	5.9
03	21-Sep-98	6.2
03	7-Dec-98	6.4
03	17-Mar-99	5.7
03	10-Jun-99	6.2
03	7-Sep-99	5.6
03	6-Dec-99	6.1
03	15-Mar-00	5.8
03	6-Jun-00	6
03	21-Sep-00	5.5
03	23-Oct-00	5.9
03	7-Dec-00	6.4
03	12-Mar-01	5.6
03	12-Jun-01	5.8
03	24-Sep-01	5.6

Table 6b. Nitrate results above 50% of the MCL for Hampstead Plant 3 (Well No. 13).

PLANT ID	SAMPLE DATE	RESULT (ppm)
04	13-Dec-93	7.3
04	30-Nov-94	7.32
04	30-Jan-95	6.9
04	24-May-95	6.7
04	8-Sep-95	7.6
04	2-Jan-96	7
04	28-Mar-96	7.1
04	3-Jun-96	6.8
04	13-Mar-97	6.9
04	19-Jun-97	5.9
04	10-Sep-97	6.1
04	5-Dec-97	6.1
04	30-Mar-98	6.5
04	25-Jun-98	6
04	21-Sep-98	6
04	19-Oct-98	6.1
04	7-Dec-98	6.2
04	17-Mar-99	5.9
04	10-Jun-99	6.1
04	7-Sep-99	5.6
04	6-Dec-99	6.2
04	15-Mar-00	5.9
04	6-Jun-00	6
04	29-Aug-00	6.2
04	21-Sep-00	5.6
04	7-Dec-00	6.6
04	12-Mar-01	5.7
04	12-Jun-01	5.9
04	24-Sep-01	5.7

Table 6c. Nitrate results above 50% of the MCL for Hampstead Plant 4 (Well No. 15).

PLANT ID	SAMPLE DATE	RESULT (ppm)
05	13-Dec-93	6.6
05	11-Mar-94	6.1
05	30-Nov-94	6.14
05	24-May-95	6.4
05	8-Sep-95	6.7
05	28-Mar-96	8.7
05	3-Jun-96	6.2
05	18-Sep-96	6.7
05	9-Dec-96	6.4
05	13-Mar-97	6.5
05	19-Jun-97	5.8
05	10-Sep-97	6.2
05	5-Dec-97	5.9
05	30-Mar-98	6.4
05	25-Jun-98	6.4
05	21-Sep-98	6.2
05	20-Oct-98	6.1
05	21-Apr-99	6.5
05	10-Jun-99	6.2
05	7-Sep-99	5.5
05	6-Dec-99	6.1

Table 6d. Nitrate results above 50% of the MCL for Hampstead Plant 5 (Well No. 19).

PLANT ID	SAMPLE DATE	RESULT (ppm)
06	12-Dec-93	9.1
06	**13-Dec-93**	**10.1**
06	19-Dec-93	9.9
06	11-Mar-94	9.1
06	22-Jun-94	9.4
06	29-Nov-94	9.4
06	30-Nov-94	9.78
06	24-May-95	9.3
06	**15-Aug-95**	**10.2**
06	8-Sep-95	9.9
06	**28-Mar-96**	**10.1**
06	3-Jun-96	8.7
06	18-Sep-96	9.7
06	9-Dec-96	9.9
06	**13-Mar-97**	**10.2**
06	17-Mar-97	9.8
06	19-Jun-97	8.9
06	10-Sep-97	9.5
06	5-Dec-97	9.1

PLANT ID	SAMPLE DATE	RESULT (ppm)
06	30-Mar-98	9.7
06	25-Jun-98	9.3
06	21-Sep-98	9.4
06	19-Oct-98	9.2
06	7-Dec-98	9.6
06	17-Mar-99	9.1
06	10-Jun-99	9.5
06	10-Jun-99	9.2
06	7-Sep-99	8.7
06	6-Dec-99	9.5
06	15-Mar-00	9
06	6-Jun-00	9.5
06	**20-Jun-00**	**10**
06	21-Sep-00	9.1
06	**7-Dec-00**	**10.7**
06	11-Dec-00	9.4
06	12-Mar-01	9.5
06	12-Jun-01	9.8
06	24-Sep-01	9.3

Table 6e. Nitrate results above 50% of the MCL for Hampstead Plant 6 (Well Nos. 20 and 21).

PLANT ID	SAMPLE DATE	RESULT (ppm)
07	24-May-95	6.6
07	**18-Oct-95**	**15**
07	15-Mar-00	9.7
07	3-Apr-00	9.2

PLANT ID	SAMPLE DATE	RESULT (ppm)
07	26-Jun-01	7.7
07	10-Aug-01	8.6
07	24-Sep-01	8.3

Table 6f. Nitrate results above 50% of the MCL for Hampstead Plant 7 (Well Nos. 22 and 23).

PLANT ID	SAMPLE DATE	RESULT (ppm)
08	13-Dec-93	8
08	11-Mar-94	7.3
08	29-Nov-94	9.04
08	30-Nov-94	8.96
08	24-May-95	8
08	8-Aug-95	7.9
08	8-Sep-95	9
08	2-Jan-96	8
08	28-Mar-96	7.6
08	28-Mar-96	8.4
08	3-Jun-96	6.7
08	3-Jun-96	7.8
08	18-Sep-96	6.3
08	18-Sep-96	7.9
08	9-Dec-96	7.1
08	9-Dec-96	7.4
08	13-Mar-97	7
08	13-Mar-97	8.2
08	19-Jun-97	6.8
08	19-Jun-97	7.4
08	10-Sep-97	7.3
08	10-Sep-97	7.7
08	5-Dec-97	7
08	30-Mar-98	5.6
08	30-Mar-98	7.7
08	25-Jun-98	5.8
08	25-Jun-98	7.1
08	21-Sep-98	7.3
08	30-Sep-98	6.5
08	7-Dec-98	7.9
08	7-Dec-98	8.1
08	17-Mar-99	6.7
08	17-Mar-99	7
08	10-Jun-99	7
08	10-Jun-99	7.4
08	7-Sep-99	6.6
08	7-Sep-99	7
08	6-Dec-99	7.1
08	6-Dec-99	7.5
08	15-Mar-00	6.5
08	15-Mar-00	7.2
08	6-Jun-00	7.3
08	21-Sep-00	5.8
08	21-Sep-00	6.8
08	23-Oct-00	6.6
08	7-Dec-00	7.3
08	7-Dec-00	8
08	12-Mar-01	7.3
08	12-Mar-01	7.4
08	12-Jun-01	6.6
08	12-Jun-01	7.3
08	24-Sep-01	7.2
08	24-Sep-01	7.1

Table 6g. Nitrate results above 50% of the MCL at Hampstead Plant 8 (Well Nos. 24 and 25).

PLANT ID	SAMPLE DATE	RESULT (ppm)
09	13-Dec-93	7.3
09	11-Mar-94	6.6
09	30-Nov-94	7.04
09	24-May-95	6.5
09	8-Aug-95	6.5
09	8-Sep-95	7.2
09	2-Jan-96	6.6
09	28-Mar-96	6.7
09	3-Jun-96	6
09	18-Sep-96	6.6
09	9-Dec-96	6.4
09	13-Mar-97	6.6
09	19-Jun-97	6.1
09	10-Sep-97	6.4
09	5-Dec-97	6.3
09	30-Mar-98	6.3
09	25-Jun-98	6
09	21-Sep-98	6.4
09	20-Oct-98	6.6
09	7-Dec-98	6.6
09	17-Mar-99	6.2
09	10-Jun-99	6.4
09	7-Sep-99	6.3
09	6-Dec-99	6.6
09	15-Mar-00	6.3
09	22-Mar-00	6.8
09	6-Jun-00	6.3
09	21-Sep-00	6.2
09	7-Dec-00	7.3
09	12-Mar-01	6.8
09	12-Jun-01	6.2
09	24-Sep-01	6.3

Table 6h. Nitrate results above 50% of the MCL for Hampstead Plant 9 (Well No. 26).

PLANT ID	SAMPLE DATE	RESULT (ppm)
10	8-Aug-95	8.7
10	2-Jan-96	8.4
10	28-Mar-96	8.7
10	3-Jun-96	7.9
10	9-Dec-96	8.6
10	9-Sep-97	7.3
10	5-Dec-97	8.1
10	30-Mar-98	8.1
10	25-Jun-98	7.7
10	21-Sep-98	8.5
10	20-Oct-98	8.4
10	7-Dec-98	8.7
10	17-Mar-99	7.8
10	10-Jun-99	8.5
10	7-Sep-99	7.4
10	6-Dec-99	8.4
10	15-Mar-00	7.7
10	22-Mar-00	8.3
10	6-Jun-00	8.3
10	21-Sep-00	8
10	7-Dec-00	8.1
10	12-Mar-01	8.1
10	12-Jun-01	8.3
10	24-Sep-01	6.3

Table 6i. Nitrate results above 50% of the MCL for Hampstead Plant 10 (Well No. 27).

PLANT ID	SAMPLE DATE	RESULT (ppm)
11	30-Jan-98	5
11	30-Jan-98	5.2
11	21-Sep-98	5.9
11	21-Sep-98	5.1
11	7-Dec-98	8.3
11	7-Dec-98	5.9
11	17-Mar-99	7.4
11	17-Mar-99	5.7
11	10-Jun-99	7.2
11	10-Jun-99	5.8
11	7-Sep-99	6.2
11	7-Sep-99	5.7
11	6-Dec-99	6.4
11	6-Dec-99	5.9
11	15-Mar-00	5.6
11	15-Mar-00	5.4
11	6-Jun-00	7.1
11	6-Jun-00	5.4
11	29-Aug-00	7.2
11	29-Aug-00	5.9
11	21-Sep-00	6.2
11	21-Sep-00	5.2
11	7-Dec-00	8.3
11	7-Dec-00	6.1
11	12-Mar-01	5.6
11	12-Mar-01	5.6
11	12-Jun-01	6
11	12-Jun-01	5.5
11	24-Sep-01	5.7
11	24-Sep-01	5.4

Table 6j. Nitrate results above 50% of the MCL for Hampstead Plant 11 (Well Nos. 28 and 29).

Volatile Organic Compounds (VOCs)

The only VOC detected above 50% of the MC was trichloroethylene (TCE). The MCL for TCE in 5 ppb. The TCE detections above 50% of the MCL in Hampstead's water supply are shown in Table 7 below. TCE has been detected

PLANT ID	CONTAMINANT NAME	MCL (ppb)	SAMPLE DATE	RESULT (ppb)
06	TRICHLOROETHYLENE	5	8-Dec-99	2.9
06	TRICHLOROETHYLENE	5	6-Jun-00	2.5
06	TRICHLOROETHYLENE	5	21-Sep-00	3.3
06	TRICHLOROETHYLENE	5	13-Mar-01	2.9

Table 7. VOC results above 50% of the MCL for Hampstead's Water Supply.

at Plant 6 (Wells 20 and 21) since 1995 and as shown in table 7 exceeded the 50% MCL threshold several times. The most recent samples taken directly from Well Nos. 20 and 21 in December 2001 were analyzed and found 1.1 and 0.6 ppb of TCE, respectively.

Since 1990 several other VOCs have also been detected, but at levels below 50% of their MCLs. The most widely detected VOC in Hampstead's water supply was methyl-tert-butyl-ether (MTBE). MTBE does not currently have a MCL but a taste and odor threshold of 20 ppb. All the levels detected were below this threshold value. MTBE has been detected at the following locations: Plant 6 (Wells 20 and 21) 0.5 - 2.2 ppb; Plant 2 (Wells 11 and 12) 2.4- 6.1 ppb;

Plant 4 (Well 15) 2.9 - 7.4 ppb; Plant 10 (Well 27) 0.7 - 1.1 ppb; and Plant 8 (Wells 24 and 25) 0.8 – 2.3 ppb. ppb and 0.6 ppb, respectively.

Methylene chloride was detected at Plant 6 at levels between 0.6 and 0.7 ppb in 1999. The MCL for methylene chloride is 5 ppb. Other VOCs were detected at Plant 4 (Well 15). Benzene (2 ppb), ethylbenzene (2 ppb), toluene (2ppb) and total xylenes (4 ppb) were found in samples collected in 2000. The MCLs for these VOCs are 5, 700, 1000 and 10,000 ppb, respectively. In addition, disinfecton byproducts known as trihalomethanes (THMs) were detected at Plant 6 (Wells 20 and 21) and Plant 11 (Wells 28 and 29). The total of the THM levels ranged from 0.9 and 2.7 ppb. The current MCL for regulated systems is 80 ppb for the total of all the THMs. Disinfection byproducts are the result of a reaction between chlorine used for disinfection and organic material in the water supply.

Synthetic Organic Compounds (SOCs)

The SOCs that were detected at or above 50% of the MCL are ethylene dibromide (EDB), heptachlor epoxide, di(2-ethylhexyl) phthalate and alachlor, respectively. Table 8 shows the levels of these SOC detections and their respective MCLS. A review of the SOC results indicated that the phthalate was found in the laboratory blanks and therefore these results are not interpreted to represent actual water quality.

PLANT ID	CONTAMINANT NAME	MCL (ppb)	SAMPLE DATE	RESULT (ppb)
02	DI(2-ETHYLHEXYL) PHTHALATE	6	9-Oct-01	4.3
04	ETHYLENE DIBROMIDE (EDB)	0.05	30-Jan-95	0.043
04	DI(2-ETHYLHEXYL) PHTHALATE	6	30-Jan-95	5.49
04	DI(2-ETHYLHEXYL) PHTHALATE	6	9-Oct-01	8
06	HEPTACHLOR EPOXIDE	0.2	19-Oct-98	0.1
09	DI(2-ETHYLHEXYL) PHTHALATE	6	8-Aug-95	5.25
10	ALACHLOR (LASSO)	2	20-Oct-98	1.8
10	DI(2-ETHYLHEXYL) PHTHALATE	6	9-Oct-01	3.9

Table 8. SOC results above 50% of the MCL for Hampstead's Water Supply

Other regulated SOCs have also been detected at levels below 50% of the MCLs. The most widespread of these SOCs is atrazine which has an MCL of 3ppb. Atrazine has been detected at Plant 2 (Wells 11 and 12) and Plant 6 (Wells 20 and 21) since 1994 at levels ranging from 0.05 to 1.48 ppb. It has also been detected at Plant 11 (Wells 28 and 29) since 1998 at levels ranging from 0.0112 to 0.31 ppb. and once in 2001 at Plant 10 (Well 27) at 0.6 ppb.

Two unregulated SOCs have also been detected in Hampstead's water supply. Metolachlor was detected twice at Plant 10 (Well 27) at 13 ppb (1998) and 9.1 ppb (2001). It was also detected once at Plant 6 (Wells 20 and 21) at 0.6 ppb (1998). Metolachlor has a health advisory of 70 ppb. Butachlor was detected

once at Plant 6 at 0.5 ppb. It does not have any health advisory at the present time. SOC data for Plant 7 (Wells 22 and 23) was not available.

Radionuclides

Gross alpha and radium were detected in Hampstead's water supply at greater than 50% of the MCL. Currently, the MCL for gross alpha is 15 picoCuries/Liter (pCi/L) and 5 pCi/L for radium as measured in the distribution system. At present there is no MCL for radon-222, however EPA has proposed an MCL of 300 pCi/L and an alternate MCL of 4000 pCi/L for community water systems if the State has a program to address the more significant risk from radon in indoor air. Table 9 shows the results of radon-222 gross alpha and radium at or above 50% of the existing and proposed MCLs*. No data was available for Plant 7 (Wells 22 and 23).

PLANT ID	CONTAMINANT NAME	MCL (pCi/L)	SAMPLE DATE	RESULT (pCi/L)
02	RADON-222	300/4000*	26-Apr-94	2575
02	RADON-222	300/4000*	5-Nov-97	3340
02	GROSS ALPHA	15	20-Jun-00	10
02	RADIUM-228	5	20-Jun-00	2.65
03	RADON-222	300/4000*	26-Apr-94	2250
03	RADON-222	300/4000*	2-Jun-97	2175
04	RADON-222	300/4000*	26-Apr-94	2805
04	RADON-222	300/4000*	2-Jun-97	2345
05	RADON-222	300/4000*	26-Apr-94	7245
05	RADON-222	300/4000*	5-Nov-97	6340
06	RADON-222	300/4000*	26-Apr-94	3805
06	RADON-222	300/4000*	5-Nov-97	4335
08	RADON-222	300/4000*	26-Apr-94	4105
08	RADON-222	300/4000*	2-Jun-97	2100
08	GROSS ALPHA	15	23-Oct-00	10
08	COMBINED RADIUM (226 & 228)	5	23-Oct-00	2.577
09	RADON-222	300/4000*	26-Apr-94	5560
09	RADON-222	300/4000*	2-Jun-97	4825
09	RADON-222	300/4000*	1-Jul-97	7211.3
10	RADON-222	300/4000*	22-Mar-00	2375
11	RADON-222	300/4000*	30-Jan-98	4129
11	RADON-222	300/4000*	30-Jan-98	3364
11	RADON-222	300/4000*	30-Jan-98	3842
11	RADIUM-228	5	20-Jun-00	3.95

Table 9. Radionuclide results above 50% of the MCL/proposed MCL for Hampstead's Water Supply.

Microbiological Contaminants

Raw water samples were collected and tested for bacteria from all the wells to determine whether these sources are ground water under the influence of surface water (GWUDI). Well Nos. 11, 12, and 27 were classified as low risk wells to GWUDI and required one dry weather bacteriological sample. No coliforms

were detected in any of the samples. Well Nos. 13, 15 and 26 were classified as moderate risk wells to GWUDI and required one wet weather (at least 0.5 inch rainfall) sample. None of the samples for these wells had any positive coliform. The rest of the wells were classified as high risk to GWUDI and required two dry weather and two sets of wet weather samples. The results of the bacteriological tests are shown in Table 10. Negative values in this table indicate absence of any coliform in the sample.

SOURCE NAME	RAIN DATE	RAIN AMOUNT (inches)	REMARK	SAMPLE DATE	TOTAL COLIFORM (col/100 ml)	FECAL COLIFORM (col/100 ml)
GRNMNT 19	7-Dec-98	0	DRY SAMPLE	7-Dec-98	-1.1	-1.1
GRNMNT 19	4-Jan-99	1.59	WET SET 1	4-Jan-99	8	-1.1
GRNMNT 19	4-Jan-99	1.59	WET SET 1	5-Jan-99	1.1	-1.1
GRNMNT 19	4-Jan-99	1.59	WET SET 1	6-Jan-99	-1.1	-1.1
GRNMNT 19	4-Jan-99	1.59	WET SET 1	7-Jan-99	-1.1	-1.1
GRNMNT 19	13-Apr-99	1.5	WET SET 2	13-Apr-99	-1.1	-1.1
GRNMNT 19	13-Apr-99	1.5	WET SET 2	14-Apr-99	-1.1	-1.1
GRNMNT 19	13-Apr-99	1.5	WET SET 2	15-Apr-99	-1.1	-1.1
GRNMNT 19	13-Apr-99	1.5	WET SET 2	16-Apr-99	-1.1	-1.1
GRNMNT 19	30-Apr-99	0	DRY SAMPLE	30-Apr-99	-1.1	-1.1
HOSPITAL 20	7-Dec-98	0	DRY SAMPLE	7-Dec-98	-1.1	-1.1
HOSPITAL 20	4-Jan-99	1.59	WET SET 1	4-Jan-99	-1.1	-1.1
HOSPITAL 20	4-Jan-99	1.59	WET SET 1	5-Jan-99	-1.1	-1.1
HOSPITAL 20	4-Jan-99	1.59	WET SET 1	6-Jan-99	-1.1	-1.1
HOSPITAL 20	4-Jan-99	1.59	WET SET 1	7-Jan-99	-1.1	-1.1
HOSPITAL 20	2-Feb-99	0.75	WET SET 2	2-Feb-99	1.1	-1.1
HOSPITAL 20	2-Feb-99	0.75	WET SET 2	3-Feb-99	1.1	-1.1
HOSPITAL 20	2-Feb-99	0.75	WET SET 2	4-Feb-99	-1.1	-1.1
HOSPITAL 20	2-Feb-99	0.75	WET SET 2	7-Feb-99	-1.1	-1.1
HOSPITAL 20	30-Apr-99	0	DRY SAMPLE	30-Apr-99	-1.1	-1.1
HOSPITAL 21	7-Dec-98	0	DRY SAMPLE	7-Dec-98	4.6	-1.1
HOSPITAL 21	4-Jan-99	1.59	WET SET 1	4-Jan-99	8	-1.1
HOSPITAL 21	4-Jan-99	1.59	WET SET 1	5-Jan-99	4.6	-1.1
HOSPITAL 21	4-Jan-99	1.59	WET SET 1	6-Jan-99	2.6	-1.1
HOSPITAL 21	4-Jan-99	1.59	WET SET 1	7-Jan-99	4.6	-1.1
HOSPITAL 21	2-Feb-99	0.75	WET SET 2	2-Feb-99	4.6	-1.1
HOSPITAL 21	2-Feb-99	0.75	WET SET 2	3-Feb-99	2.6	-1.1
HOSPITAL 21	2-Feb-99	0.75	WET SET 2	4-Feb-99	1.1	-1.1
HOSPITAL 21	2-Feb-99	0.75	WET SET 2	5-Feb-99	-1.1	-1.1
HOSPITAL 21	30-Apr-99	0	DRY SAMPLE	30-Apr-99	-1.1	-1.1

Table 10. Raw water bacteriological test results for Hampstead's high risk wells.

SOURCE NAME	RAIN DATE	RAIN AMOUNT (inches)	REMARK	SAMPLE DATE	TOTAL COLIFORM (col/100 ml)	FECAL COLIFORM (col/100 ml)
ROB FLD 22	25-Sep-00	1.28	WET SET 1	25-Sep-00	-1.1	-1.1
ROB FLD 22	25-Sep-00	1.28	WET SET 1	26-Sep-00	-2	-2
ROB FLD 22	25-Sep-00	1.28	WET SET	27-Sep-00	-1.1	-1.1
ROB FLD 22	25-Sep-00	1.28	WET SET 1	28-Sep-00	-1.1	-1.1
ROB FLD 22	25-Sep-00	1.28	WET SET 1	29-Sep-00	-2	-2
ROB FLD 22	5-Oct-00	0	DRY SAMPLE	5-Oct-00	-2	-2
ROB FLD 22	26-Nov-00	0.75	WET SET 2	28-Nov-00	-1.1	-1.1
ROB FLD 22	26-Nov-00	0.75	WET SET 2	29-Nov-00	-1.1	-1.1
ROB FLD 22	26-Nov-00	0.75	WET SET 2	30-Nov-00	-1.1	-1.1
ROB FLD 22	26-Nov-00	0.75	WET SET 2	1-Dec-00	-1.1	-1.1
ROB FLD 22	6-Nov-00	0	DRY SAMPLE	6-Nov-00	-1.1	-1.1
ROB FLD 23	25-Sep-00	1.28	WET SET 1	26-Sep-00	-2	-2
ROB FLD 23	25-Sep-00	1.28	WET SET 1	27-Sep-00	-2	-2
ROB FLD 23	25-Sep-00	1.28	WET SET 1	28-Sep-00	-2	-2
ROB FLD 23	25-Sep-00	1.28	WET SET 1	29-Sep-00	4	-2
ROB FLD 23	28-Nov-00	0.75	WET SET 2	28-Nov-00	-1.1	-1.1
ROB FLD 23	28-Nov-00	0.75	WET SET 2	29-Nov-00	-1.1	-1.1
ROB FLD 23	28-Nov-00	0.75	WET SET 2	30-Nov-00	-1.1	-1.1
ROB FLD 23	28-Nov-00	0.75	WET SET 2	1-Dec-00	-1.1	-1.1
ROB FLD 23	6-Nov-00	0	DRY SAMPLE	6-Nov-00	-1.1	-1.1
SM XING 24	7-Dec-98	0	DRY SAMPLE	7-Dec-98	-1.1	-1.1
SM XING 24	4-Jan-99	1.59	WET SET 1	4-Jan-99	-1.1	-1.1
SM XING 24	4-Jan-99	1.59	WET SET 1	5-Jan-99	4.6	4.6
SM XING 24	4-Jan-99	1.59	WET SET 1	6-Jan-99	-1.1	-1.1
SM XING 24	4-Jan-99	1.59	WET SET 1	7-Jan-99	-1.1	-1.1
SM XING 24	2-Feb-99	0.75	WET SET 2	2-Feb-99	-1.1	-1.1
SM XING 24	2-Feb-99	0.75	WET SET 2	3-Feb-99	-1.1	-1.1
SM XING 24	2-Feb-99	0.75	WET SET 2	4-Feb-99	-1.1	-1.1
SM XING 24	2-Feb-99	0.75	WET SET 2	5-Feb-99	-1.1	-1.1
SM XING 24	30-Apr-99	0	DRY SAMPLE	30-Apr-99	-1.1	-1.1
SM XING 24	6-Dec-99	0.72	WET SET 3	6-Dec-99	-1.1	-1.1
SM XING 24	6-Dec-99	0.72	WET SET 3	7-Dec-99	-1.1	-1.1
SM XING 24	6-Dec-99	0.72	WET SET 3	8-Dec-99	-1.1	-1.1
SM XING 24	6-Dec-99	0.72	WET SET 3	9-Dec-99	-1.1	-1.1

Table 10 (continued). Raw water bacteriological test results for Hampstead's high risk wells.

SOURCE NAME	RAIN DATE	RAIN AMOUNT (inches)	REMARK	SAMPLE DATE	TOTAL COLIFORM (col/100 ml)	FECAL COLIFORM (col/100 ml)
SM XING 25	7-Dec-98	0	DRY SAMPLE	7-Dec-98	-1.1	-1.1
SM XING 25	4-Jan-99	1.59	WET SET 1	4-Jan-99	-1.1	-1.1
SM XING 25	4-Jan-99	1.59	WET SET 1	5-Jan-99	-1.1	-1.1
SM XING 25	4-Jan-99	1.59	WET SET 1	6-Jan-99	-1.1	-1.1
SM XING 25	4-Jan-99	1.59	WET SET 1	7-Jan-99	-1.1	-1.1
SM XING 25	2-Feb-99	0.75	WET SET 2	2-Feb-99	-1.1	-1.1
SM XING 25	2-Feb-99	0.75	WET SET 2	3-Feb-99	-1.1	-1.1
SM XING 25	2-Feb-99	0.75	WET SET 2	4-Feb-99	-1.1	-1.1
SM XING 25	2-Feb-99	0.75	WET SET 2	5-Feb-99	-1.1	-1.1
SM XING 25	30-Apr-99	0	DRY SAMPLE	30-Apr-99	-1.1	-1.1
CORBIN WELL 28	7-Dec-98	0	DRY SAMPLE	7-Dec-98	-1.1	-1.1
CORBIN WELL 28	4-Jan-99	1.59	WET SET 1	4-Jan-99	-1.1	-1.1
CORBIN WELL 28	4-Jan-99	1.59	WET SET 1	5-Jan-99	-1.1	-1.1
CORBIN WELL 28	4-Jan-99	1.59	WET SET 1	6-Jan-99	-1.1	-1.1
CORBIN WELL 28	4-Jan-99	1.59	WET SET 1	7-Jan-99	-1.1	-1.1
CORBIN WELL 28	2-Feb-99	0.75	WET SET 2	2-Feb-99	-1.1	-1.1
CORBIN WELL 28	2-Feb-99	0.75	WET SET 2	3-Feb-99	-1.1	-1.1
CORBIN WELL 28	2-Feb-99	0.75	WET SET 2	4-Feb-99	-1.1	-1.1
CORBIN WELL 28	2-Feb-99	0.75	WET SET 2	5-Feb-99	-1.1	-1.1
CORBIN WELL 28	30-Apr-99	0	DRY SAMPLE	30-Apr-99	-1.1	-1.1
CORBIN WELL 29	7-Dec-98	0	DRY SAMPLE	7-Dec-98	-1.1	-1.1
CORBIN WELL 29	4-Jan-99	1.59	WET SET 1	4-Jan-99	-1.1	-1.1
CORBIN WELL 29	4-Jan-99	1.59	WET SET 1	5-Jan-99	-1.1	-1.1
CORBIN WELL 29	4-Jan-99	1.59	WET SET 1	6-Jan-99	-1.1	-1.1
CORBIN WELL 29	4-Jan-99	1.59	WET SET 1	7-Jan-99	-1.1	-1.1
CORBIN WELL 29	2-Feb-99	0.75	WET SET 2	2-Feb-99	-1.1	-1.1
CORBIN WELL 29	2-Feb-99	0.75	WET SET 2	3-Feb-99	-1.1	-1.1
CORBIN WELL 29	2-Feb-99	0.75	WET SET 2	4-Feb-99	-1.1	-1.1
CORBIN WELL 29	2-Feb-99	0.75	WET SET 2	5-Feb-99	-1.1	-1.1
CORBIN WELL 29	30-Apr-99	0	DRY SAMPLE	30-Apr-99	-1.1	-1.1

Table 10 (continued). Raw water bacteriological test results for Hampstead's high risk wells.

SUSCEPTIBILITY ANALYSIS

Hampstead's wells 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.

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. Properly constructed wells with no potential sources of contamination in their WHPA should be well protected from contamination.

Inorganic Compounds (IOCs)

Nitrate has been detected in all of Hampstead's water treatment plants above 50% of the MCL (tables 6a- 6j). Nitrate was detected above the MCL of 10 ppm once in Plant 3 (Well No. 13) and Plant 7 (Well Nos. 22 and 23) and several times in Plant 6 (Well Nos. 20 and 21). Sources of nitrate can generally be traced to land use. Fertilization of cropland and residential properties are non-point sources in ground water. Onsite septic systems are also sources of nitrate in ground water. A large portion of the WHPA was cropland in the past and is now being converted to residential land and nearly all the areas within the town limits are served by public sewer.

A review of the nitrate monitoring data for Hampstead's water supply shows that nitrate levels are decreasing for Plants 2, 3, 4, 5, 8, 9 and 10 (Well Nos. 11, 12, 13, 15,19, 24, 25, 26, and 27). Figure 5a represents the nitrate trend in these wells. Plants 6 and 11 (Wells Nos. 20, 21, 28, and 29) show no increase or decrease in overall nitrate levels just seasonal variations. Figure 5b represents the nitrate trend in these wells. There is insufficient data to make any determinations in nitrate trends for Plant 7 (Well Nos. 23 and 24), since these wells were not in operation for a long time and only recently were put into service.

Based on the above analysis, Hampstead's water supply is susceptible to nitrate contamination. If the decreasing nitrate trends continue, the water supply will should become less susceptible to nitrates in the future.

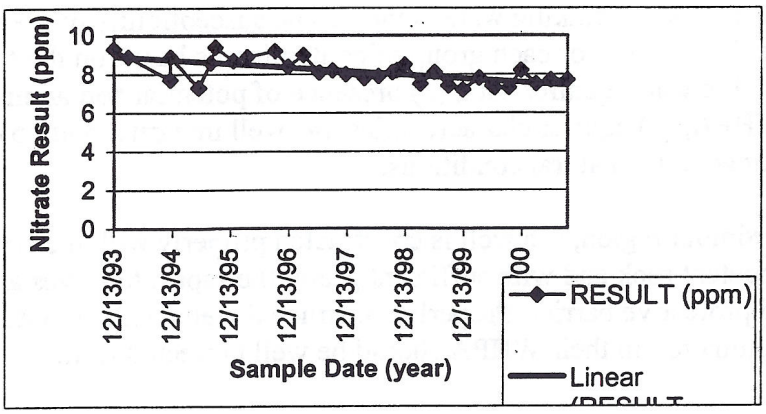

Figure 5a. Nitrate trend for Plant 2 (Well Nos. 11 and 12).

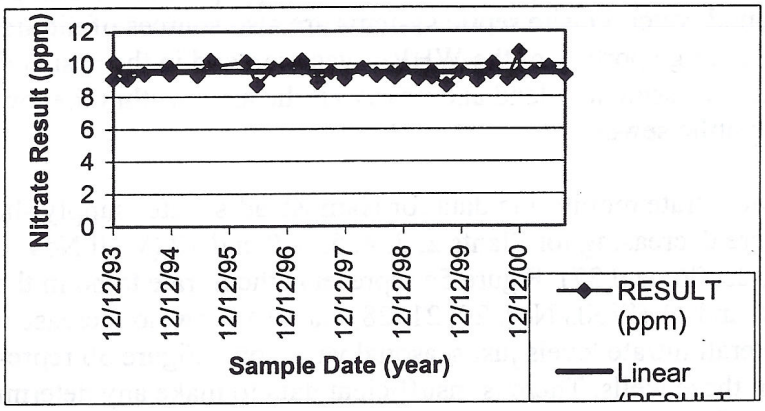

Figure 5b. Nitrate Trend for Plant 6 (Well Nos. 20 & 21).

Hampstead's water supply is **not** susceptible to inorganic compounds other than nitrate, based on the water quality. There are a few sources of metals in the WHPA, but not of these sources discharge them into ground water or store them underground. Hence the contaminants are unlikely to impact ground water.

Volatile Organic Compounds (VOCs)

Trichloroethylene (TCE) is the only VOC that has been detected in Hampstead's water supply (Plant 6 – Well Nos. 20 and 21) at above 50% of the MCL of 5 ppb (table 7). TCE is an industrial and commercial solvent with a variety of uses like degreasing metals and dry cleaning. MTBE has been detected in 8 of the wells since 1996. MTBE is used as an additive to gasoline for cleaner burning. Methylene chloride an organic solvent was detected in Wells 20 and 21 Benzene, ethylbenzene, toluene and xylene have been detected at Well 15. These VOCs are components of gasoline. Hampstead's WHPA extends right through the Town's commercial and industrial areas. Several commercial facilities have had

their USTs removed due to leaks or noncompliance with the State's tank regulations (table 2). Currently there are no known active cases of ground water contamination due to leaking USTs, and all the facilities are in compliance with the State's regulations. Potential sources of VOCs are present in the WHPAs for all the Town wells.

Based on the above analysis, Hampstead's water supply **is** susceptible to VOC contamination.

Synthetic Organic Compounds (SOCs)

Ethylene dibromide (EDB), heptachlor epoxide and alachlor have been detected at above 50% of the MCL (table 8). EDB was used as an additive for leaded gasoline and may have been detected in Well 15 due to a former leaking UST site upgradient of the well. Heptachlor epoxide is the oxidation product of heptachlor which is an instectide. Alachlor is a herbicide used in various crops like corn and soybeans. In addition, atrazine has been detected a levels below 50% of the MCL at 7 of the Town's wells since 1994. Atrazine is a herbicide that is applied prior to the planting season. Metolachlor and butachlor two unregulated SOCs have also been detected in three of the Town wells. Both these SOCs are herbicides.

Cropland and residential land make up a large portion of the Hampstead WHPA and improper application of pesticides for crop production or landscaping can be a potential source of SOC contamination.

Based on SOC sampling data and analysis, Hampstead's water supply **is susceptible** to SOC contamination.

Radionuclides

Gross alpha, radium-228 and combined radium (226 and 228) have been detected at above 50% of the MCl in Plant 2 (Wells 11 and 12), Plant 8 (Wells 24 and 25) and Plant 11 (Wells 28 and 29). In addition, radon-222 has also been detected at all the plants at levels ranging from 2100 pCi/L to 7245 pCi/L. The source of these radionuclides can be traced to the natural occurrence of uranium and thorium in the bedrock. Radon is prevalent in ground water due to the radioactive decay of uranium bearing minerals in the bedrock (Bolton, 1996).

Based on the above analysis, Hampstead's water supply **is** susceptible to radionuclides.

Microbiological Contaminants

Based on raw water bacteriological data (table 10) Hampstead's current wells being used were determined not to be under the direct influence of surface water. Hence the Hampstead wells are **not** susceptible to any microbiological contaminant present at the surface including *Giardia and Cryptosporidium*. But the bacteriological data indicated low concentrations of total coliform in Well

Nos. 19, 21, and 23 and fecal coliform in Well No. 24 (table 10). Two subsequent wet weather sample sets for Well No. 24 indicated the absence of any coliform. Due to the presence of coliform, Well Nos. 19, 21, 23 and 24 are susceptible to total coliform.

MANAGEMENT OF THE WHPA

Form a Local Planning Team

- The team should represent all the interests in the community. The Town Council, the Town Utilities Department, Carroll County Planning and Health Departments, residents, farmers, local businesses, and developers should work to reach a consensus on how to protect the water supply.
- MDE has grant money available for Wellhead Protection projects.

Public Awareness and Outreach

- The Consumer Confidence Report should include a summary of this report and information that this report is available to the general public through their county library, or by contacting the Town or MDE.
- Conduct educational outreach to facilities that may present potential contaminant sources. Important topics include: (a) compliance with MDE and federal guidelines for USTs, (b) best management practices, (c) chemical storage and (d) appropriate use and application of fertilizers and pesticides.
- Placing signs at the WHPA boundaries is a good way to make the public aware of protecting their source of water supply. The County has placed signs at WHPA boundaries along county roads.

Cooperative Efforts with Other Agencies

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

Planning/New Development

- Hampstead should work closely with the Carroll County Bureau of Water Resource Planning to conduct site review of new developments prior to approval of the developments to ensure water supply source protection.
- Hampstead should encourage and support County adoption of the Performance Standards and Management Criteria for Water Resource Management that was developed by the County and approved by MDE.
- Hampstead should also consider a local ordinance for protection of its water supply.

Monitoring

- Continue to monitor for all Safe Drinking Water Act contaminants as required by MDE.
- Annual raw water bacteriological testing is a good check for well integrity.
- Follow up previous intermittent positive coliform results by conducting detailed well inspections to evaluate well and pipe integrity.

Land Acquisition/Easements

- Loans are available for the purchase of property or easements for the protection of a water supply. Eligible property must lie within the designated WHPA. Loans are currently being offered at zero percent interest and zero points. Contact the WSP for more information.

Contingency Plan

- COMAR 26.04.01.22 regulations require all community water systems to prepare and submit for approval a plan for providing a safe and adequate drinking water supply under emergency conditions.

Changes in 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.

Contaminant Source Inventory/Well Inspection

- The Town should review the potential sources of contaminants within the WHPA and update them if necessary, including a consideration of historical uses.
- Periodic inspections and a regular maintenance program for the supply wells will ensure their integrity and protect the aquifer from contamination.
- Wells that are not planned for use anymore should be abandoned according to State well construction standards.

REFERENCES

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, 167 p.

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

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Nutter, L. J., and Otton, E. G., 1969, Ground-Water Occurrence in the Maryland Piedmont: Maryland Geological Survey Report of Investigations No. 10, 56p.

R. E. Wright Associates, Inc., 1988, Phase II Report Carroll County Water Resources Study Volumes I and II.

R. E. Wright Associates, Inc., 1989, Recommended Water Resource Management Standards, Criteria, and Administrative Procedures.

U.S. Environmental Protection Agency, 1991, Delineation of Wellhead Protection Areas in Fractured Rocks: Office of Water and Drinking Water, EPA/570/9-91-009, 144 p.

OTHER SOURCES OF DATA

Water Appropriation and Use Permits: CL1974G062, CL1974G162, CL1974G0362, CL1990G0149
Public Water Supply Inspection Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Carroll County WHP Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles: Hampstead NE, NW, SE, and SW, Linesboro SE and SW, Manchester SE, Westminster NE
USGS Topographic 7.5 Minute Littlestown and Linesboro Quadrangles
Maryland Office of Planning 2000 Carroll County Land Use Map
Maryland Office of Planning 1995 Carroll County Sewer Map

FIGURES

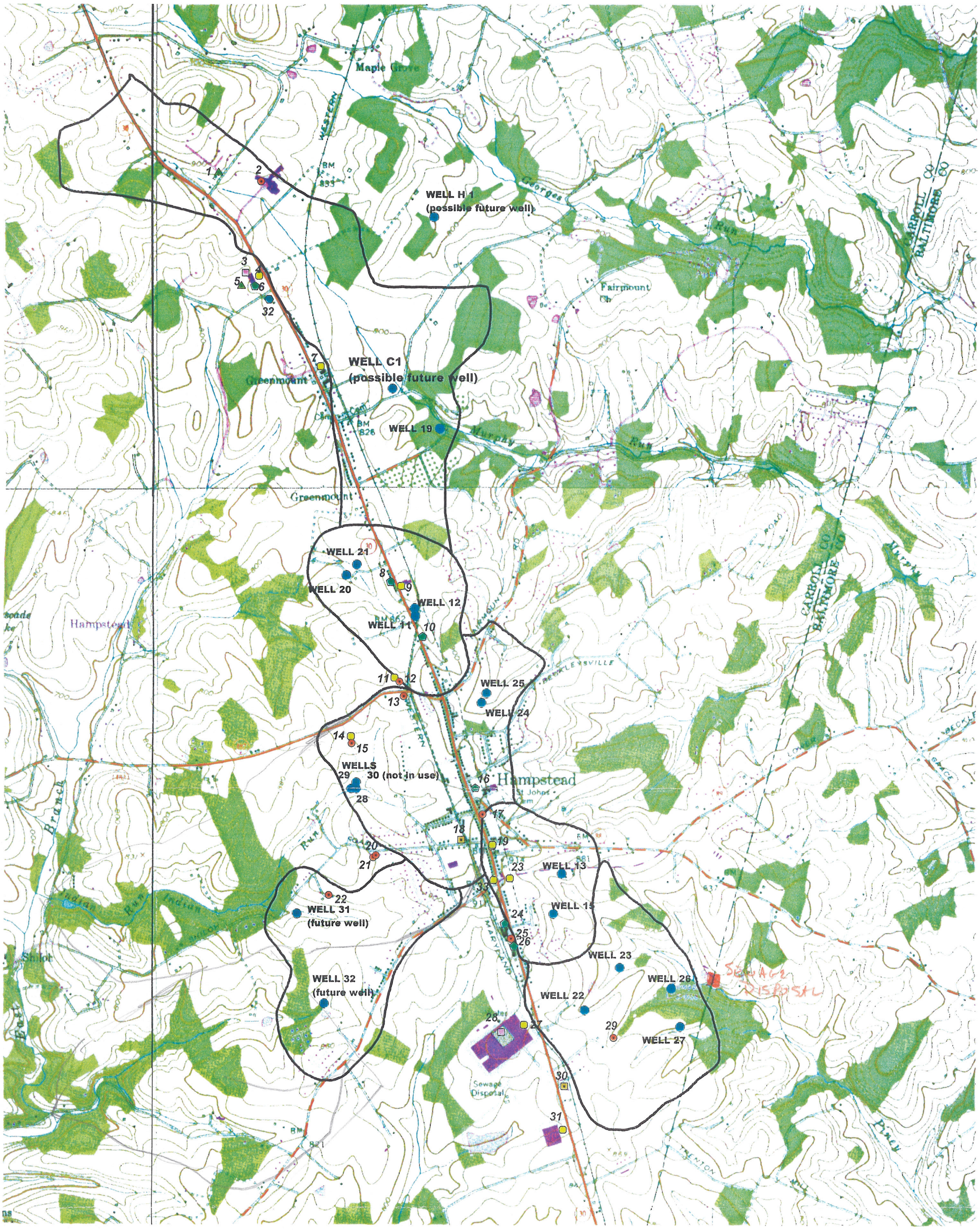

Figure 2. Hampstead Wellhead Protection Area with Potential Contaminant Sources

LEGEND

Suppy Well		CERCLA		Junkyard	
Underground Storage Tank		Ground Water Discharge		Miscellaneous	
CHS Generator		Pesticide Dealer		Wellhead Protection Area	

N

Base Map: USGS Topographic 7.5 Minute Quadrangles - Littlestown and Lineboro

2000 0 2000 4000 Feet

Figure 3. Land Use Map of the Hampstead Wellhead Protection Area

Base Map: Maryland Office of Planning 2000 Land Use Map for Carroll and Baltimore Counties

Figure 4. Sewer Service Map of the Hampstead Wellhead Protection Area

LEGEND

Sewer Service Area Categories

- No Planned Service
- Existing Service
- Service within 2 to 6 years
- Service within 6 years
- Wellhead Protection Area
- Supply Well

N

2000 0 2000 4000 Feet

Base Map: Maryland Office of Planning Carroll County and Baltimore County 1995 Sewer Maps