2008 Source Water Assessment
RICHMOND WELLHEAD PROTECTION AREA

SUMMARY

The Richmond Water Supply Board Wellhead Protection Area (WHPA) is an irregular shaped region located in northwestern Richmond and northeastern Hopkinton (figure 1). This WHPA consists of two active wells (Gravel Packed Well #1: 1000040-01 and Gravel Packed Well #2: 1000040-02). The Richmond WHPA covers approximately 630 acres and consists mostly of forested land (table 2). Results of the pollution risk assessment for Richmond wells 1 and 2 are summarized in table 1.

Overall the WHPA was given a score of 10, meaning it has a low pollution risk. A LOW rating does NOT mean that the source is free from contamination risk. Without sufficient protection, ANY water supply can become contaminated.

For further information please contact the Richmond Water Supply Board located at 5 Richmond Town House Rd., Wyoming, RI 02898 (401) 539-9000 (x24). Additional information on this assessment is found below.

Figure 1. Location of the Richmond Water Supply Board WHPA.

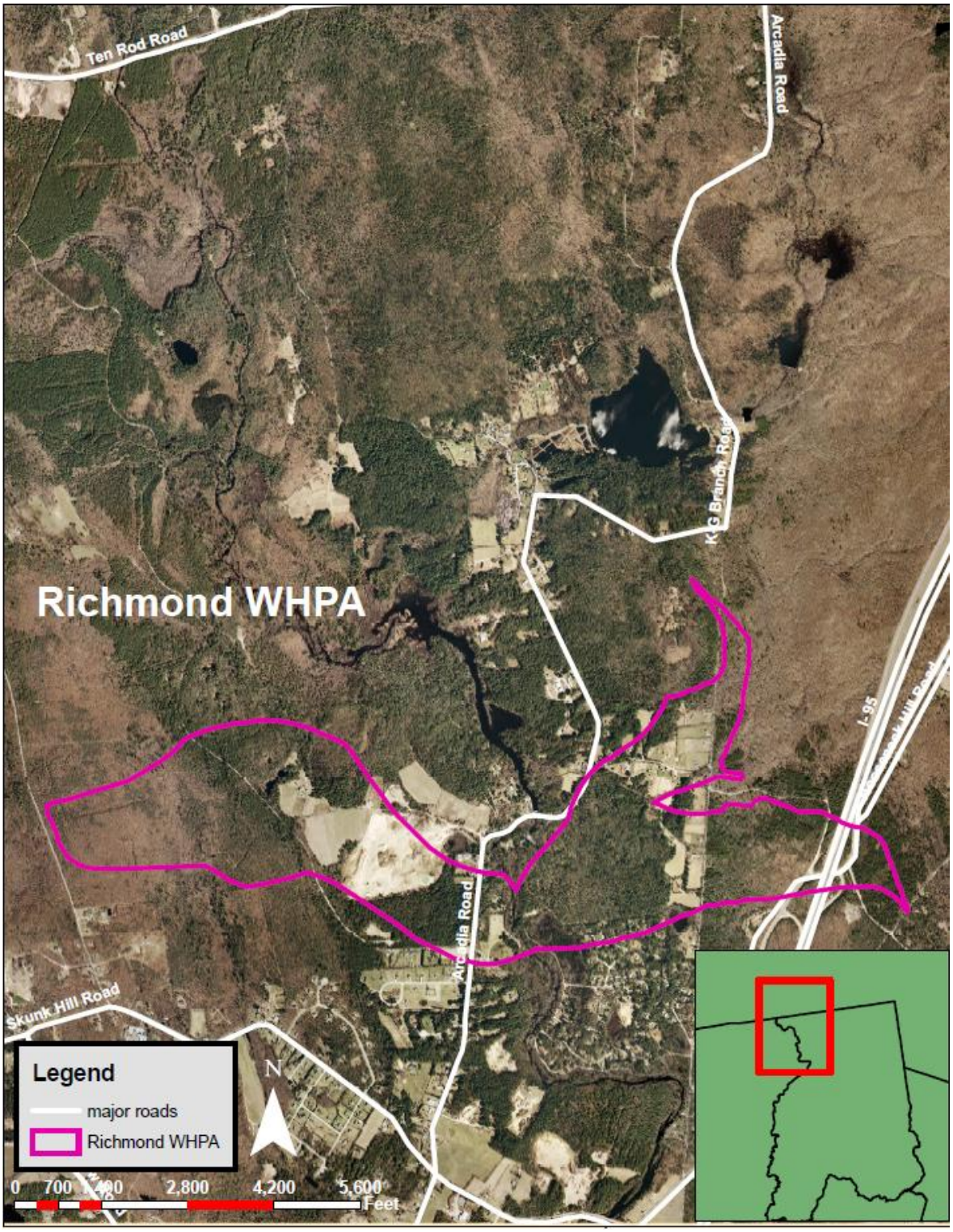


Table 1. Summary of pollution risk results for Richmond Wells 1 and 2

Risk Indicator	Calculated Value - Risk Rating (score)	Explanation
Wellhead Protection Area Land Use		
1. High Intensity Land Use	7 % - Low (0)	
Existing or potential pollution sources		
2. Pollution Sources within inner protective radius (400' to 200') of well	No data - Medium[1] (5)	
3. Pollution sources per acre throughout WHPA, excluding inner protective radius	No data - Medium[1] (5)	
Water Quality		
4. History of Contaminant Detects within the last 5 years	Trace[2] – Low (0)	There has been no detection of regulated contaminants (excluding bacteria and nitrates) Low level detections of unregulated contaminant nickel have occurred, suggesting that the water supply is susceptible to contamination.
5. Source Water Bacteria Detects within the last 5 years	No Detections – Low (0)	Bacteria have not been detected
6. Maximum nitrate – nitrogen (NO_3-N) concentration in the last 5 years	0.21 mg/L – Low (0)	Nitrate levels in groundwater have been consistently low.
Overall Rating	**10 - Low**	**Low** **Note: A LOW rating does NOT mean that the source is free from contamination risk. Without sufficient protection, ANY water supply can become contaminated.**

Notes:

[1]No data are present for this risk indicator, therefore the risk rating of moderate is automatically assigned. Although data are not available there may still be pollution sources present.

[2] Trace = Less than 10% of the contaminant MCL (Maximum Contaminant Level).

UNDERSTANDING THE ASSESSMENT

WHY WAS THE ASSESSMENT DONE?

The Safe Drinking Water Act (SDWA) Amendments of 1996 required states to develop and implement source water assessment programs (SWAPs) to analyze existing and potential threats to the quality of the public drinking water throughout the state. Using these programs, most states have completed source water assessments for every public water system -- from major metropolitan areas to the smallest towns. Even schools, restaurants, and other public facilities that have wells or surface water supplies have been assessed. A source water assessment is a study and report, unique to a water system that provides basic information about the water used to provide drinking water. States are working with local communities and public water systems to identify protection measures to address potential threats to sources of drinking water.

In Rhode Island, RI HEALTH's Office of Drinking Water Quality administers the Source Water Assessment Program.

WHAT AREA WAS EVALUATED FOR THIS ASSESSMENT?

The source water protection area, the area evaluated for this assessment, is the critical area surrounding a public water supply well or an intake on a surface source. For a public water supply well this is the wellhead protection area (WHPA). The WHPA is the estimated area from which groundwater and surface water will flow from under severe pumping conditions. This can also be stated as the maximum estimated area that water withdrawn from the well will ever be drawn from. For most bedrock wells, this area is a volume dependent circle For wells in sand and gravel this area is generally not a circle, but an irregular shape determined by sedimentary deposits and pumping rate. The source protection area for surface water sources is generally the watershed of the surface waterbody.

WILL THE POTENTIAL CONTAMINATION SOURCES IDENTIFIED IN THE SANTIARY SURVEY CONTAMINATE MY SOURCE?

Potential contamination sources identified in sanitary surveys are facilities that typically use, produce, handle or store contaminants of concern, which, if improperly managed, could find their way to a source of public drinking water. It is important to understand that a release may never occur from a potential contamination source, provided it is using good management practices. Many potential contamination sources are regulated at the federal level, the state level, or both, to reduce the risk of a release. There are a number of methods that waster systems can use to work cooperatively with potential contamination sources. These often involve educational visits and inspections of stored materials.

HOW SHOULD THIS ASSESSMENT BE USED?

This assessment should be used to plan for improved protection of public drinking water sources. Additional information may also be useful such as identification of the 100-year flood plain, tax map information, soils information or high-density development areas. This assessment is a good starting place for planning protection programs. **Communities should act now to protect valuable water supply resources; once contamination occurs clean-up is costly and sometimes technically infeasible. Additionally, unprotected watersheds and wellheads can lead to deterioration of water quality that may eventually lead to higher treatment costs.**

EXPLANATION & DETERMINATION OF POLLUTION RISK FACTORS

Overview
This Source Water Assessment was completed using the "Guide to Updating Source Water Assessments and Protection Plans, Version 3 – 2010". All risk indicator ratings were obtained from the "Guide". A summary of methods as well as calculated risks is presented here.

Risk Factor 1. High Intensity Land Use
High intensity land use was determined using Rhode Island GIS (RIGIS) land use data (2003/2004 data). Land uses within the WHPA were calculated using ArcView 9.3 (ESRI) and then aggregated based on land use categories defined in the MANAGE model. The MANAGE model assigns RIGIS land use types into a reduced number of categories, 11 of which are identified as High Intensity Land Use (table 3). The MANAGE model is a GIS based tool that informs decisions about environmental risks associated with land use. Technical documentation for MANAGE model can be viewed at : http://www.uri.edu/ce/wq/NEMO/Tools/mapping.htm. The percentage of high intensity land use in the WHPA under study is then compared to the rating scale for risk indicator 1, High intensity land use. **A summary of all land uses found within the Richmond WHPA reveals that 7% of the WHPA is considered to be developed as high intensity land use, corresponding with a risk rating of low.**

Risk Indicator	Rating (Score)			
	Low (0)	Medium (5)	High (10)	Extreme (25)
1. High intensity land use	**<10%**	10-24%	25-50%	>40%

Table 2. Richmond WHPA Land Use

Land Use (MANAGE Code & Description)	Total Area (acres)	% of Total Land Use
[1] HD Res.(>8 /ac)	0.0	0.0%
[2] MHD Res.(4-7.9/ac)	0.0	0.0%
[3] MD Res.(1-3.9/ac)	16.4	2.6%
[4] MLD Res.(0.5-0.9/ac)	10.0	1.6%
[5] LD Res.(<0.5/ac)	6.4	1.0%
[6] Commercial	0.0	0.0%
[7] Industrial	0.0	0.0%
[8] Roads	4.5	0.7%
[9] Airports	0.0	0.0%
[10] Railroads	0.0	0.0%
[11] Junkyards	0.0	0.0%
[12] Recreation	0.0	0.0%
[13] Institution	0.0	0.0%
[14] Pasture	18.5	2.9%
[15] Cropland	40.1	6.4%
[16] Orchards	0.0	0.0%
[17] Brush	0.0	0.0%
[18] Forest	494.6	78.5%
[19] Barren	36.1	5.7%
[20] Wetland	0.0	0.0%

Land Use (MANAGE Code & Description)	Total Area (acres)	% of Total Land Use
[21] Water	3.8	0.6%
[22] Transitional	0.0	0.0%
Total (acres)	630.4	100.0%
Total High Intensity Land Use	44.6	7.1%
*high intensity land uses are highlighted in yellow		

Figure 2. High intensity land use in and around the Richmond WHPA.

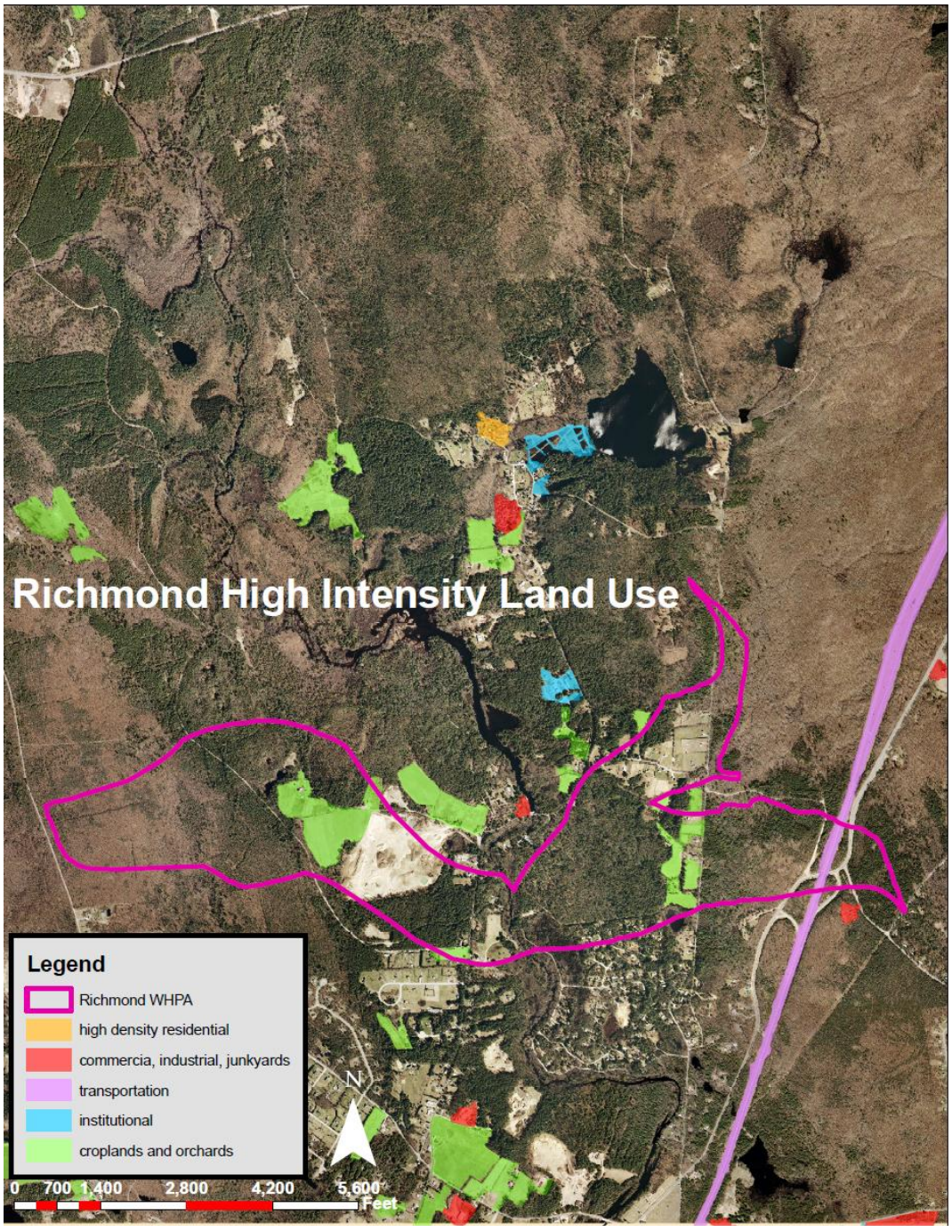


Table 3. Land Use Aggregations Utilized in SWAP Reports (Updated to correspond with RIGIS 2003/2004 Land Use Data)

MANAGE Code	MANAGE Category	RIGIS Category and Code	High Intensity Land Use
1	HDR	High Density Residential (111)	X
		Commercial/Residential Mixed (151)	X
2	MHDR	Medium High Density Residential (112)	X
3	MDR	Medium Density Residential (113)	
4	MLDR	Medium Low Density Residential (114)	
5	LDR	Low Density Residential (115)	
6	COMMERCIAL	Commercial & Services (120)	X
		Other (147)	X
		Commercial/Industrial Mixed (152)	X
7	INDUSTRIAL	Industrial (130)	X
8	ROADS	Roads (141)	X
9	AIRPORTS	Airports (142)	X
10	RAILROADS	Railroads (143)	X
11	JUNKYARDS	Waste Disposal Areas (145)	X
12	RECREATION	Developed Recreation (161)	
		Urban Open Space (162)	
		Cemeteries (163)	
13	INSTITUTION	Water and Sewage Treatment Facilities (144)	X
		Institutional (170)	X
14	PASTURE	Power Lines (146)	
		Pasture (210)	
15	CROPLAND	Cropland (220)	X
		Confined Feeding Operations (240)	X
16	ORCHARDS	Orchards, Groves, Nurseries (230)	X
17	BRUSH	Idle Agriculture (250)	
		Brushland (300)	
18	FOREST	Deciduous Forest (410)	
		Softwood Forest (420)	
		Mixed Forest (430)	
19	BARREN	Beaches (710)	
		Sandy Areas other than Beaches (720)	
		Rock Outcrop (730)	
		Strip Mines, Quarries, Gravel Pits (740)	
		Mixed Barren (760)	
20	WETLAND	Wetland (600)	
21	WATER	Water (500)	
22	Assigned to MD Res. Unless otherwise specified Transitional Areas (750)		

Notes:
Manage code: The numeric category that MANAGE method groups land use data by.
Manage category: The descriptive category that MANAGE method groups land use data by.
RIGIS category and code: The RIGIS land use category and associated code number
High Intensity Land Use: land uses designated in MANAGE as having a greater potential pollution load. The designations as presented above were used in the SWAP reports and are provided here for reference.

Risk Factor 2 & 3: Pollution Sources Within Inner Protective Radius and Per Acre Throughout the WHPA

Information on the presence or absence of pollution sources within the inner protective radius of the well can usually be obtained through the Rhode Island Department of Health (RIDOH) Sanitary Surveys and Waivers. The most recent RIDOH waiver of the Richmond WHPA was completed in 2006 for the previous and much larger WHPA (WHPA was modified and became smaller in 2008). The waiver file does mention several sources of potential pollutants within the watershed including an active gravel pit and small Christmas tree farm, which do appear to be within the new updated WHPA. But, the waiver text does not provide an analysis of pollution sources within the inner protective radius nor a per acre count of potential sources throughout the WHPA. Therefore, Risk Factor 2 – Pollution Sources Within Inner Protective Radius and Risk Factor 3 – Pollution Sources Per Acre Throughout the WHPA—were both set at Medium. The RIDOH waiver is included as an attachment.

Risk Indicator	Rating (Score)			
	Low (0)	Medium (5)	High (10)	Extreme (25)
2. Pollution sources within inner protective radius (400 ft of 200 ft of well)	0	**1 (set by default)**	2-3	>3
3. Pollution sources per acre throughout WHPA, excluding inner protective radius (multiply by 10)	<0.1	**0.1 - 0.5 (set by default)**	0.5 - 1	>1

Risk Factor 4, 5 & 6: History of Contaminant, Bacteria and Nitrate-Nitrogen Detections

Laboratory results for samples collected from the active wells in the Richmond WHPA (Gravel Packed Wells 1 and 2) were obtained from Rhode Island Department of Health (RIDOH) and used to determine risk factors 4, 5 and 6. As wells 1 and 2 are less than 1,000 ft apart, the wells were assessed as one for the purposes of this analysis and only one risk rating score is provided for risk factors 4, 5 and 6.

Risk Factor 4 – History of contaminant detections within the last 5 years was determined by reviewing all contaminant detections in the laboratory records (excluding bacteria, nitrogen, sodium, calcium and magnesium). A risk rating for each contaminant above the detection limit was then assigned based on the Maximum Contaminant Level (MCL). The MCL is based on either Rhode Island or EPA drinking water standards and advisory levels. The highest risk rating observed was used to set the total risk rating for the WHPA. Risk factor 4 for Richmond wells 1 and 2 was set at low; there have been no detection of regulated contaminants (excluding bacteria and nitrates).

Although the risk rating is set at low for the WHPA, low level detections of unregulated contaminant nickel have occurred, suggesting that the water supply is susceptible to contamination.

Additionally, sodium levels have exceeded 20 mg/L in Richmond well #1 where the sodium levels ranged from 20.6 – 29.4 mg/L during the monitoring period. Sodium levels are approaching 20 mg/L in Richmond well #2 where sodium levels ranged from 13.2-17.8 mg/L during the monitoring period. Calcium, sodium and magnesium data are not analyzed as contaminants (risk factor 4) as they are naturally occurring. However, sodium is reviewed when levels consistently approach or exceed 20 mg/L because sodium and chloride are indicators of contamination from road salt and can also indicate the presence of other runoff pollutants. The EPA listed sodium on the "drinking water advisory" list with 20 mg/L as the guidance level for those on a restricted sodium diet (EPA 822-R-09-011, 2009 Edition of the Drinking Water Standards and Health Advisories, October 2009). This is not an official contamination level; however, sodium concentrations approaching or exceeding 20 mg/L should be reported.

Risk Factor 5 – Source Water Bacteria Detections within the last 5 years was determined by viewing all available bacteria data for each well. The number of bacteria sample detections was used to determine the risk rating. Risk factor 5 for Richmond wells 1 and 2 was set at Low – Bacteria have not been detected.

Risk Factor 6 – Maximum nitrate-nitrogen (NO3-N) concentration in the last 5 years was determined by viewing all detections of nitrate-nitrogen in the laboratory record for all the wells in the WHPA. The maximum observed nitrate-nitrogen value was 0.21 mg/L NO3-N. This nitrate-nitrogen value corresponds with a risk rating of low - nitrate levels in groundwater have been consistently low.

The yearly maximum and average nitrogen values for the WHPA were plotted and the data reviewed for trends. There does not appear to be an observable upward or downward trend in nitrate-nitrogen values in the WHPA.

Risk Indicator	Rating (Score)			
	Low (0)	Medium (5)	High (10)	Extreme (25)
4. History of contaminant detections within the last 5 years	**Trace (Maximum value is less than 10% of MCL)**	Less than ½ MCL	Greater than ½ MCL	Greater than MCL (violation)
5. Source water bacteria detections within the last 5 years	**Less than 5% of samples have detected total coliform**	Greater than 5% of samples have detected total coliform	One or more Fecal coliform samples exhibit a detection	One or more Fecal coliform samples is above water quality standards*
6. Maximum nitrate-nitrogen (NO3-N) concentration in the last 5 years	**< 0.5 mg/L NO3-N**	0.5-2 mg/L NO3-N	2-5 mg/L NO3-N	>5 mg/L NO3-N

*It is assumed for the purposes of the SWAP that if fecal coliform samples are found to be in violation that the cause of the contamination was identified and corrected. Therefore, no bacterial samples are ranked in the extreme category.

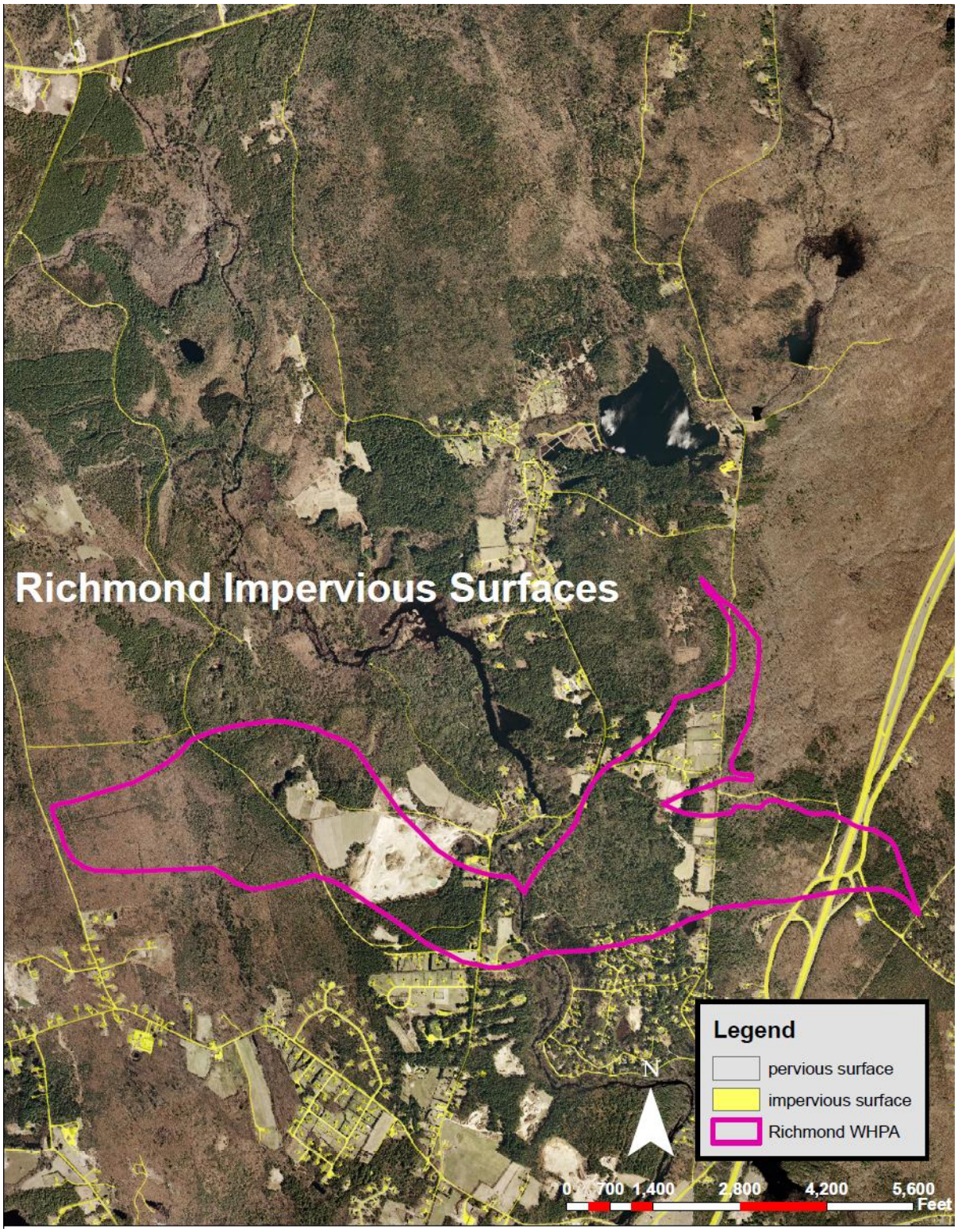
Additional Optional Assessment Steps: Impervious Surface Analysis

Although an impervious cover analysis is not included as a risk assessment indicator it is an important consideration when performing a pollution risk assessment. A high amount of impervious surface generally is associated with higher amounts of stormwater runoff. Stormwater runoff can transport harmful contaminants into surface water bodies as it flows over impervious surfaces such as roads, parking lots and commercial facilities. Impervious surfaces also impede precipitation from reaching groundwaters, reducing recharge. The risk rating scale for percentage of impervious surface is as follows:

Risk Indicator	Rating			
	Low	Medium	High	Extreme
Percentage of impervious surface in WHPA	**<10%**	10-14%	15-25%	>25%

Impervious surface coverage for the Richmond WHPA was calculated in ArcView 9.3 (ESRI) using the Rhode Island Impervious Surface Coverage available from RIGIS (Rhode Island Geographic Information System). The percentage of impervious surface found in Richmond WHPA is 3%, corresponding to a risk raging of low.

Figure 3. Impervious surfaces in and around the Richmond WHPA.



REFERENCES

Rhode Island Geographic Information Systems (RIGIS), Geospatial Data, Available at http://www.edc.uri.edu/RIGIS/.

Rhode Island Department of Health, 2007, Sanitary Survey Report for the Westerly Water Department. Obtained from Rhode Island Department of Health.

Rhode Island Department of Health and URI NEMO Program, 2010, Guide to Updating Source Water Assessments and Protection Plans.

Rhode Island and Providence Plantations, Rules and Regulations Pertaining to public Drinking Water, as Amended April 2009, R46-13-DWQ

USEPA National Primary Drinking Water Regulations (Factsheet), EPA 816-F-09-004, May 2009

2009 Edition of the Drinking Water Standards and Health Advisories, October 2009, EPA 822-R-09-011

ATTACHMENT 1: EXPLANATION OF RISK RATING SYSTEM (from 2010 Guide to Updating SWAPS).

Wellhead Protection Area RISK INDICATOR	RATING				Richmond Results	Richmond Rating
	Low	Medium	High	Extreme		
	0	5	10	25		
Wellhead Protection Area land use						
1. High intensity land use.	**< 10%**	10 - 24%	25 - 40%	> 40%	7 %	0
Existing or potential pollution sources						
2. Pollution sources within inner protective radius (400' or 200') of well.	0	**1**	2 - 3	> 3	Nd[2]	5
3. Pollution sources per acre throughout WHPA, excluding inner protective radius. Multiply this number by 10.	< 0.1	**0.1 - 0.5**	0.5 - 1	> 1	Nd[2]	5
Water quality						
4. History of contaminant detects within last 5 years.	**Trace** [1]	≤1/2 MCL	>1/2 MCL	Violation	Trace	0
5. Source water Bacteria detects within 5 years.	**none**	Total coliform detection	Fecal coliform detected; cause identified and corrected	Fecal coliform violation	No detections	0
6. Maximum nitrate-nitrogen (NO_3-N) concentration in last 5 years.	**≤.5 mg/l**	.5 - 2 mg/l	> 2 - 5 mg/l	> 5 mg/l	0.21 mg/L	0
Maximum	*0*	*30*	*60*	*150*		
Overall Ranking - Sum of all risk ratings.	**0 – 19**	**20 – 59**	**60 – 100**	**> 100**		10

Notes:
[1] Trace = Less than 10% contaminant MCL
[2] Indicates that no data is present for this risk indicator, therefore the risk rating of moderate is automatically assigned. Although the data is not available there may still be pollution sources present

ATTACHMENT 2: DEPARTMENT OF HEALTH RECORDS FOR CONTAMINANTS, BACTERIA, AND NITRATES

Richmond water supply wells 1 and 2

Wells are less than 1,000 ft apart and therefore are treated as one for purposes of analysis

Bacteria Risk

Risk Rating: LOW - Bacteria have not been detected

Date	Well Description	Well ID	ANALYTE NAME	Conc.
07-Apr-03	GRAVEL PKD WELL # 1	WL001	COLIFORM, FECAL	0
07-Apr-03	GRAVEL PKD WELL # 1	WL001	COLIFORM, TOTAL (PRE-TCR)	0
16-Mar-04	GRAVEL PKD WELL # 1	WL001	COLIFORM, FECAL	0
16-Mar-04	GRAVEL PKD WELL # 1	WL001	COLIFORM, TOTAL (PRE-TCR)	0
22-Mar-07	GRAVEL PKD WELL # 1	WL001	COLIFORM, TOTAL (PRE-TCR)	0
10-Mar-08	GRAVEL PKD WELL # 1	WL001	COLIFORM, TOTAL (PRE-TCR)	0
07-Apr-03	GRAVEL PKD WELL #2	WL002	COLIFORM, FECAL	0
07-Apr-03	GRAVEL PKD WELL #2	WL002	COLIFORM, TOTAL (PRE-TCR)	0
16-Mar-04	GRAVEL PKD WELL #2	WL002	COLIFORM, FECAL	0
16-Mar-04	GRAVEL PKD WELL #2	WL002	COLIFORM, TOTAL (PRE-TCR)	0
22-Mar-07	GRAVEL PKD WELL #2	WL002	COLIFORM, TOTAL (PRE-TCR)	0

Contaminant Risk

Risk Rating: Low - There has been no detections of regulated contamiants (excluding bacteria and nitrates).

Low level detections of unregulated contaminant nickel have occurred, suggesting that the water supply is susceptible to contamination.

Date	Well Description	Well ID	ANALYTE NAME	Conc.	Units	MCL	MCL Source	Risk rating
10-Mar-08	GRAVEL PKD WELL # 1	WL001	BARIUM	0.009	MG/L	2 mg/L	RI Rules and Regulations Petraining to Public Drinking Water R46-13-DWQ As amended April 2009	Low
22-Feb-05	GRAVEL PKD WELL # 1	WL001	BERYLLIUM	0.0007	MG/L	0.004 mg/L	RI Rules and Regulations Petraining to Public Drinking Water R46-13-DWQ As amended April 2009	Low
22-Mar-05	GRAVEL PKD WELL # 1	WL001	FLUORIDE	0.3	MG/L	4.0 mg/L	RI Rules and Regulations Petraining to Public Drinking Water R46-13-DWQ As amended April 2009	Low
10-Mar-08	GRAVEL PKD WELL # 1	WL001	FLUORIDE	0.29	MG/L	4.0 mg/L	RI Rules and Regulations Petraining to Public Drinking Water R46-13-DWQ As amended April 2009	Low
10-Mar-08	GRAVEL PKD WELL #2	WL002	BARIUM	0.006	MG/L	2 mg/L	RI Rules and Regulations Petraining to Public Drinking Water R46-13-DWQ As amended April 2009	Low
22-Feb-05	GRAVEL PKD WELL #2	WL002	BERYLLIUM	0.0003	MG/L	0.004 mg/L	RI Rules and Regulations Petraining to Public Drinking Water R46-13-DWQ As amended April 2009	Low
22-Mar-05	GRAVEL PKD WELL #2	WL002	FLUORIDE	0.23	MG/L	4.0 mg/L	RI Rules and Regulations Petraining to Public Drinking Water R46-13-DWQ As amended April 2009	Low
10-Mar-08	GRAVEL PKD WELL #2	WL002	FLUORIDE	0.24	MG/L	4.0 mg/L	RI Rules and Regulations Petraining to Public Drinking Water R46-13-DWQ As amended April 2009	Low
10-Mar-08	GRAVEL PKD WELL #2	WL002	NICKEL	0.027	MG/L	0.1 mg/L	unregulated, reported advisory level of 0.02 mg/L from WHO 1998 and 0.1 mg/L for State of MA, reported in www.atsdr.cdc.gov	Low

Nitrogen Risk

Risk rating: Low - Nitrate levels in groundwater have been consistently low.

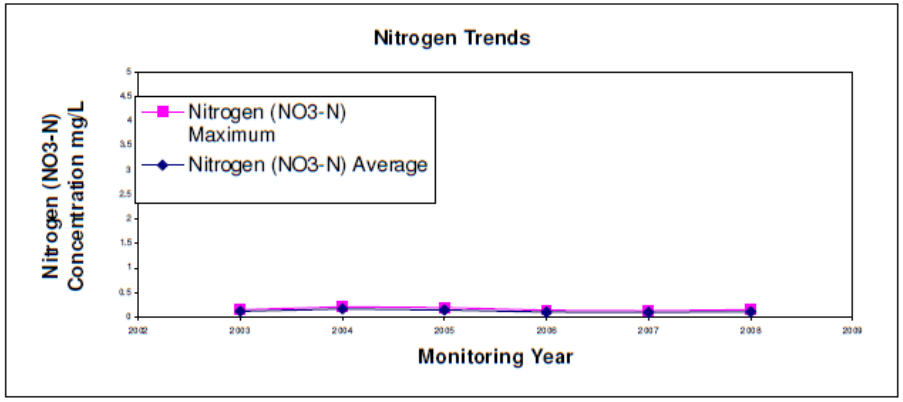
Date	Well Description	Well ID	ANALYTE NAME	Conc.	Units	
07-Apr-03	GRAVEL PKD WELL # 1	WL001	NITRATE (AS N)	0.15	MG/L	
16-Mar-04	GRAVEL PKD WELL # 1	WL001	NITRATE (AS N)	0.21	MG/L	**(Maximim NO3-N conc. observed)**
22-Mar-05	GRAVEL PKD WELL # 1	WL001	NITRATE (AS N)	0.19	MG/L	
09-Mar-06	GRAVEL PKD WELL # 1	WL001	NITRATE (AS N)	0.14	MG/L	
22-Mar-07	GRAVEL PKD WELL # 1	WL001	NITRATE (AS N)	0.13	MG/L	
10-Mar-08	GRAVEL PKD WELL # 1	WL001	NITRATE (AS N)	0.15	MG/L	
07-Apr-03	GRAVEL PKD WELL #2	WL002	NITRATE (AS N)	0.09	MG/L	
16-Mar-04	GRAVEL PKD WELL #2	WL002	NITRATE (AS N)	0.12	MG/L	
22-Mar-05	GRAVEL PKD WELL #2	WL002	NITRATE (AS N)	0.1	MG/L	
09-Mar-06	GRAVEL PKD WELL #2	WL002	NITRATE (AS N)	0.06	MG/L	
22-Mar-07	GRAVEL PKD WELL #2	WL002	NITRATE (AS N)	0.06	MG/L	
10-Mar-08	GRAVEL PKD WELL #2	WL002	NITRATE (AS N)	0.06	MG/L	

Wellhead Protection Area Nitrogen Trend Table

WHPA Name: Richmond wells 1 and 2_____

Well Identification Number: _____

RISK INDICAT	Year					
	2003	2004	2005	2006	2007	2008
Nitrogen (NO3-N) Average (mg/L)	0.12	0.17	0.15	0.10	0.10	0.11
Nitrogen (NO3-N) Maximum (mg/L)	0.15	0.21	0.19	0.14	0.13	0.15



Sodium Levels

Calcium, sodium and magnesium data are not analyzed as they are naturally occurring. However, sodium is reviewed when levels consistently approach or exceed 20 mg/L because sodium and chloride are indicators of contamination from road salt and can also indicate the presence of other runoff pollutants. The EPA listed sodium on the "drinking water advisory" list (EPA, 2004) with 20 mg/L as the guidance level for those on a restricted sodium diet. This is not an official contamination level; however, sodium concentrations approaching or exceeding 20 mg/L should be reported.

Date	Well Description	Well ID	ANALYTE NAME	Conc.	Units
07-Apr-03	GRAVEL PKD WELL # 1	WL001	SODIUM	20.6	MG/L
16-Mar-04	GRAVEL PKD WELL # 1	WL001	SODIUM	21.0	MG/L
22-Mar-05	GRAVEL PKD WELL # 1	WL001	SODIUM	23.5	MG/L
09-Mar-06	GRAVEL PKD WELL # 1	WL001	SODIUM	26.0	MG/L
22-Mar-07	GRAVEL PKD WELL # 1	WL001	SODIUM	29.4	MG/L
10-Mar-08	GRAVEL PKD WELL # 1	WL001	SODIUM	28.0	MG/L
07-Apr-03	GRAVEL PKD WELL #2	WL002	SODIUM	14.3	MG/L
16-Mar-04	GRAVEL PKD WELL #2	WL002	SODIUM	14.1	MG/L
22-Mar-05	GRAVEL PKD WELL #2	WL002	SODIUM	17.8	MG/L
09-Mar-06	GRAVEL PKD WELL #2	WL002	SODIUM	13.4	MG/L
22-Mar-07	GRAVEL PKD WELL #2	WL002	SODIUM	13.9	MG/L
10-Mar-08	GRAVEL PKD WELL #2	WL002	SODIUM	13.2	MG/L

ATTACHMENT 3: RIDOH WAIVER

***FACILITY: Richmond Water Supply Board Wood River Drive Richmond, R.I. 02898; PWS# 1000040; Community Water System; Main Number 539-0150; Official in Charge/Contact Person is Leon Millis, Manager, 578-4171; Population served: 2000; Two wells- Gravel Packed Well #1 (01) and Gravel Packed Well #2 (02); 180 service connections; Average production is 35,000 gpd; Water storage capacity is 300,000 gallons; Last sanitary survey performed 04/08/05; Inventory conducted 2/14/95; Prepared by Michael Brusseau; Updated by Rich Amirault.

TOPOGRAPHY/SLOPES/WATERSHED/WHPA:

The WHPA is a very large (2,049-acre) irregular-shaped region located in northwestern Richmond and northeastern Hopkinton. The WHPA covers portions of the towns of Hopkinton, Exeter and Richmond. A large portion of the WHPA is included in the Arcadia Management Area.

The Richmond Water Supply wells and WHPA are located within the Hope Valley Topographic Quadrangle and the Wood River Watershed.

SURFACE WATER BODIES:

The Richmond Water Supply wells are located in close proximity to the Wood River.

According to RIDEM's *State of the State's Waters* (1994), the Wood River is threatened by "salt piles, landfills, and septic system failure (Hope Valley area), and agricultural withdrawals during low flow conditions on the Wood River and some tributaries (Beaver River). Wood River is assessed as threatened for overall use support due to exceedances of chronic lead criteria as observed in the 1991 URI study and 1992-1993 chemical monitoring. Biological monitoring of the Wood River [served as] a reference station with a fully supporting aquatic life use support". Upstream tributaries of the Wood River have had elevated lead, sodium, chloride and fecal coliform levels. **NOTE:** The above conditions are not necessarily symptomatic of activities occurring within the water system's WHPA.

Riparian wetlands are also prevalent in the area near the wells.

GEOLOGY/AQUIFER CHARACTERISTICS:

The bedrock geology consists of rocks of the Esmond-Dedham Subterrane (West Bay Area), Scituate Igneous Suite, granite (**Dsg**) (Devonian). This unit is described by O.D. Hermes, L.P. Gromet, and D.P. Murray (1994) as a "gray to pink, coarse-grained, porphyritic to subporphyritic subsolvus granite (phenocrysts of perthite, microcline, and plagioclase). Contains microcline, perthite, plagioclase, quartz, and accessory biotite, hornblende, allanite, zircon, apatite, fluorite, and opaque minerals; minor garnet is present in some varieties; some secondary muscovite, calcite, and epidote. Ovoid clots of mafic and accessory minerals are locally prominent. Some rock is massive, but most is commonly lineated and foliated, especially in the west and south near the Hope Valley Shear Zone. Includes rocks mapped formerly as the Scituate Granite Gneiss, and some rock mapped as the Hope Valley Alaskite Gneiss."

GEOLOGY/AQUIFER CHARACTERISTICS:

The surficial geology/geomorphology of the area surrounding the wells consists of stratified drift and outwash deposits associated with glacial outwash plains.

Stratified drift/ outwash plains typically consist of well sorted, stratified gravels, sands, and silts (usually coarse textured materials with loose or granular soil structure) deposited in valleys. Outwash often has a thicker saturated thickness, a higher transmissivity, and higher well yield than glacial till. Under ideal conditions these aquifers can provide sufficient quantities of quality groundwater to be used as municipal drinking water supplies. However, shallow wells in stratified drift aquifers are sometimes vulnerable to contamination due to the coarse textured, well-sorted, highly permeable, and low pollutant attenuation capacity, typical of these aquifers.

The wells are located just east of the Upper Wood River Stratified Drift Aquifer (designated as having a saturated thickness of more than 40 feet and a transmissivity greater than 4,000 ft^2).

In general, groundwater flow in the immediate area of the wells is in a southerly and south-southeasterly direction (R.I. Water Resources board - no date).

SOILS:

The soils in the general vicinity of the Richmond Water Supply wells appear to be the Hinckley gravelly sandy loams (**HkC** and **HkD**) with an area of Ridgebury, Whitman and Leicester soils (**Rf**) just south of the wells.

Hinckley gravelly sandy loam, rolling (HkC): This excessively drained soil is on terraces, outwash plains, kames and eskers.

Typically, the surface layer is dark brown gravelly sandy loam about 6" thick. The subsoil is 11" thick. The upper 4" is yellowish brown gravelly sandy loam, and the lower 7" is light yellowish brown gravelly sandy loamy sand. The substratum is light brownish gray very gravelly sand to a depth of 60" or more.

The permeability of this soil is rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is low and runoff is slow. The soil is extremely acid through medium acid.

This soil is suitable for community development. Onsite septic systems need careful design and installation to prevent pollution of groundwater. Slopes of excavated areas are commonly unstable.

Many areas of this soil are wooded. The soil is suited to trees, but is limited by droughtiness.

The soil is suited to cultivated crops and some areas are used for pasture. The hazard of erosion is moderate.

This soil is suited to woodland wildlife habitat and openland wildlife habitat. It is too dry to provide wetland wildlife habitat.

The hydrologic group for this soil is A. The potential frost action is low. The risk of corrosion to uncoated steel is low; the risk of corrosion to concrete is high.

SOILS-Continued:

Hinckley gravelly sandy loam, hilly (HkD): This excessively drained soil is on terraces, outwash plains, kames, eskers, and recessional moraines.

Typically, the surface layer is dark brown gravelly sandy loam about 2" thick. The subsoil is 15" thick. The upper 8" is yellowish brown gravelly sandy loam, and the lower 7" is light yellowish brown gravelly sandy loamy sand. The substratum is light brownish gray very gravelly sand to a depth of 60" or more.

The permeability of this soil is rapid in the surface layer and subsoil and very rapid in the substratum. Available water capacity is low and runoff is medium. The soil is extremely acid through medium acid.

Steep slopes make this soil poorly suited to community development. Onsite septic systems need special design and installation to prevent effluent from seeping to the surface or polluting the ground water. Slopes of excavated areas are commonly unstable.

This soil is suited to trees, and most areas are wooded. The major limitations for woodland are steep slopes and droughtiness. Because of the steep slopes, the soil is poorly suited to cultivated crops. The hazard of erosion is severe.

This soil is suited to woodland wildlife habitat. It is poorly suited to openland wildlife habitat, and it is too dry to provide wetland wildlife habitat.

The hydrologic group for this soil is A. The potential frost action is low. The risk of corrosion to uncoated steel is low; the risk of corrosion to concrete is high.

Ridgebury, Whitman, and Leicester extremely stony fine sandy loams (Rf): These nearly level, poorly drained and very poorly drained soils area along drainageways and in depressions in glacial till uplands. Stones and boulders cover 10 to 35 percent of the surface of the unit. Slopes range from 0 to 3 percent but are dominantly less than 2 percent. The areas of the unit consist of Ridgebury soils, Whitman soils, or Leicester soils or all three of the soils. The soils were mapped together because they have no major differences in use and management.

Typically the surface layer of the Ridgebury soils is black fine sandy loam about 4" thick. The subsoil is 16" thick. It is grayish brown fine sandy loam that is mottled in the lower part. The substratum is yellowish brown, mottled gravelly fine sandy loam to a depth of 60" or more.

Typically the surface layer of the Whitman soils is black fine sandy loam about 10" thick. The substratum extends to a depth of 60" or more. It is gray gravelly fine sandy loam that is mottled at a depth of more than 18 inches.

Typically the surface layer of the Leicester soils is very dark grayish brown fine sandy loam about 8" thick. The subsoil is light brownish gray and light yellowish brown, mottled fine sandy loam 18" thick. The substratum is gray, mottled gravelly sandy loam to a depth of 60" or more.

The permeability of the Ridgebury and Whitman soils is moderate or moderately rapid in the surface layer and subsoil and slow or very slow in the substratum. The permeability of the Leicester soils is moderate or moderately rapid in the surface layer and subsoil and moderate to rapid in the substratum. Available water capacity in all three soils is moderate, and runoff is slow to medium. These soils are very strongly acid through medium acid.

SOILS-Continued:

The high water table and the slow or very slow permeability in the Ridgebury and Whitman soils make this unit poorly suited to community development. The use of onsite septic systems is not feasible without extensive filling.

The soils are poorly suited to trees. The main limitations for woodland are wetness and the stones and boulders on the surface, which hinder the use of equipment. Tree windthrow is common. The stones and boulders on the surface make these soils unsuitable for cultivated crops and the use of farming equipment impractical.

These soils are suited to woodland wildlife habitat and wetland wildlife habitat. They are not suited to openland wildlife habitat.

The hydrologic group for the Ridgebury soil is C. The potential frost action is high. The risk of corrosion to uncoated steel is high; the risk of corrosion to concrete is high.

The hydrologic group for the Whitman soil is D. The potential frost action is high. The risk of corrosion to uncoated steel is high; the risk of corrosion to concrete is high.

The hydrologic group for the Leicester soil is C. The potential frost action is high. The risk of corrosion to uncoated steel is low; the risk of corrosion to concrete is high.

LAND USE ZONING:

Most of the developed land within the WHPA consists of very low-to-moderate density single-family residential development. The WHPA is heavily forested, especially in the Arcadia State Management Area.

Arcadia Management Area is a very large, undeveloped, State-owned and managed, forested, low impact recreational park. The area is located primarily in the northern and eastern portions of the Richmond Water Supply's WHPA and is used for camping, hiking, mountain biking, cross country skiing, snowmobiling, horseback riding, and nature observation. Low risk.

Land use along **Nooseneck Hill Road (Route 3)** consists primarily of forest. However, **an old, long inactive gasoline service station**, **Bill's Used Auto Parts/ junkyard, and Tumbleweeds Bar and Grill** are all located along Nooseneck Hill Road (Route 3) near the northeastern boundary of the WHPA. If USTs haven't been removed at the abandoned filling station, they are probably highly corroded by this time. Moderate-to-high risk in terms of VOCs.

Land use along **Old Nooseneck Hill Road** consists of low-density single-family residential development interspersed among forest. Low risk.

Land use along **Blitzkrieg Trail** consists of low-to-moderate density single-family residential development and a relatively large and active gravel pit.

"The extraction of sand and gravel is the principal surface mining operation in (Rhode Island and) Massachusetts. Generally, sand and gravel pits are located in permeable glacial outwash deposits that supply recharge to the groundwater system. The presence of water in these pits is usually a sign that they are hydraulically connected to the water table. In most cases, these pits lack a significant soil and vegetative cover which acts as both a buffer and filter to incoming contaminants and prevents soil erosion and subsequent sedimentation".

LAND USE/ZONING-Continued:

"Due to the permeable nature of their deposits, location in aquifer recharge areas, proximity to the water table and lack of soil cover, sand and gravel pits make groundwater especially vulnerable to contamination. Furthermore, these pits can act as large conduits to the groundwater system. The use and storage of diesel fuel, motor oil, hydraulic fluid and solvents in these sensitive areas can result in groundwater contamination if spills/leaks occur or if the spent products are disposed of improperly".

"Sand and gravel mining operations use trucks, bulldozers, conveyor belts and sizing/ sorting machinery to extract material for use as fill or in the mixing of concrete. Groundwater contamination may occur during routine machinery maintenance (oil and hydraulic fluid refills or changes) if performed in the sand and gravel pit. Degreasing solvents may also be used to clean parts and machinery. Oftentimes, bulldozers and trucks are refueled on-site. Many large mining operations maintain garages in order to provide on-site repair and refueling services. These garages may store large quantities of petroleum products and solvents".

"Another major threat to groundwater quality is from the unregulated dumping or disposal of wastes in abandoned excavation pits. A wide variety of materials have been found in abandoned pits including junk automobiles tires, garbage, salt-laden snow, used motor oil and other liquid wastes. Potential groundwater contaminants are as varied as the wastes. Leachate from wastes can easily percolate down through the remaining sand and gravel layers into the groundwater system" (Cape Cod Aquifer Management Plan 1989).

Land use along **K & G Ranch Road** consists primarily of low-density single-family residential development interspersed among forest. Some homes have been constructed on large grassed lots that may have been used for agricultural purposes many years ago. Also, Morgan's Woodworking Shop is located along K & G Ranch Road. This woodworking shop is operated out of a resident's home, is very small, and most likely insignificant in terms of potential contamination from regulated wood preservatives. The woodworking shop is at least 2,700' from the Richmond Water Supply and is very, very unlikely to have regulated wood preservatives on hand due to the expense of both purchasing and training to use and handle these chemicals as required by law. Low risk.

Land use along **Route 95** consists primarily of forest. Route 95 bisects the eastern side of the WHPA and may be generating a great deal of pollutant-laden stormwater runoff in the WHPA from heavy traffic. Typical stormwater pollutants generated from highly active transportation corridors include a variety of VOCs, nutrients, metals, salt, and bacteria. Leaks and spills resulting from accidents or the carelessness of hazardous materials transporters can be problematic if a major "discharge" occurs. Low-moderate risk depending on the volume and nature of leaks and spills.

Land use along **Carolina Nooseneck Road** consists of low-density single-family residential development. Low risk.

Land use along **Wood River Drive** consists of low-density single-family residential development. The wells are located off of this road. Low risk.

LAND USE/ZONING-Continued:

Land use along **Arcadia Road** consists primarily of low density single-family residential development, forest, a **one or two acre Christmas tree farm** (trees are 2-5' in height meaning probably 2-5 years old), and the **gravel pit** constrained by Blitzkreig Trail. It is impossible to know whether the farm will expand its operation in the future, has shrank its operation from the past, or which pesticides, if any, are, have been, or will be used at the site. Due to the lack of information associated with these issues, it is best that the water system test for some pesticides. Low to moderate risk.

SOCs commonly applied to Christmas tree farms include: atrazine (Phase II, herbicide), carbofuran (Phase II, insecticide), lindane (Phase II, insecticide), methoxychlor (Phase II, insecticide), simazine (Phase V, herbicide), glyphosate (Phase V, herbicide, State waiver), methomyl, metolachlor, 3-hydroxycarbofuran, dicamba (unregulated), and carbaryl (unregulated, insecticide).

Atrazine (6-chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine, A 361, Aatram, Atratol, Nine-O, Aatrex 80W, 4L, Aatrex Nine-o, Atrex, Actinite PK, Al3-28244, Aktikon PK, Aktinit A (PK), Atred, Atranex, Candex, Cekuzinz-T, Chromozin, Crisatrina, Crisazine, Crisazina, Cyazin, Geigy 30027, Gesaprim 50, Gesaprim, Triazine A 1294, Vectal (SC), Wonuk, Zeapos, Zeazin (50), Hungazin, Inakor, Oleogesaprim, Zeaphos, and is a component of Bicep, Bullet, Extrazine, Lariat, Laddok (M), Marksman, Primatol (A), Prozine, and Sutazine): Atrazine is an herbicide used on Christmas trees, corn, soybeans, and turf. Atrazine's solubility is 33/ ppm. The soil half-life of atrazine is approximately 60 days. Koc is 100; Found In Ground Water - yes; Pesticide Leaching Potential is large; and Pesticide Surface Loss Potential is medium (URI Cooperative Extension 1992).

Atrazine's health effects include liver, kidney, lung, cardiovascular effects, and is considered to be a Group "C" carcinogen. Group C is defined as a "possible human carcinogen based on limited evidence or carcinogenicity in animals in the absence of human data" (EPA). MCLG (mg/l) is 0.003; MCL (mg/l) is 0.003.

Carbofuran (Furadan 4F, ENT 27164, Curaterr, Au'ultramicin, Bay 70143 (78537), Brifur, Carbofurane, Chrisfuran, ENT 27164, FMC 10242, Kenofuran, NIA-10242, Niagra 10242, pillafuran, yaltox) is a pesticide, used at nurseries, or on shrubs, Christmas trees, corn, strawberries, potatoes, vegetables, alfalfa, tobacco, rice, peanuts, sorghum, sugarcane, soybeans, cotton, grapes, small grains, cucubrits, and sunflowers.

Carbofuran's solubility is 351 ppm; half-life is 46-50 days; Koc is 22-29; Found In Ground Water - yes; the Pesticide Leaching Potential is large; and the Pesticide Surface Loss Potential is small (URI Cooperative Extension 1992). Carbofuran's potential health effects include nervous system and reproductive effects. MCLG (mg/l) is 0.04; MCL (mg/l) is 0.04.

3-hydroxycarbofuran: is a pesticide and a "degradate" of carbofuran; see "carbofuran" section (**not listed on the RI, Massachusetts, or Sprayer's lists**).

LAND USE/ZONING-Continued:

Lindane (1,2,3,4,5,6-Hexachloro-cyclohexane, gamma-hexachloro-cyclohexane, gamma.666, 666, gamma BHC, gamma HCH, ENT-7796, benzine hexachloride, benhexachlor, Forlin, Silvanol, Isotox, Valent, Gamaphex, Gammex, Lacco, Lindatox, Lindagam, Lindex, Lindosep, Lintox, Linvur, Lorexane, Lindagrain, Lindagranox, Lindalo, Lindamul, Lindapourdre, Lindaterra, Novigam, Lindafor, Linosol, Novigam, and is a component of Agrox 3-Way, Gammatin, Grannol NM, Isopro, Exgama, Aalindan, Aficide, agrocide, ameisenmittel, aparasin, aphtiria, aplidal, arbitex, BBX, Ben-hex, bentox, bexol, celanex, chlorosene, codechine, cyclohexane, DBH, demtol, devoran, dol granule, drilltox, entomoxan, fenoform forte, forst-nexen, gamacide, gammalin, gammaterr, gammexane, geobilan, geolin, gexane, HCC, heclotox, hexa, hexachlorane, hexachlorocyclohexane, hexaklor, hexaverm, hexicide, hexyclan, HGL, hilbeech, hortex, hungaria, jacutin, kokotine, kwell, lasochron, lendine, lentox, lidenal, Gallogamma, Inexit, Kwell, mglawik, milbol 49, mszycol, neo-scabicidol, nexen FB, Nexit, Nexit-stark, nexol-E, nichochloran, omnitox, OMS 17, ovadziak, owadziak, pedraczak, pflanzol, PLK, quellada, sang-gamma, spritzlindane, spritz-rapidin, spruehpflanzol, streunex, TAP 85, Tri-6, verindal ultra, and Gammexane) is part of the class of chlorinated hydrocarbons.

Lindane is an insecticide used at nurseries (on shrubs and ornamentals to kill "borers"), on Christmas trees and vegetables, for soil treatment, and as a dog dip. Lindane is sold over the counter at least one nursery/ lawn and garden store in Rhode Island. The name of the company that "manufactures" the product is "Dragon". There are some restrictions to the use of this chemical; Solubility-7; half-life is 400 days; Koc-1,100; Found In Ground Water - yes; Pesticide Leaching Potential is medium; and the Pesticide Surface Loss Potential is large (URI Cooperative Extension 1992). According to EPA (1994), the potential health effects of Lindane include liver, kidney, nervous, immune, and circulatory system effects. MCLG (mg/l) is 0.0002; MCL (mg/l) is 0.0002.

Methoxychlor (2,2-bis(p-methoxyphenyl)-1,1,1-trichloroetane, ENT, DMDT, Malate, Maxie, Flo Pro MeSeed Protectant, Marlate, Maralate, Metox, and Ortho Vegetable Garden Insect Dust) is an insecticide effective against flies, mosquitoes, cockroaches, and a wide variety of other insects. The chemical is used on Christmas trees, apples, strawberries, grapes (vineyards), peaches, pears, plums, shrubs, flowers, pumpkins, squash, and asparagus. The chemical can be applied to agriculture, forests, and on pets and farm animals.

The chemical is described as a pale-yellow powder with a slightly fruity or musty odor. It does not readily evaporate into air or dissolve in water. Pesticide workers usually dissolve methoxychlor in a petroleum-based liquid and apply it as a spray, or mix it with other chemicals and apply it as a dust. Methoxychlor is used mostly during the spring and summer. Methoxychlor binds to the soil, and therefore, does not readily move from one place to another. However, wind can transport the chemical relatively easily. Some methoxychlor may also move deeper into the ground and enter groundwater, but the amount that reaches the groundwater is usually small. Smaller amounts of methoxychlor in air may settle into surface water bodies. Once it is in the water it usually binds to sediments or organic matter and settles to the bottom. Methoxychlor can breakdown in water or in the soil from bacteria and other microorganisms, and sunlight. However, these processes are slow and may take several months. The chemical can accumulate in algae, bacteria, snails, clams, and fish (U.S. Department of Health and Human Services 1994).

LAND USE/ZONING-Continued:

Methoxychlor is sold over-the-counter for use on roses and at orchards. Agway is one company that sells methoxychlor for use on orchards. Methoxychlor's solubility is 0.1; half-life - 120 days; Koc - 80,000; Found In Ground Water - yes; Pesticide Leaching Potential is small; and the Pesticide Surface Loss Potential is large (URI Cooperative Extension 1992).

According to EPA (1994), the potential health effects of methoxychlor include developmental, liver, kidney, and nervous system effects. MCLG and MCL are each 0.04 mg/l.

Simazine (Aquazine, Caliber, Princep 80W, Cal 90, 4L, 4G, Caliber 90, Gesatop, Weedex, Drexel, Simtrol, A 2079, Al3-51142, Aktinit S, 2,4-bis(ethylamino)-6-chloro-s-triazine, bitemol S-50, Caswell No. 740, CAT (herbicide), CDT, Cekuzina-S, CET, Framed, Geigy 27692, H1803, Herbazin 50, Herbex, Hungazin DT, Premazine, Primatel S, Primatol S, Tafazine (50-W), Taphazine, triazine A 384, Weedex, Zeapur) is an herbicide used on Christmas trees, apples, blueberries, raspberries, grapes (vineyards), shrubs, apples, pears, peaches, plums, cherries, corn, and turf. Simazine's solubility is 6.2 ppm; half-life is 2 months; Koc - 130; Found In Ground Water - yes; Pesticide Leaching Potential is large; and the Pesticide Surface Loss Potential is medium (URI Cooperative Extension 1992). This chemical may cause cancer in laboratory animals such as rats and mice when exposed to high levels over their lifetimes.

Simazine has been classified by EPA (1994) as having a Group "C" cancer threat. Group C is described as a "possible human carcinogen based on limited evidence of carcinogenicity in animals in the absence of human data". Other potential health effects include body weight changes and blood effects. MCLG (mg/l) is 0.004; MCL (mg/l) is 0.004.

Glyphosate (Rattler, Roundup, Ortho Kleen-up) is a foliar-absorbed systemic herbicide that is rapidly inactivated in soil and is effective in controlling most weed and brush species with the right doses and timing (dose is typically 10-60 gallons per acre). The chemical is used as a herbicide around Christmas trees, flowers, apples, strawberries, blueberries, raspberries, grapes (vineyards), asparagus, beets, nurseries, corn, pumpkins, squash, and most vegetables. Glyphosate is commonly sold "over the counter" at many lawn and garden stores.
Glyphosate's solubility is 900,000 ppm; half-life is 47 days; Koc is 24,000; Found In Ground Water - no; Pesticide Leaching Potential - small; Pesticide Surface Loss Potential is large (URI Cooperative Extension 1992).

Potential health effects of glyphosate include liver and kidney damage. MCLG (mg/l) is 0.7; MCL (mg/l) is 0.7; **This chemical is waived by the State.**

Methomyl (Nudrin, Lannate) is a broad spectrum carbamate insecticide used to control insects on vegetables (asparagus, beans, corn, tomatoes, soybeans, cabbage, broccoli, cauliflower, and head lettuce), cotton, other field crops, certain fruit crops, ornamentals at nurseries and is sometimes applied to forests. Lannate is available in several formulations, all of which are very toxic and carry the signal word Danger-poison, and most of which are classified Restricted use. Methomyl is one of the more acutely toxic carbamate pesticides and is highly toxic to fish, bees, birds and wildlife.

LAND USE/ZONING-Continued:

Methomyl has a large leaching potential and has been found in groundwater in the U.S. Because methomyl is applied foliarly, less pesticide reaches the soil and is available to leach. The insecticide's solubility is 58,000 ppm; half-life is 30 days; Koc is 72; Found In Ground Water - yes; and the Pesticide Leaching Potential is large (URI Cooperative Extension 1992). There is currently a proposal to upgrade the classification of this chemical from "unregulated" to "regulated" under Phase VIB beginning in 1999.

Metolachlor (Primextra, Dual 8E, Pennant) is a selective herbicide used commonly as a preplant surface-applied, preplant incorporated or preemergence treatment for control of most annual grasses and certain broadleaf weeds around corn, grain sorghum (milo), soybeans, pod crops, peanuts, potatoes, at nurseries, on landscape plantings, and on turf grass. This chemical has a dual toxicity signal word range from "Caution" to "Warning" depending on the formulation. metolachlor has been found in groundwater and may be considered a possible hazard to groundwater. metolachlor degrades very slowly in the soil and can leach, especially in soils with low organic matter content. The herbicide's solubility is 530 ppm; half-life is 90 days; Koc is 200; Found In Ground Water - yes; and the pesticide leaching potential is large (URI Extension 1992). There is currently a proposal to upgrade the classification of this chemical from "unregulated" to "regulated" under Phase VIB beginning in 1999.

Carbaryl (1-naphthyl-N-methylcarbamate, Sevin, Sevimol) is an "unregulated" SOC insecticide typically used on flowers, tomatoes, and most vegetables; applied on citrus fruit, apples, forage crops, cotton, forests, field crops, lawns, nuts, ornamentals, rangeland, turf, shade trees, corn (sweet) and pasture land. The pesticide is used to target caterpillars, beetles, and chewing insects on vegetable and fruit gardens. Carbaryl's half-life ranges from 7 days in sandy soil to 112 days in loamy/ silty soils (Farm Chemicals Handbook 1989 and Pesticide Dictionary 1990).

Carbaryl can cause excessive cholinergic stimulation, nausea, vomiting, mild abdominal cramping, dimness of vision, dizziness, headache, weakness and difficulty breathing. Carbaryl attacks the respiratory system, skin, central nervous system, and cardiovascular system (HTHC 1981).

Carbaryl has a solubility (ppm) ver.9.50 of 120; half-life is 10 days, Koc ver.9.50 is 300; found in groundwater class-yes; small pesticide leaching potential and medium pesticide surface loss potential (NPURG 1992).

LAND USE/ZONING-Continued:

Dicamba (Banvel, Trooper, Sandoz, Trimec, Bannel, Ace Spot Weed Killer, Lesco three way, Lesco eight One (M), TrexSan (m), Weedmaster, Trimec Plus, and Mec-amine Plus (all three with 2,4-D) is a herbicide used for preemergence and postemergence control of growth suppression of many annual, biennial and perennial broadleaf weeds and many woody brush and vine species in corn, Christmas trees, milo, small grains, pastures, rangeland, non-cropland, turf, and conservation reserve program acres. Banvel has the toxicity signal word, "Warning".

Dicamba is considered mobile in soils, has a large leaching potential and may be a potential hazard to groundwater. Dicamba can cause significant damage to desirable trees and plants especially beans, cotton, flowers, fruit trees, grapes, ornamentals, peas, potatoes, soybeans, sunflowers, tobacco and tomatoes if it comes in contact with their roots, stems, or foliage. The pesticide readily volatizes when temperatures exceed 85 degrees Fahrenheit. Dicamba should not come in contact with drainage ditches or water used for domestic purposes (URI Cooperative Extension 1992). Dicamba's solubility is 400,000 ppm; half-life is 14 days; Koc is 2; Found in ground Water - yes; and the Pesticide Leaching Potential is large. Dicamba is currently classified as an "unregulated" chemical. However, there is recent proposal to begin "regulating" this chemical under Phase VIB beginning in 1999.

Dicamba salt has a solubility (ppm) ver.9.50 of 400,000; half-life is 14 days, Koc ver.9.50 is 2; found in groundwater class -yes; large pesticide leaching potential and small pesticide surface loss potential (NPURG 1992).

Land use along **Dutch Island Road** consists of low-density single-family residential development interspersed among forest. Low risk.

Land use along **New London Turnpike** consists of low density single-family residential development interspersed among forest. Low risk.

Land use along **Baker Pines Road** consists of low-density single-family residential development interspersed among forest. Low risk.

Land use along **Cherry Lane** consists of low-density single-family residential development interspersed within forested land. Low risk.

Land use along **Belforest Lane** low to moderate density, relatively new, single-family residential development. Low risk.

Land along **Teft Hill Trail** consists primarily of forest. Low risk.

HISTORIC LAND USE:

Historically, the area consisted primarily of forest. Many homes have been built in the past 20 years.

WASTE DISPOSAL/STORMWATER/USTs/ABOVE GROUND/UIC/CERCLIS/RIPDES:

There were no CERCLIS sites, State-funded cleanup projects, dumps, landfills, LUSTs, registered UICs, industry, hazardous materials surface impoundments, RIPDES permittees, or salt storage piles found within Richmond Water Supply's WHPA.

WELL CHARACTERISTICS:

The last sanitary survey was performed in April 2005. Most of the following information was obtained from the RIDOH water system files:

Gravel Packed Well #1 (01): The well is located approximately 475' north of Gobeille Drive, 185' east of the Wood River Drive dirt roadway, 350' east of the Wood River and 213' west of Well #2. The 65' deep, 18" diameter gravel packed well was dug in September of 1985 by R.E. Chapman well drillers. The well utilizes a Crane-Deming vertical turbine well pump. The well's seal terminates 10' below grade.

There are two observation wells near Well #1. The observation well inside the pumphouse is 3' from the well and the observation well outside the pumphouse is approximately 45' south of the well. Both observation wells are capped and locked to prevent potential contamination.

Gravel Packed Well #2 (02): The well is 54' deep, 8" in diameter, terminates as a pitless adapter approximately 1 foot above grade and is located inside the barbed wire fenced in area next to the pumphouse. The well was installed by Laframboise Well Drilling, Inc. on 2/15/95, but was not placed in service until 6/29/95. The well is powered by a Goulds submersible pump with a pumping capacity of 225 gpm. This pump does not pose any threat of PCB-contamination to the well.

There are three observation wells located 10' south of the well, 75' east of the well, and 35' northwest of the well. All three observation wells are capped and padlocked to prevent contamination.

Nitrate levels over the past five years, from 2003 through 2007:

Gravel Packed Well #1 (01): 0.15 mg/l, 0.21 mg/l, 0.19 mg/l, 0.14 mg/l and 0.13 mg/l;

Gravel Packed Well #2 (02): 0.09 mg/l, 0.12 mg/l, 0.10 mg/l, 0.06 mg/l and 0.06 mg/l;

WHICH LABORATORY IS USED? DOH;

NEARBY PRIVATE WELL CONTAMINATION:

A private well data review of sixteen streets located within the Richmond Water Supply WHPA revealed no detections of any SOC analytes. There was a 1,1,1-trichloroethane detection in a private well located along Nooseneck Hill Road (Route 3) in Richmond in October of 1980. It is unknown at this time whether this residence is located within the Richmond Water Supply's WHPA. There were no other private well VOC detections discovered within the WHPA.

CONTAMINANTS/PROBLEMS:

Acute MCL violation for Total Coliform was issued on 9/24/93. Non-Acute MCL violation for Total Coliform was issued on 9/22/93 and 7/14/00. Coliform "present" in the distribution system (1/91, 9/93, 9/05 and 10/05); Fecal Coliform "present" in the distribution system (9/93); Lead was found at elevated levels in the distribution system (8/93, 3/94, 8/95 and 9/05); Copper was found at elevated levels in the distribution system (8/93 and 9/98); **Gravel Packed Well #1 (01):** Beryllium- 0.2 ug/l (10/96), 0.5 ug/l (3/02), 0.7 ug/l (2/05); Lead- 11 ug/l (5/91), 9 ug/l (5/92); Sodium above "dietary warning" level of 20 mg/l (4/98, 4/03, 3/04, 3/05, 3/06 and 29.4 mg/l peak level in 3/07); Radon- 2750 pCi/L (10/00); **Gravel Packed Well #2 (02):** Chloroform- 0.88 ug/l (5/95-"new well"); Beryllium- 0.3 ug/l (3/02), 0.3 ug/l (2/05); Nickel- 20 ug/l (5/95 and 3/99); Radon-3390 pCi/L (10/00).

PCBs AND PESTICIDE MONITORING SUMMARY (1993 THROUGH 2007):

PE4, PE18 and PE25 not waived due to small Christmas tree farm in WHPA. Sampled by CT2, CT3, CT5, PE4 and PE14 at Well #1 in 1993. Triennial sampling by PE4, PE18 and TO25 at Gravel Packed Well #1 in 1996. Quarterly sampling by PE4, PE18 and TO25 at Gravel Packed Well #2 in 1996-1997. Triennial sampling by PE4, PE18 and TO25 (NH1) at both wells in 2000. Triennial sampling by PE4, [PE14, PE18 and TO25 (NH2 and NH5)] at both wells in 2003. Reported DEHP-3.5 ug/l (B)-Suspected lab contamination in NH2 sample for Gravel Packed Well #2 (and lab blank?). Resample of Gravel Packed Well #2 by TO25 in 9/03 showed no detects. Triennial sampling by PE4, PE18 and TO25 at both wells in 2005. None of the analytes were detected.

MISCELLANEOUS:

See hard file for sketch of property layout and maps of the facility's WHPA. Copies of aerial photographs covering the site and WHPA are available in the Division's map file.

A USGS study entitled, "Simulation of Ground-Water Flow and Areas Contributing Recharge to Production Wells in Contrasting Glacial Valley-Fill Settings, Rhode Island", Scientific Investigations Report 2007-5133, was published in 2007. The Richmond Water Supply Board water supply was one of the two featured study sites.

Based on the USGS study, RIDEM proposed a new delineation for the wellhead protection area for the Richmond Water Supply Board wellfield. The new delineation will be offered for public notice and final approvals during the Spring of 2008. For informational purposes, maps showing pertinent investigative information were generated using the new delineation and are included in the file.

The text describing the land use in the waiver file was not modified from the original determination. The listing of synthetic organic compounds not waived for this water supply is due to identification of a christmas tree farm that remains in the newly proposed delineation for the WHPA. There is no net change in the SOC monitoring waivers for this water supply.

WAIVED SOCs:

All regulated SOCs are waived with the exception of Atrazine (Phase II, TO25), Carbofuran (Phase II, PE4), Lindane (Phase II, PE18/TO25), Methoxychlor (Phase II, TO25) and Simazine (Phase V, TO25). These chemicals cannot be waived at this time due to the possibility of their use on a small Christmas tree farm located within the Richmond Water Supply's WHPA.

APPROXIMATE SAVINGS: See cost/ savings spreadsheet.