Source Water Assessment of the Public Water Supply Wells For Town of Delmar Sussex County, Delaware

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Summary

The Delaware Department of Natural Resources and Environmental Control (DNREC) Division of Water Resources has completed the Source Water Assessment for the public water supply wells for Town of Delmar as required under the 1996 amendments to the Safe Drinking Water Act. This assessment has been performed using the methods specified in the State of Delaware Source Water Assessment Plan (SWAP) (DNREC, 1999).

There are two ground water supply wells used by Town of Delmar for their drinking water supply. Well 2A is deep unconfined aquifer well located in the Manokin Formation and screened in the Manokin aquifer. Well 3A is deep unconfined aquifer well located in the Beaverdam Formation and screened in the Columbia aquifer. The two unconfined wells are screened at depths up to 205 feet below the ground surface (fbgs). Because these wells are screened deep into their respective unconfined aquifer, they are considered to have a medium vulnerability.

Because the pumping capacity of each unconfined well used by Town of Delmar is greater than 35 gallons per minute (GPM) the wellhead protection areas (WHPAs) for the two wells will consist of a 5-year capture zone delineation generated using a computerized ground-water flow model.

There are no discrete potential sources of contamination located within the WHPA around these two wells. The principal land uses found within the WHPAs for the Town of Delmar are residential and cropland.

Data from the Department of Health and Social Services' Division of Public Health's Office of Drinking Water's (DPH-ODW) analytical database was reviewed for raw/untreated water quality data for the past five years. If any naturally occurring compound was detected above 50% of the drinking water standard or any synthetic compound was detected, then all data for that compound was recorded.

A system-wide susceptibility is based on the most conservative rating from the wells that summarizes the most susceptible portion to this system. Overall, the drinking water supply system exceeds drinking water standards for metals; has a high susceptibility to petroleum hydrocarbons; a moderate susceptibility to nutrients; and a low susceptibility to other inorganic substances, other organic substances, pathogens, PCBs, and pesticides.

Overall Susceptibility for the Wells of Town of Delmar

Overall Susceptibility	Contaminant Class	Comments Regarding Substances Detected in Raw (Untreated) Water
Exceeds Standards	Metals	Sources of metals locate in source water areas.
Very High		
High	Petroleum Hydrocarbons	Sources of petroleum hydrocarbons located in source water areas.
Moderate	Nutrients	Sources of nutrients located in source water areas.
Low	Other Inorganic Substances	Sources of other inorganic substances located in source water areas.
	Other Organic Substances	Sources of other organic substances located in source water areas.
	Pathogens	Sources of pathogens located in source water areas.
	PCBs	Sources of PCBs located in source water areas
	Pesticides	Sources of pesticides located in source water areas.
Very Low		
Not Susceptible		

This is a conservative assessment of the system based on a roll-up of the individual wells. The system wide susceptibility does not stand alone in describing a system's water quality. The system wide susceptibility is a tool in which to better understand what *could* be happening in the source water area. To completely understand the overall system susceptibility, a well-by-well approach is needed to fully understand the susceptibility to Town of Delmar's Water.

Introduction

The 1996 amendments to the Safe Drinking Water Act (SDWA) require that source water assessments be performed for all sources of public drinking water in each state. Because of this, each state was required to develop a Source Water Assessment Plan (SWAP). The State of Delaware's SWAP was developed by a committee of scientists, water industry professionals, conservation groups, government agencies and interested citizens in 1998 and approved by the United States Environmental Protection Agency in October, 1999.

This assessment has been performed using the methods specified in the State of Delaware Source Water Assessment Plan (SWAP)(DNREC, 1999)

The assessment consists of these four critical steps:

1) Delineation of source water areas;
2) Determination of the vulnerability of a well or intake to contamination;
3) Identification of existing and potential sources of contamination; and
4) Determination of the susceptibility of the source water area to contamination.

Step 1 consists of mapping the land surface area that contributes to the water supply. For ground water systems, this is called the wellhead protection area or WHPA. Town of Delmar uses two wells to provide drinking water to the public. Because the pumping capacity of each unconfined well used by Town of Delmar is greater than 35 gallons per minute (GPM) the wellhead protection areas (WHPAs) for the two wells will consist of a 5-year capture zone delineation generated using a computerized ground-water flow model.

Step 2 uses a step-by-step decision making process by which each well or surface water intake for a particular system is examined to determine its vulnerability to contamination. Vulnerability is the relative ease with which contaminants, if released into a source water area, could move and enter a public water supply well or intake at concentrations of concern. Vulnerability includes consideration of such factors as aquifer characteristics, well or surface water intake integrity, and well screen depth. A series of questions about the type of system (surface water or ground water), hydrologic setting, and well construction are used in the decision making process.

Step 3 consists of creating an inventory of all existing and potential sources of contamination within the delineated source water protection areas. This was done utilizing the DNREC Contaminant Site Inventory, 1997 land use maps, analytical data compiled by the Office of Drinking Water and through visual examination during site visits.

Step 4 consists of determining the susceptibility of the source water area to contamination. This process combines steps 1, 2, 3, water quality reports, and other information.

This information must be summarized into a report and provided to the public. It is the goal of the Division of Water Resources that the summaries provided from the source water assessment and protection program will help communities understand the potential threats to their drinking water supply. By understanding the potential threats imposed on the water supply one will be able to make a more educated decision on how to address any corrections that need to be made.

Study Area

The Town of Delmar is located in southwestern Sussex County, Delaware and northwestern Wicomico County, Maryland, approximately 6 miles south of the Town of Laurel, DE (Appendix A: Town of Delmar Water Base Map). The Town of Delmar serves a population of nearly 2400 persons and has approximately 930 service connections (DPH-ODW, 2001).

Public Water Supply Well Data

Table 1 contains current data contained in databases, files, and reports from DNREC Water Supply Section, the Delaware Geological Survey (DGS), and the Department of Health and Social Services, Office of Drinking Water (DPH-ODW) and has been verified as correct by Town of Delmar.

Table 1: Town of Delmar Well Construction Data

Well Number	DNREC Permit #	Allocation #	Year Constructed	Capacity (gpm)	Diameter (inches)	Screen Interval (fbgs)	Aquifer
2A	47006	89-0006B	1980	1100	16	155-205	Manokin
3A	64384	89-0006A	1986	750	10	116-146	Columbia

gpm = gallons per minute fbgs = feet below ground surface

Geology and Hydrogeology

Town of Delmar withdraws water from two deep unconfined wells.

The Columbia aquifer, also referred to as the water table aquifer, consists of the saturated portion of the Beaverdam Formation in most portions of central and southwestern Sussex County. The Beaverdam Formation has a maximum thickness of 90 – 100 feet between Seaford and Laurel. The Beaverdam Formation is often in hydraulic connection with the sands of the underlying Bethany Formation making the overall saturated thickness of the Columbia Aquifer approximately 200 feet in the vicinity of Delmar (Johnston, 1973). The upper unit of the Beaverdam Formation is composed of yellow-orange, light brown and light gray quartzose fine medium sand, sandy silt, and clayey silt with a white to light yellow silt and clay matrix. The lower unit of the Beaverdam Formation is characterized by light gray to yellow-orange medium to coarse sand, gravelly sand and sandy gravel with occasional beds of gray, blue, and green-gray clays and silts (Andres, 1996). The Columbia aquifer is a major aquifer in Sussex County and is used primarily for agricultural and domestic wells.

The Manokin aquifer, in the vicinity of Delmar, is often in hydraulic connection with the sands of the overlying Bethany and Beaverdam Formations making the overall saturated thickness of the Columbia Aquifer approximately 200 feet (Johnston, 1973). The upper unit of the Manokin Formation is composed of gray to yellow-orange to red-orange fine to medium quartz sand with beds of gravelly sand common. The lower unit of the Manokin Formation is characterized by lignitic gray to blue-gray and brown-gray clayey and silty sand (Andres, 1996).

Source Water Protection Area Delineation

The State of Delaware Source Water Assessment Plan describes the methods to be used for the delineation of the areas that contribute water to public drinking water supplies. Town of Delmar uses ground water pumped from two public supply wells as its sources of drinking water. WHPAs must therefore be mapped for each of the town's wells (Appendix A: Town of Delmar Water Delineation Map).

Based upon the geologic and hydrologic setting of the Town of Delmar area, both wells have been determined through review of well logs and well construction information to be screened in the unconfined aquifer. Using this information and the methodology described in section 3.5 of the Delaware SWAP, the source water areas for these wells were delineated using EPA's WhAEM ground-water modeling software (see Table 2a).

Table 2a: Aquifer type and Delineation Method

Well #	DNREC Permit #	Formation	Aquifer	Delineation Method
2A	47006	Manokin	Manokin	WhAEM Model
3A	64384	Beaverdam	Columbia	WhAEM Model

In order to have this model produce reasonable and accurate results the characteristics of both the wells and the geology must be determined and input into the model. A review of the well construction data provided the needed information for the wells, and a literature review provided the needed data to represent the various hydrogeologic factors. Table 2b below summarizes these data with references where appropriate. Using these data, the well locations, and same regional hydrology, it should be possible to recreate the model output using the same model (WhAEM 2000 v2.03).

Table 2b: Parameters and Settings Used in WhAEM

Well Parameters

Well #	Pumping Rate (ft^3/day)	Well Radius (feet)	Number of Flow Tracing Particles	Particle Release Depth (feet below sea level)
2A	177678	0.6666666	20	130
3A	109725	0.4166666	20	81

Model Settings

Property	Value	Units	Reference
Duration	1825	Days (equiv. 5 yrs)	Delaware SWAP, 1999
Recharge	0.004	Inches/year	Denver, 1986; Johnston, 1976
Porosity	20-30	percent	Average range inferred from Andres and Ramsey, 1994
Hydraulic Conductivity	125	Ft/day	Andres, 1994;Denver, 1986; Johnston, 1976
Base of Aquifer	175-200	Feet Below Sea Level	Andres and Ramsey, 1994; Andres, 1994
Aquifer Thickness	125	Feet	Andres and Ramsey, 1994; Andres, 1994

Because of the differences between the complexity of the real-world and the simplifications necessary for the model, a brief discussion of the methodology for the source water area delineation is appropriate. This particular model uses the regional stream flow to generate a representative water table surface. From this, the model then "pumps" the wells and calculates the changes to this surface caused by the water being withdrawn from the wells. During this time the model tracks "particles" over the duration of the model run to detail how water flows into the wells over that time period. Because of the lack of site-specific real world data across the entire modeled area assumptions have to be made and the results scrutinized. Some of the key assumption that were made are as follows:

- Although the hydrogeology varies with depth and distance, the exact details of the subsurface are not known. Therefore the model parameters that represent these features need to be varied (multiple model runs then make a composite of the results);

- This is a Steady-State Model, meaning that the wells must be pumping continuously over the model duration (yields a conservative, larger, wellhead area)

- The specifics of the interactions between the aquifer and the smaller streams are not well known. Therefore it is assumed that these streams are not significant sources of water to the aquifer (wellhead areas can extend across smaller streams)

More discussion on specific model assumptions can be found in the model documentation (Kraemer et al, 2001). ***Based upon this methodology, the resulting delineated Source Water Areas are conservative and may be larger than the true capture zones for each well; however without more data and more complex modeling requirements this method results in Source Water Protection Areas that more reliably protect the water supply.*** As more data and more time become available, it may be possible to further refine the areas and more closely simulate real-world conditions.

Vulnerability Determination

The vulnerability is the relative ease with which contaminants, if released into a source water area, could move and enter a public water supply well or surface water intake at concentrations of concern. Individual intakes or wells are ranked as having high, medium, or low vulnerability according to the process described in section 5.1 of the Delaware SWAP. The determination of this vulnerability is conducted through a series of questions about the type of intake (surface or ground water), hydrogeologic setting, and construction. Figure 1 demonstrates this process for Town of Delmar.

Town of Delmar uses 2 wells as its source of supply of drinking water to its residents. All of these wells were drilled after July 14, 1969, the date that Delaware officially adopted water well construction regulations. Data obtained through the Sanitary Survey process by the Division of Public Health - Office of Drinking Water, shows that these wells are properly sealed and maintained at the ground surface. Since a proper seal has been maintained around the well casings, the integrity of the wells has been determined to be "Good".

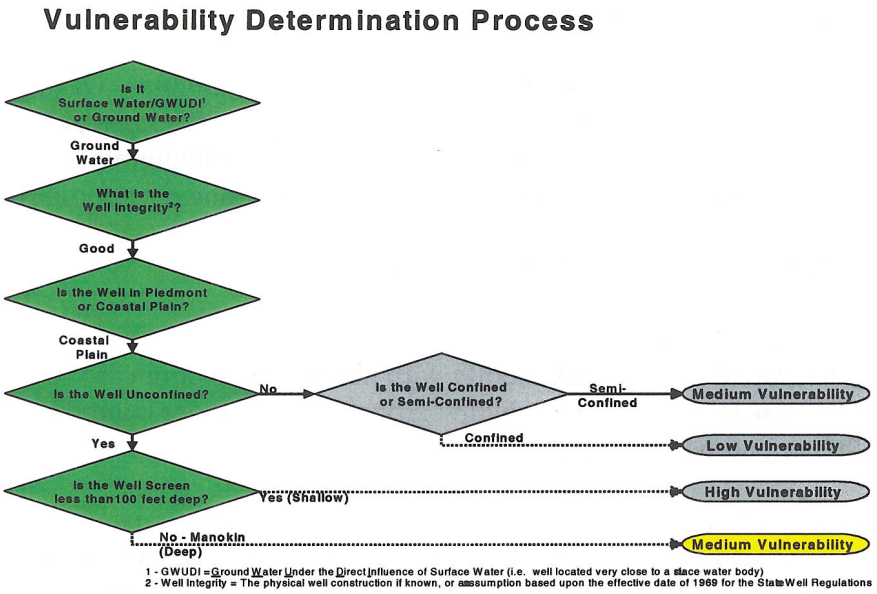

Figure 1: Vulnerability Determination process for wells used by Town of Delmar

The two wells for Town of Delmar are located in the coastal plain and are screened greater than 100 feet into the unconfined aquifer. According to the Delaware SWAP these wells are classified as having a **Medium Vulnerability**.

Existing and Potential Sources of Contamination

There are a multitude of potential contaminant sources that could degrade drinking water quality. Most of these sources are anthropogenic, however, natural contaminants such as salt water or iron deposits can also impact water supplies. Most human impacts occur at or just below the ground surface and therefore are much more of a concern for shallow water supplies that lack a protective confining layer.

Discrete Sources

Discrete sources are defined as sources of pollution to surface or ground-water supplies at well defined, usually manufactured "points" or locations. The SWAPP has divided the discrete sources into the following categories:

Leaking & Underground Storage Tanks
Landfills / Dumps
National Pollutant Discharge Elimination Sys.
Tire Piles
Hazardous Waste Generators
Toxic Release Inventory
Salvage Yards
Pesticide Loading, Mixing, & Storage Facility
State and Federal Superfund Sites
Large On-Site Septic
Wastewater Spray Irrigation
Waste Sludge Application
Animal Feedlot Operations
Combined Sewer Overflows
Dredge Spoils
Golf Courses
Domestic Septic Systems

These discrete sources can contaminate source waters depending upon the conditions. For example, golf courses may contribute both pesticides and nutrients to the surface and ground waters by means of

surface application for landscaping purposes, whereas tire piles generally do not pose a threat to the waters of the state unless they begin to burn.

There are 17 discrete sources located within the WHPA for Town of Delmar. Of these, two (2) are noted to be of high contaminant potential, three (3) are of medium contaminant potential, nine (9) are of low contaminant potential and the remaining three (3) sites have a negligible contaminant potential. A brief description of each of these sites and their associated contaminant potential follows:

Town of Delmar Well 2A (47006) and Well 3A (64384):

Lewes Dairy Market (MAP ID: UT5347)

This is an underground storage tank facility with historic product release. This site has a **high contaminant potential** for petroleum hydrocarbons because these compounds have been detected in the ground water on site.

Car City Auto (MAP ID: UT5735)

This is an underground storage tank facility with historic product release. This site has a **high contaminant potential** for petroleum hydrocarbons because these compounds have been detected in the ground water on site.

Crystal Steel Fabricators (MAP ID: HW7839)

This is an hazardous waster generator facility. This site has a **medium contaminant potential** for other organic substances because contaminants could be present at levels of concern but there is no or insufficient monitoring data.

Delmar Exxon (MAP ID: UT5351)

This is an underground storage tank facility. This site has a **medium contaminant potential** for petroleum hydrocarbons because contaminants could be present at levels of concern but there is no or insufficient monitoring data.

Cheers (formerly Galaxy Beverage Co.) (MAP ID: MDE 01)

This is an underground storage tank facility. This site has a **medium contaminant potential** for petroleum hydrocarbons because contaminants could be present at levels of concern but there is no or insufficient monitoring data.

Crystal Steel Fabricators (MAP ID: HW6845)

This is a hazardous waster generator facility. This site has a **low contaminant potential** for other organic compounds. A low contaminant potential is where contaminants are present in significant quantities in the source water area but monitoring data indicates no or minimal releases.

Concrete Building Systems, Inc. (MAP ID: UT5192)

This is an underground storage tank facility. This site has a **low contaminant potential** for petroleum hydrocarbons. A low contaminant potential is where contaminants are present in significant quantities in the source water area but monitoring data indicates no or minimal releases.

Gordy Fuel Company (MAP ID: UT5350)

This is an underground storage tank facility. This site has a **low contaminant potential** for petroleum hydrocarbons. A low contaminant potential is where contaminants are present in

significant quantities in the source water area but monitoring data indicates no or minimal releases.

Al's Used VW, Inc. (MAP ID: UT5357)

This is an underground storage tank facility. This site has a **low contaminant potential** for petroleum hydrocarbons. A low contaminant potential is where contaminants are present in significant quantities in the source water area but monitoring data indicates no or minimal releases.

All Waste Environmental Service, Chesapeake (MAP ID: UT5374)

This is an underground storage tank facility. This site has a **low contaminant potential** for petroleum hydrocarbons. A low contaminant potential is where contaminants are present in significant quantities in the source water area but monitoring data indicates no or minimal releases.

Delmar Water Treatment Facility (MAP ID: UT5556)

This is an underground storage tank facility. This site has a **low contaminant potential** for petroleum hydrocarbons. A low contaminant potential is where contaminants are present in significant quantities in the source water area but monitoring data indicates no or minimal releases.

JGRC, Inc. (MAP ID: UT5625)

This is an underground storage tank facility. This site has a **low contaminant potential** for petroleum hydrocarbons. A low contaminant potential is where contaminants are present in significant quantities in the source water area but monitoring data indicates no or minimal releases.

Delmar Fire Department (MAP ID: UT5690)

This is an underground storage tank facility. This site has a **low contaminant potential** for petroleum hydrocarbons. A low contaminant potential is where contaminants are present in significant quantities in the source water area but monitoring data indicates no or minimal releases.

Johnson's Used Cars (MAP ID: UT5896)

This is an underground storage tank facility. This site has a **low contaminant potential** for petroleum hydrocarbons. A low contaminant potential is where contaminants are present in significant quantities in the source water area but monitoring data indicates no or minimal releases.

Columbia Vending Corp. (MAP ID: UT5372)

This is an underground storage tank facility. This site has a **negligible contaminant potential** for all contaminant categories. A negligible contaminant potential is contaminants not present in sufficient quantities in the source water area to cause concern.

Steel Tech Fabricators (MAP ID: UT5695)

This is an underground storage tank facility. This site has a **negligible contaminant potential** for all contaminant categories. A negligible contaminant potential is contaminants not present in sufficient quantities in the source water area to cause concern.

Concrete Building Systems, Inc. (MAP ID: WW205)

This is a NPDES waste water outfall. This site has a **negligible contaminant potential** for all contaminant categories. A negligible contaminant potential is contaminants not present in sufficient quantities in the source water area to cause concern.

Additional Information

Additional information for these contaminant sources can be found on the DNREC web site (http://www.dnrec.state.de.us/) using the Environmental Navigator. The inventory contains categorized data for multiple forms of media (surface water, ground water, etc). A list of discrete sources found for Town of Delmar WHPAs is available on the Town of Delmar Water Discrete Sources Map in Appendix A and detailed in Appendix B Table 1.

A list of contact information regarding the programs that monitor and regulate these different site types is available in Appendix D. These programs will be able to supply data regarding individual sites in greater detail than can be addressed in this assessment report. Please contact the program directly for more information.

Land Use / Land Cover

Anthropogenic activities associated with various land uses have the potential to contribute to ground-water quality problems, particularly when examining potential "non-point" source contamination. There is, however, some overlap between discrete sources of contamination and some land use categories.

The Town of Delmar Land Use Map (Appendix A) shows the land use within the delineated areas. Residential and cropland land uses account for approximately 63% of the land uses within the WHPA for Town of Delmar. Figure 2 and the table located on the land use map summarize the system-wide land use for Town of Delmar. This may be different from the well specific data shown in Appendix B Table 2. Based upon the SWAP, the contaminant potential could be adjusted depending on the percentage of land use within the WHPA.

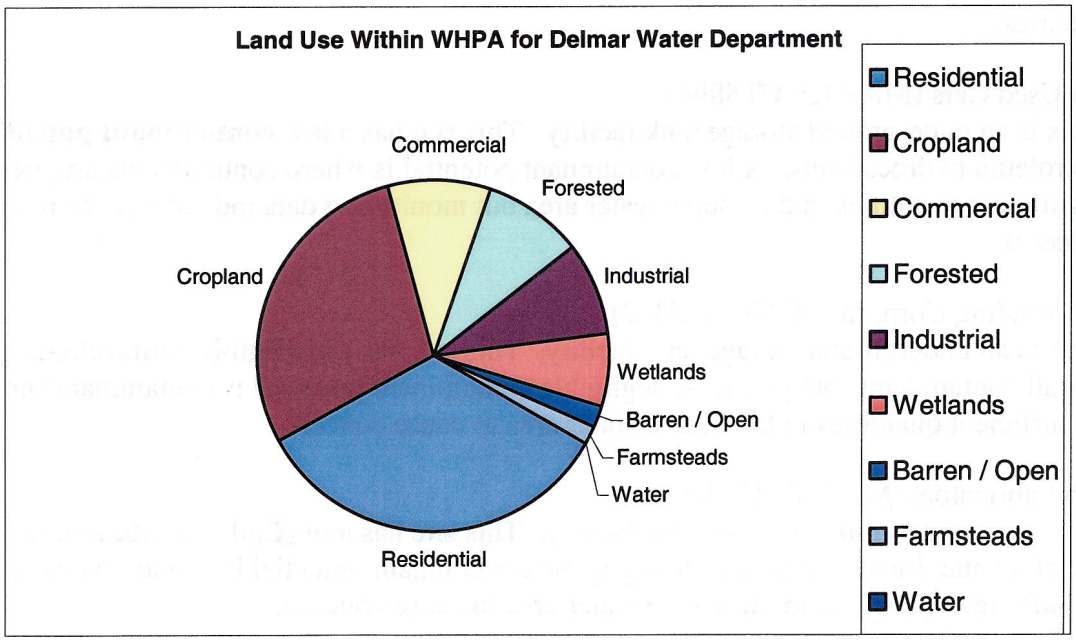

Figure 2: Land Use within Town of Delmar Wellhead Protection Areas

Roads and Railroads

Roads and railroads represent *potential* conduits for the entry of contaminants into soils, surface water, and ground water. The possibility exists that an accident could impact water quality through contamination of ground water by way of a spill or accidental release of a substance. Table 3 summarizes the total lengths of roads and railroads found in the WHPAs.

Table 3: Road and Rail Summary for Town of Delmar WHPAs

Transit Type	Subdivision	Mileage	Percentage
Roadway	Major Road	0.69	100
	Primary Road	0	0
	Secondary Road	0	0
	Total Roads	**0.69 miles**	**100%**
Rail	Main Rail	0.82	68
	Siding Rail	0.38	32
	Total Rail	**1.2 miles**	**100%**

Water Quality Data

This portion of the source water assessment evaluates the water quality of raw water *before* it enters into any treatment process (i.e. filtration, disinfection, fluoridation, softening, etc.) and/or the distribution system. However, it should be noted that many water supply systems utilize certain treatment methods that remove contaminants or impurities from the drinking water before it is delivered to the public.

The Delaware SWAP classifies contaminants into eight (8) categories. Examples of contaminants within each of the eight categories are as follows:

Category	Example
Other Inorganic Compounds:	Fluoride, Chloride, Sulfate, Radon, Radium, Strontium
Metals:	Copper, Arsenic, Iron, and Manganese
Nutrients:	Nitrate
Other Organic Compounds:	Vinyl Chloride, PCE, TCE
Pathogens:	Coliform Bacteria, Cryptosporidium, Giardia lambia
Pesticides:	Alachlor, Atrazine, Glyphosate
Petroleum Hydrocarbons:	Benzene, Toluene, MTBE
Polychlorinated Biphenyls:	PCB

The SWAPP has reviewed the available analytical data for this system for the previous five years. While this report may show an exceedence for a particular contaminant at one instance, the DPH-ODW, which regulates drinking water quality, may not consider it a violation based upon more

detailed procedures detailed within their regulations. In the event that a contaminant, which is not naturally found in the source water, has been detected as a result of maintenance to the water distribution system, its results will be noted and explained within the text. These results will not be considered when determining the final susceptibility for a well and/or public water system.

Naturally Occurring Contaminants

There are several naturally occurring substances that will be considered as contaminants if they exceed threshold levels set by DPH-ODW and the U.S. EPA. When these substances exceed 50% of the established levels they will be identified and considered as contaminants in the assessments of public water supplies. These substances include iron, chloride, sodium, radon, radium, sulfate and others. These will be identified as part of the susceptibility determination for each well and listed as being naturally occurring if detected and present in the data reviewed. It should be noted that DPH-ODW does test water supplies for manganese when it receives complaints from residents on a public water system, however the SWAPP is unable to search their database for this information at this time. Please contact DPH-ODW at (302) 739-5410 regarding questions involving manganese in ground water.

Analytical Data

Well specific data from the DPH-ODW's analytical database was reviewed for raw/untreated water quality data for the past five years. If any naturally occurring compound was detected above 50% of the drinking water standard or any synthetic compound was detected, then all data for that compound was recorded. These results, grouped by contaminant category, are provided in Appendix B. The Delaware SWAP details the contaminants examined for in each source water assessment. A table of these contaminants has been provided in Appendix F of this report. For more information regarding the analysis of drinking water, water quality, and drinking water standards please contact the Division of Public Health, Office of Drinking Water at (302) 739-5410.

Data obtained through the ODW database, showed that there were standards exceeded in one of the above eight contaminant classes.

Water Treatment Methods

The Delmar water treatment plant draws its water from two alternating wells. The raw water quality contains a low pH, low alkalinity, is potentially corrosive, and has an iron content of 0.3 – 1.0 mg/l.

When the water is drawn out of the well, it is pumped to the top of an air-stripping tower where carbon dioxide is removed. The water exits the bottom of the tower and enters a wet well for storage until it is pumped out for further treatment. After the water is pumped out of the wet well, it is treated with chlorine to oxidize iron, provide disinfection residual, and aid in iron removal. Lime is also added to adjust the water's pH level for further treatment.

The water then enters three green sand filters for iron removal before being treated with fluoride to prevent tooth decay and an orthopolyphosphate to prevent pipe corrosion. When these final chemicals have been added, the water leaves the water treatment plant and enters the York Street elevated storage tank.

For more information about the water treatment used by Town of Delmar please contact the Town of Delmar Water System Operator at (302) 846-2664 between the hours of 9 a.m. and 5 p.m. Monday - Friday.

Susceptibility Determination

The key part of a source water assessment is the determination of the likelihood that a particular public water supply system will capture contaminants at concentrations of concern. This analysis, termed susceptibility determination, combines the source water protection area delineation, the vulnerability determination for the wells, the contaminant source inventory, and the water quality information to yield a relative susceptibility for the public water system. Each individual water source is rated for each of the eight contaminant categories on a scale ranging from no susceptibility to documented drinking-water standard exceedences (Table 4).

Table 4. Susceptibility Range

Susceptibility Rating	Susceptibility Text
1	Not Susceptible
2	Very Low
3	Low
4	Medium
5	High
6	Very High
7	Documented Exceedence

Vulnerability

As stated in the Vulnerability Determination section, all three of Town of Delmar 's wells are classified as being highly vulnerable based upon the physical characteristics and geological locations of the wells.

Contaminant Inventory

As detailed in the Existing and Potential Sources of Contamination section there was one discrete source of contamination were found within two delineated WHPAs for Town of Delmar. Refer to Appendix B Table 1 for more specific information.

Land uses, in particular residential has the greatest potential to introduce contaminants into Town of Delmar 's source water. Refer to Appendix B Table 2 for more specific information.

Water Quality

As reported in the Water Quality Data section there were no standards exceeded in any of the eight contaminant classes. Refer to Appendix B Table 3 for more specific information.

Individual Source Susceptibility

Each of the wells in Town of Delmar's public water supply system has unique properties, such as depth, location, date drilled, and pumping rate. These influence the delineated area, the vulnerability determination, and the contaminant inventory. Therefore, a susceptibility assessment must be performed for each individual well.

By examining the individual wells in their respective wellfields it is possible to determine areas where resources may be applied in an effort to protect the drinking water source.

Well 2A (47006)

Well 2A for Town of Delmar is a deep unconfined aquifer well and has been classified as having a medium vulnerability. This well exceeds drinking water quality standards for metals; has a high susceptibility to petroleum hydrocarbons; a moderate susceptibility to nutrients; and a low susceptibility to other inorganic substances, other organic substances, pathogens, PCBs, and pesticides. The exceeds standards is due to analytical samples indicating iron in the untreated water at levels greater than the drinking water standard of 10 mg/l. The high susceptibility to petroleum hydrocarbons is due to the locations of underground storage tanks with historic produce releases within the delineated wellhead area. The moderate susceptibility to nutrients is due to the percentage of land uses with predominant nutrient contaminant potential. The low susceptibility to other inorganic substances, other organic substances, pathogens, PCBs, and pesticides is due to the location of existing and potential discrete sources of contamination or land use practices within the delineated wellhead area for this unconfined aquifer well.

Well 3A (64384)

Well 3A for Town of Delmar is a deep unconfined aquifer well and has been classified as having a medium vulnerability. This well has a very high susceptibility naturally occurring iron (metals); a high susceptibility to petroleum hydrocarbons; a moderate susceptibility to nutrients; and a low susceptibility to other inorganic substances, other organic substances, pathogens, PCBs, and pesticides. The very high susceptibility to metals is due to analytical samples indicating iron in the untreated water at levels greater than 50% of the drinking water standard of 10 mg/l. The high susceptibility to petroleum hydrocarbons is due to the locations of underground storage tanks with historic produce releases within the delineated wellhead area. The moderate susceptibility to nutrients is due to the percentage of land uses with predominant nutrient contaminant potential. The low susceptibility to other inorganic substances, other organic substances, pathogens, PCBs, and pesticides is due to the location of existing and potential discrete sources of contamination or land use practices within the delineated wellhead area for this unconfined aquifer well.

System Wide Susceptibility

The individual susceptibilities of each of this system's wells are detailed in the previous section. On a source-by-source basis these wells could have very different susceptibility ratings. When looked at as a group for the entire system some generalized, conservative statements can be made. For instance, if one assumes that the system is only as protected as its weakest link, then the system-wide susceptibility to any given contaminant category is determined by the most susceptible water source. Using this methodology, a drinking water system with five wells that have a low susceptibility to metals, and one well that is highly susceptible to metals would be rated as having a high susceptibility

to that contaminant category. In many instances this could mean that a particular land use overlying an unconfined well could drive the system-wide susceptibility higher. However, it is also possible that a confined-aquifer well that withdraws iron-rich water could dramatically raise this system's susceptibility rating for metals.

As stated, this system-wide susceptibility is a conservative rating that summarizes the most susceptible portions of any system. This susceptibility is the relative likelihood that a public water supply might draw water contaminated at concentrations of concern to public health. This Susceptibility Assessment is a summary of the vulnerability and contaminant potential to raw water supplies. The actual water quality delivered to the consumer is reported in the Consumer Confidence Reports and is not part of this assessment.

Overall, the drinking water supply system exceeds drinking water standards for metals; has a high susceptibility to petroleum hydrocarbons; a moderate susceptibility to nutrients; and a low susceptibility to other inorganic substances, other organic substances, pathogens, PCBs, and pesticides (Table 5).

The untreated drinking water exceeds standards with respect to metals due to analytical samples indicating iron in the untreated water at levels greater than the drinking water standard of 10 mg/l.

The high susceptibility to petroleum hydrocarbons is due to the locations of underground storage tanks with historic produce releases within the delineated wellhead area.

The moderate susceptibility to nutrients is due to the percentage of land uses with predominant nutrient contaminant potential.

The low susceptibility to other inorganic substances, other organic substances, pathogens, PCBs, and pesticides is due to the location of sources of these contaminants associated with different land uses within the WHPAs.

Table 5: Overall Susceptibility Rating For Town of Delmar Raw Water

Overall Susceptibility	Contaminant Class	Comments Regarding Substances Detected in Raw (Untreated) Water
Exceeds Standards	Metals	Sources of metals locate in source water areas.
Very High		
High	Petroleum Hydrocarbons	Sources of petroleum hydrocarbons located in source water areas.
Moderate	Nutrients	Sources of nutrients located in source water areas.
Low	Other Inorganic Substances Other Organic Substances Pathogens PCBs Pesticides	Sources of other inorganic substances located in source water areas. Sources of other organic substances located in source water areas. Sources of pathogens located in source water areas. Sources of PCBs located in source water areas Sources of pesticides located in source water areas.
Very Low		
Not Susceptible		

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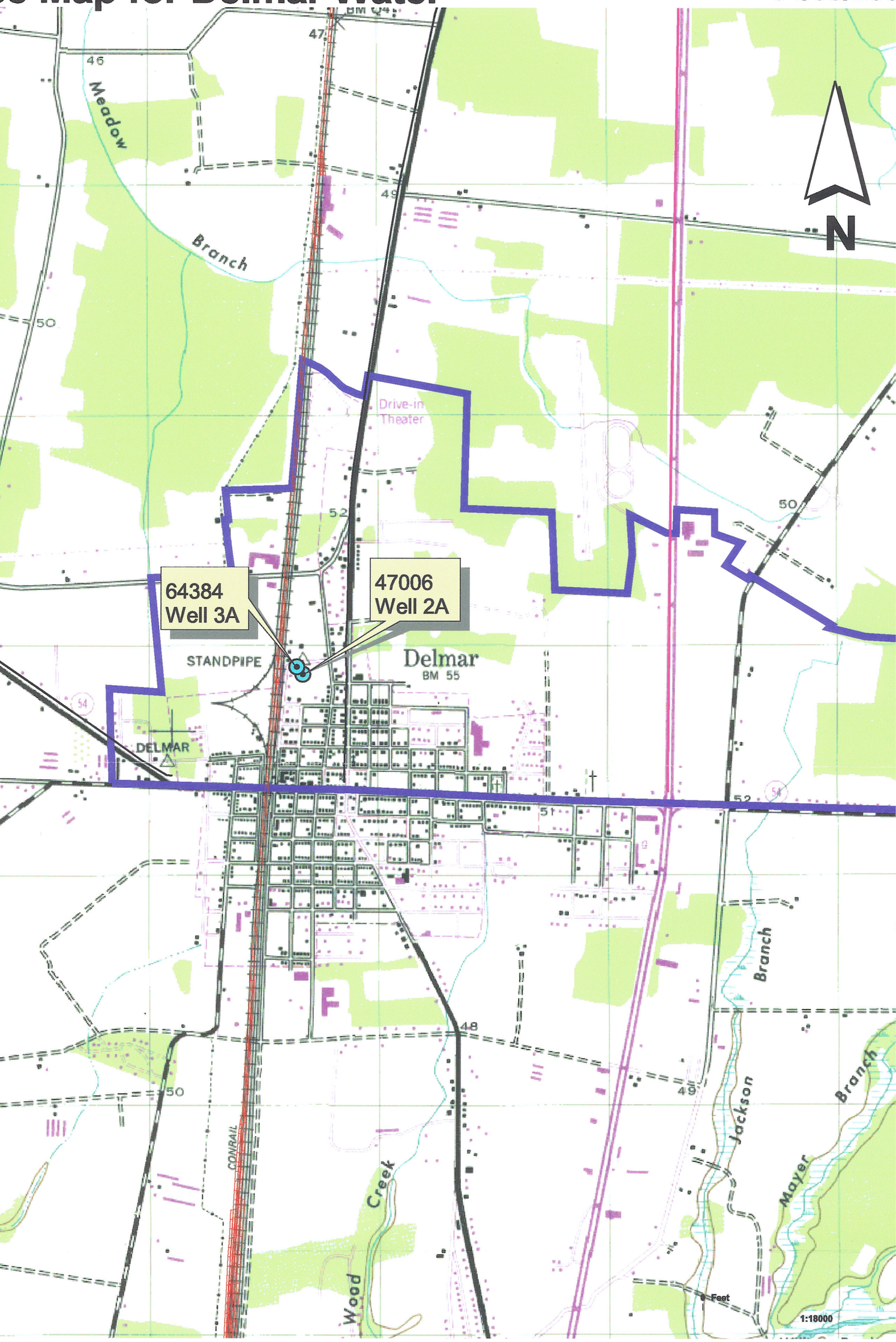
Appendix A: Maps

se Map for Delmar Water

04/08/200



se Legend

DNREC ID	LOCAL ID	DATE DRILLED	CAPACITY (gpm)	DIAMETER (inches)	DEPTH (feet)
47006	2A	1980-10-17	1100	16	205.0
64384	3A	1986-04-07	750	10	146.0

Appendix B: Tables

Delmar Water Department

Discrete Sources Within WHPA

WHPA	Site Type	Site Name	Site ID	Nutrients	Pathogens	Petroleum	Pesticides	PCBs	Organics	Metals	Inorganics	Site Comments
Town of Delmar WHPA Well 2A (47006) & Well 3A (64384)	Hazardous Waste Generator	Crystal Steel Fabricators	DE-1017060	N	N	N	N	N	L	N	N	
	Hazardous Waste Generator	Crystal Steel Fabricators	DEO001017060	N	N	N	N	N	M	N	N	
	Underground Storage Tank	Cheers (was Galaxy Bvg. Co.)	UST MDE DA 01	N	N	M	N	N	N	N	N	
	Underground Storage Tank	Concrete Building Systems, Inc.	5000028	N	N	L	N	N	N	N	N	
	Underground Storage Tank	Lewes Dairy Market	5000194	N	N	H	N	N	N	N	N	
	Underground Storage Tank	Gordy Fuel Co.	5000197	N	N	L	N	N	N	N	N	
	Underground Storage Tank	Delmar Exxon	5000198	N	N	M	N	N	N	N	N	
	Underground Storage Tank	Al's Used VW, Inc.	5000205	N	N	L	N	N	N	N	N	
	Underground Storage Tank	Columbia Vending Corp.	5000223	N	N	N	N	N	N	N	N	
	Underground Storage Tank	All Waste Environmental Service, Chesapeake	5000230	N	N	L	N	N	N	N	N	
	Underground Storage Tank	Delmar Water Treatment Facility	5000424	N	N	L	N	N	N	N	N	
	Underground Storage Tank	JGRC, Inc.	5000501	N	N	L	N	N	N	N	N	
	Underground Storage Tank	Delmar Fire Department	5000597	N	N	L	N	N	N	N	N	
	Underground Storage Tank	Steel Tech Fabricators Co.	5000602	N	N	N	N	N	N	N	N	
	Underground Storage Tank	Car City Auto	5000648	N	N	H	N	N	N	N	N	
	Underground Storage Tank	Johnsons Used Cars	5000841	N	N	L	N	N	N	N	N	
	Waste Water Outfall	Concrete Building Systems, Inc.		N	N	N	N	N	N	N	N	
				N	N	H	N	N	M	N	N	

Delmar Water Department

Land Use Data

Well	LULC	Area (acres)	Percent	Nutrients	Pathogens	Petroleum	Pesticides	PCBs	Organics	Metals	Inorganics	Site Comments
Town of Delmar WHPA for Well 2A (47006) and Well 3A (64384)	Residential	126.79	33.61	L	L	L	L	N	N	N	N	
	Cropland	108.97	28.89	M	N	N	L	N	N	N	L	
	Commercial	35.63	9.44	L	N	L	L	L	L	L	L	
	Forested	33.94	9.00	N	N	N	L	N	N	N	N	
	Industrial	32.74	8.68	N	N	L	N	L	L	L	L	
	Wetlands	24.54	6.51	N	N	N	N	N	N	N	N	
	Barren / Open	8.01	2.12	N	N	N	N	N	N	N	N	
	Farmsteads	6.30	1.57	L	L	L	L	N	N	N	N	
	Water	0.16	0.04	N	N	N	N	N	N	N	N	
Total		377.08		M	L	L	L	L	L	L	L	

H = High, L = Low, M = Medium, N = Negligible

Conversion Chart for determining Susceptibility based upon Vulnerability and Contaminant Potential

Vulnerability + (Matrix Row)	Contaminant Potential = (Matrix Column)	Susceptibility
High Vulnerability		
High +	High Contaminant Potential =	Very High Susceptibility (6)
High +	Medium Contaminant Potential =	High Susceptibility (5)
High +	Low Contaminant Potential =	Moderate Susceptibility (4)
High +	Negligible Contaminant Potential =	Low Susceptibility (3)
Medium Vulnerability		
Medium +	High Contaminant Potential =	High Susceptibility (5)
Medium +	Medium Contaminant Potential =	Moderate Susceptibility (4)
Medium +	Low Contaminant Potential =	Low Susceptibility (3)
Medium +	Negligible Contaminant Potential =	Very Low Susceptibility (2)
Low Vulnerability		
Low +	High Contaminant Potential =	Moderate Susceptibility (4)
Low +	Medium Contaminant Potential =	Low Susceptibility (3)
Low +	Low Contaminant Potential =	Very Low Susceptibility (2)
Low +	Negligible Contaminant Potential =	Not Susceptible (1)

Well Susceptibility: Delmar Water Department

	Nutrients	Pathogens	Petroleum Hydrocarbons	Pesticides	PCBs	Other Organics	Metals	Other Inorganics
Well 2A 47006 Vulnerability: Medium								
Contaminant Potential Summary								
From Discrete Sources	Negligible	Negligible	High	Negligible	Negligible	Medium	Negligible	Negligible
From Land Use	Medium	Low	Low	Low	Low	Low	Low	Low
Highest Potential	Medium	Low	High	Low	Low	Low	Low	Low
Susceptibility								
Based Only on Vulnerability	Medium	Low	High	Low	Low	Low	Low	Low
Adjusted Due to Analytical Data							Exceeds Standards	
Final Susceptibility Determination	**Moderate**	**Low**	**High**	**Low**	**Low**	**Low**	**Exceeds Standards**	**Low**

	Nutrients	Pathogens	Petroleum Hydrocarbons	Pesticides	PCBs	Other Organics	Metals	Other Inorganics
Well 3A 64384 Vulnerability: Medium								
Contaminant Potential Summary								
From Discrete Sources	Negligible	Negligible	High	Negligible	Negligible	Medium	Negligible	Negligible
From Land Use	Medium	Low	Low	Low	Low	Low	Low	Low
Highest Potential	Medium	Low	High	Low	Low	Low	Low	Low
Susceptibility								
Based Only on Vulnerability	Medium	Low	High	Low	Low	Low	Low	Low
Adjusted Due to Analytical Data							Very High	
Final Susceptibility Determination	**Moderate**	**Low**	**High**	**Low**	**Low**	**Low**	**Very High**	**Low**

Overall System Susceptibility: Delamar Water Department

	Nutrients	Pathogens	Petroleum Hydrocarbons	Pesticides	PCBs	Other Organics	Metals	Other Inorganics
Well 2A 47006	Moderate	Low	High	Low	Low	Low	Exceeds Standards	Low
Well 3A 64384	Moderate	Low	High	Low	Low	Low	Very High	Low
Minimum	Moderate	Low	High	Low	Low	Low	Very High	Low
Average	Moderate	Low	High	Low	Low	Low	Very High	Low
Maximum	Moderate	Low	High	Low	Low	Low	Exceeds Standards	Low

Appendix C: Analytical Data

DELMAR WATER DEPARTMENT

CONTAMINANT CATEGORY: Metals

Iron (Fe) LIMIT: SMCL 0.3 mg/L Occurence: Natural

Facility	Sample date	Result
WELL #2A		
	3/27/2000	0.34
WELL #3A		
	3/27/2000	0.24

Appendix D: Data Sources

Data Sources Used in Source Water Assessments			
Data Type	**Organization**	**Section**	**Phone Number**
Public Water Supply Well Data	Department of Natural Resources and Environmental Control	Water Supply Section	(302) 739-4793
Public Water Supply Well Data	Delaware Geological Survey		(302) 831-2833
Water Quality Data	Department of Health and Social Services	Division of Public Health Office of Drinking Water	(302) 739-5410
Land Use / Land Cover GIS Coverage	Delaware Office of State Planning Coordination		(302) 739-3090
Animal Feedlot Operations	County Conservation Districts		Kent: (302) 697-2600 New Castle: (302) 832-3100 Sussex: (302) 856-3990
Combined Sewer Overflows (CSOs)	Department of Natural Resources and Environmental Control	Surface Water Discharges Section	(302) 739-5731
Dredge Spoil Disposal Areas	Department of Natural Resources and Environmental Control	Soil and Water Conservation	(302) 739-4411
Hazardous Waste Generator Sites	Department of Natural Resources and Environmental Control	Solid and Hazardous Waste Management Branch	(302) 739-3689
Landfills and Dumps	Department of Natural Resources and Environmental Control	Solid and Hazardous Waste Management Branch	(302) 739-3689
Large On-site Septic Systems	Department of Natural Resources and Environmental Control	Ground Water Discharges Section	(302) 739-4762
NPDES Wastewater Outfalls	Department of Natural Resources and Environmental Control	Surface Water Discharges Section	(302) 739-5731
Pesticide Loading, Mixing, and Storage Facilities	Delaware Department of Agriculture	Pesticide Management Section	(302) 739-4811
Salvage Yards	Department of Natural Resources and Environmental Control	Solid and Hazardous Waste Management Branch	(302) 739-3689
Site Investigation and Restoration Branch (SIRB) [Superfund] Sites	Department of Natural Resources and Environmental Control	Site Investigation and Restoration Branch	(302) 395-2600
Sludge Application Sites	Department of Natural Resources and Environmental Control	Surface Water Discharges Section	(302) 739-5731
Spray Irrigation Sites	Department of Natural Resources and Environmental Control	Ground Water Discharges Section	(302) 739-4762
Tire Piles	Department of Natural Resources and Environmental Control	Solid and Hazardous Waste Management Branch	(302) 739-3820
Toxic Release Inventory Sites	Department of Natural Resources and Environmental Control	Air Quality Management Section	(302) 739-4791
Underground Storage Tanks	Department of Natural Resources and Environmental Control	Underground Storage Tank Branch	(302) 395-2500