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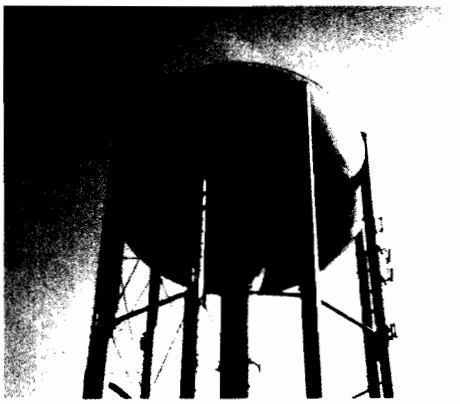
MASSAPEQUA WATER DISTRICT

NASSAU COUNTY, NEW YORK



SUMMARY REPORT

WATER QUALITY STUDY

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WATER QUALITY STUDY

SUMMARY REPORT

The Massapequa Water District supplies water to approximately 13,750 services in an area of approximately 6.5 square miles. The District service area includes the unincorporated area of Massapequa and the Incorporated Village of Massapequa Park.

The Massapequa Water District maintains four water supply sites with four well pump stations, eight operating supply wells, three booster pump stations, four storage tanks and approximately 146 miles of water mains. The District serves a residential population of approximately 40,000 persons.

The quality of the District's groundwater supply has been excellent, meeting Federal and State Drinking Water Standards, except that the concentration of iron in the water produced by five of the District's wells exceeds the aesthetic maximum containment level (MCL). The District treats all of its wells with phosphate to sequester the iron present in the water and to inhibit corrosion of the District's unlined cast iron water mains. The District also treats the water produced by all of its wells with sodium hypochlorite to oxidize any hydrogen sulfide that may be present in the raw well water. The chlorine treatment also maintains the quality of the water in the distribution system. Disinfection by chlorination is required by Part 5 of the New York State Sanitary Code.

Even though the water distributed by the District meets all Federal and State Drinking Water Standards, the District has always had a concern about the levels of iron present in the raw water, the need to treat with phosphates to sequester the iron and the need for chlorination.

The Water Quality Study includes:

- A review of the naturally occurring chemical composition of the water that the District pumps from the groundwater aquifer.
- A review of the District's current water treatment practices.
- An investigation of alternative treatment practices.
- An investigation of health risks of the chemicals naturally present in the water and of those chemicals which are added to the water.
- Conclusions and recommendations.

EXISTING WATER SYSTEM

The District's source of supply consists of eight wells with a total of 11,900 gallons per minute (gpm) (17 million gallons per day [MGD]). The District's wells draw water from

the Magothy aquifer and range in depths from 445 to 850 feet below the ground surface. The District has four storage tanks with a total capacity of 4,000,000 gallons and approximately 146 miles of water mains ranging in size from 6-inch to 18-inch diameter. Approximately 86 miles of the water mains are unlined cast iron pipe.

The District treats all water at the well head of each well with sodium hypochlorite, sodium hydroxide and a polyphosphate. Sodium hypochlorite is added to oxidize (remove) any hydrogen sulfide which may be present and to maintain the quality of the water in the distribution system. Sodium hydroxide is added to raise the pH to slightly above neutral, which reduces the corrosion of the unlined cast iron mains and of customers plumbing systems. Phosphate is added to sequester (maintain in solution) the iron present in the well water and as an additional corrosion control measure.

WATER QUALITY

In general, the raw water produced by the District's wells can be characterized as being of excellent quality. The water is very soft with a Total Hardness of 5 milligrams per liter (mg/l) as calcium carbonate, or less; has low Alkalinity and Dissolved Solids; and is highly aggressive (corrosive).

The District's wells produce water which contains iron and trace amounts of other naturally occurring chemicals. The levels of iron present in the water do not in any way pose a health concern. Five wells produce water with iron concentrations greater than the aesthetic (color and staining) maximum contaminant level (MCL) of 0.3 mg/l. The level of iron in samples taken from the distribution system over the past seven years averaged between 0.25 and 0.40 mg/l. As previously indicated, the water produced by all of the District's wells is treated with a phosphate compound to sequester the iron present in the water to prevent color and staining and to inhibit corrosion. This treatment method is acceptable to Federal, State and County regulatory agencies.

COMPLAINTS

The water quality complaints received by the District addresses two major areas: (1) cloudy or colored (rusty) water; and (2) taste and odor. Rusty or cloudy water consumer complaints in a groundwater supply are generally from iron and manganese in the raw well water as well as iron from unlined cast iron pipe corrosion which can deposit in the piping system. Events in the distribution system such as flow reversals, high demands, opening hydrants, etc. can cause the iron deposits in the mains to be disturbed and carried in the water to the consumer's faucet. Taste and odor consumer complaints in a groundwater supply may be associated with the presence of hydrogen sulfide in the raw well water; iron, manganese and metallic products of corrosion; and with chlorine used to disinfect the water.

Complaints to the District from 1993 to 1997 were compared to the complaints received by four other water suppliers that are located on the south shore of Nassau County that have iron present in the raw water at concentrations above 0.3 mg/l. The average rusty water complaint rate for the five water suppliers for the five year period ranged from 4.9 to 43.7 complaints per 1,000 customers per year. The average for the District was 6.9

complaints per 1,000 customers per year. The District experienced problems with its chemical metering pumps in 1996/1997 and corrected the problems prior to 1998. The rusty water complaint rate decreased to 2.7 complaints per 1,000 customers per year in 1999. This rusty water complaint rate can be considered expected and normal for a typical Long Island south shore groundwater supplier such as the Massapequa Water District.

The average taste and odor complaint rate for four of the five suppliers for the five year period ranged from 1.1 to 6.4 complaints per 1,000 customers per year. The average for the District was 2.9 complaints per 1,000 customers per year. The District's taste and odor complaints rate decreased to 1.3 complaints per 1,000 customers per year in 1999. This taste and odor complaint rate can also be considered expected and normal for a typical Long Island south shore groundwater supplier such as the Massapequa Water District.

HEALTH RISK LITERATURE REVIEW

The Health Risk Literature Review was focused upon naturally occurring chemicals in the source groundwater or from treatment chemicals added to the water supply for disinfection or corrosion control and their possible affect on the health or well-being of the District's consumers.

The literature search made use of numerous medical, technical and environmental data bases such as compiled by the National Library of Medicine (Medline), American Cancer Society, American Medical Association, American Water Works Association Research Foundation, Environmental Health Information Service, Environmental Research Foundation, U.S. Centers for Disease Control and Prevention, and Environmental Protection Agency (USEPA).

Chemical constituents that were researched were grouped into general categories such as:

- Metals - calcium, magnesium, copper, lead, iron, manganese, sodium, and zinc.
- Other Contaminants - nitrates, ammonia, sulfides, sulfates, phosphates, sodium hydroxide, asbestos and methyl tertiary butyl ether (MTBE) – a gasoline additive.
- Disinfectants - chlorine and chlorination byproducts.

Epidemiological studies indicate that some chemical constituents are or possibly may be carcinogens or be related to other health problems (heart, lungs, neurological, etc.) only when chronically ingested at high dosage levels and quantities. Other studies suggest that certain chemicals, notably calcium and magnesium at high levels, may provide a protective beneficial effect against gastric cancer and cardiac or cerebrovascular problems.

There is no indication that the low concentration of chemicals found in the water supplied by the Massapequa Water District suggests any adverse or beneficial effects on the health of the consumers.

TREATMENT METHODS LITERATURE REVIEW

The Treatment Methods Literature Review concentrated on identifying the available processes for the treatment currently provided by the District which are as follows:

- Removal of hydrogen sulfide.
- Iron Control
- Disinfection
- Corrosion Control

The District currently provides treatment to address each of these water quality parameters as required by the regulatory agencies prior to distributing the water to customers.

Hydrogen Sulfide

Treatment methods identified for hydrogen sulfide include adsorption, aeration, filtration and chemical oxidation. The most practical and cost effective methods are aeration and chemical oxidation. The District uses chlorine to chemically oxidize the hydrogen sulfide that may be present in the water at an estimated operating cost of $5.50 per million gallons. The chlorine treatment also maintains the bacteriological quality of the water in the distribution system. Aeration would require capital expenditures to construct the treatment facility and a clear well, which would require double pumping of the water and would result in additional operating costs. The capital cost for a tray aerator type treatment facility including a clear well and booster pump, for a 2.0 MGD well is estimated at $388,000 and the operating cost for this treatment is estimated at $102.00 per million gallons.

Iron

The two treatment methods that are used on Long Island to treat the iron naturally present in some wells are sequestering and removal by any one of several methods. Sequestering of the iron with a linear chain polyphosphate is the most common sequestering method used on Long Island and is the method currently used by the District. Operating cost for sequestering iron with phosphates is estimated at $23.00 per million gallon.

The literature search identified oxidation/filtration as the most applicable treatment for iron removal for groundwater systems, since these processes can be operated under pressure, thus eliminating the need for re-pumping to the distribution system. The filters require periodic backwashing which is required to remove material collected on the filter

beds. Backwash water is generally discharged to a sanitary sewer system and a permit would be required. The capital cost for an iron removal treatment facility for one 2.0 MGD well is estimated at $2,100,000 and the operating cost is estimated at $96.00 per million gallons.

Disinfection

The State Health Department requires disinfection by chlorination or other acceptable disinfection method as a minimum treatment for groundwater sources. The State may grant a waiver to this disinfection rule for groundwater sources on the submission of a written application and providing the supplier meets certain criteria. When chlorine is used as a disinfectant, the State requires the supplier to maintain a free chlorine residual at representative points in the distribution system.

The review of treatment methods literature identified other disinfection methods, but none of the other methods offer the same reliability nor are they as cost effective as chlorination. Disinfection by products (DBPs) are generally not found in groundwater systems, since the precursors needed for the chlorine to react with to form the DBPs are generally not present in a groundwater source.

The most feasible alternatives available to the District are to continue to practice disinfection by chlorination or to obtain a waiver from chlorination. In order to obtain a waiver from chlorination, the District would first have to construct aeration treatment facilities at each of its wells to eliminate the need to treat with chlorine to oxidize hydrogen sulfide. If the District elects to construct iron removal treatment facilities that use chlorine to oxidize the iron, de-chlorination would be required as part of the iron removal treatment facility. As an alternative, the District could construct aeration and iron removal facilities and continue disinfection with a low concentration of chlorine.

Other consequences to evaluate when considering discontinuing chlorination are: (1) the lack of a chlorine residual in the distribution system to protect against microbial problems that may occur, and (2) past experience of the District with complaints when the chlorine residual dissipated due to long residence times in the distribution system in some low flow areas.

Corrosion Control

Three methods were identified for corrosion control as follows:

- Calcium Carbonate Precipitation
- Carbonate Passivation
- Inhibitor Passivation

Raw water characteristics of pH, alkalinity and calcium content are used to determine the best corrosion control alternative for a water supplier. Based upon the District's raw water quality of low pH, low Alkalinity and low calcium concentration, the two alternatives available to the District are carbonate passivation and inhibitor passivation.

The District currently uses a combination of carbonate passivation and inhibitor passivation to achieve optimum corrosion control.

Carbonate passivation consists of adjusting the alkalinity and pH of the water to minimum required levels. Inhibitor passivation consists of adding a corrosion inhibitor such as phosphates or silicates and maintaining optimum levels in the distribution system.

The District uses sodium hydroxide to raise the pH of the raw water. The sodium hydroxide reacts with the carbon dioxide naturally present in the water to form alkalinity. This raises the low alkalinity in the raw water to above the minimum levels required for corrosion control. Lime is the only viable alternate chemical available to the District for pH adjustment. The District converted from lime treatment to sodium hydroxide treatment for pH adjustment a number of years ago, because lime treatment requires a lot of operating personnel time and is difficult to use. The District is able to maintain adequate pH and alkalinity levels for corrosion control with the sodium hydroxide treatment.

There is no designated limit for a maximum contaminant level for sodium, but the State Health Department recommends that water containing more than 20 mg/l should not be used for drinking by people on severely restricted sodium diets and that water containing more than 270 mg/l of sodium should not be used for drinking by people on moderately restricted diets. Even though the District uses sodium hypochlorite for chlorination, sodium hydroxide for pH adjustment and sodium phosphate for sequestering iron, the total level of sodium in the water delivered to customers ranges from approximately 10mg/l to 24 mg/l.

The regulations require that a demonstration study be performed before any changes are made in corrosion control treatment.

CONCLUSIONS

The conclusions reached by this study follow:

1. Raw Water Quality – The District's raw water is highly aggressive (corrosive), is very soft, contains iron and, at times, contains hydrogen sulfide which produces a rotten egg odor. The quality of the raw water has been relatively consistent over the past few years with no apparent increase in any of the chemicals for which analysis are performed. The District's raw water is considered to be of excellent quality because it meets drinking water quality MCLS and because it does not contain any harmful parameters that require removal prior to distribution.

2. Distribution System Water Quality – The water in the District's distribution system is mildly corrosive. Iron concentrations in the distribution system water appear to reflect the concentrations in the raw water, but slightly higher copper levels indicate that minimal corrosion is taking place. The District's distribution water is considered to be of excellent quality.

3. Treatment – Based upon the District's rusty or cloudy water complaint rate, the treatment of iron present in the raw water is being effectively treated by sequestering it with phosphates. The lead and copper sampling results indicate that with the addition of sodium hydroxide to raise the pH of the raw water and the addition of phosphates, the District has optimized corrosion control treatment. The chlorine, which is added to oxidize any hydrogen sulfide that may be present in the raw water and to maintain water quality in the distribution system has been effective as the District continues to have negative results for microbial sampling analyses year after year. Treatment provided by the District has been optimized to meet the intended goals.

   The capital and operating cost for aeration treatment at each well to remove hydrogen sulfide in lieu of oxidation of the hydrogen sulfide is excessive and its justification is questionable. Based upon past studies and the District's experience, the District will still be required to chlorinate the water produced by each of its wells to maintain a chlorine residual in the distribution system, to avoid potential taste and odor complaints as a result of the reduction of sulfate to hydrogen sulfide.

   The capital and operating cost for iron removal treatment at each well to remove iron in lieu of sequestering the iron with phosphates is excessive and its justification is questionable, since the sequestering is effective and there would be a minimal benefit. The addition of phosphates as a corrosion inhibitor will still be required to inhibit the corrosion of the unlined cast iron mains and most likely, to also maintain optimal corrosion control. The addition of phosphates also coats and protects the transite mains in the distribution system.

4. Complaints – The District's rusty and cloudy water and taste and odor complaint rates are low compared to comparable suppliers on the south shore in Nassau County. There is no known health related problem associated with the rusty water, tastes or odors in those areas where complaints were received or in any other area of the District.

5. Causes of Complaints – The major factors in the cause of rusty water complaints are the corrosive nature of the water, hydraulic dead ends in the distribution system and actual dead end pipes. Over the past several years, the District eliminated complaints from customers on dead end pipes by replacing the unlined cast iron pipes with cement lined ductile iron mains. The District also eliminated complaints from a hydraulic dead end area by mechanical cleaning and cement lining of the mains in the area.

   The major factor in the cause of most of the taste and odor complaints has been attributed to the lack of a chlorine residual in the distribution system.

   By taking the actions it has over the past several years and by maintaining proper levels of phosphate and chlorine treatment the District has effectively addressed complaints.

RECOMMENDATIONS

Following are recommendations regarding water quality and treatment for the Massapequa Water District.

1. General – It is recommended that the District wait until the EPA promulgates the Groundwater Rule (GWR) prior to considering any changes in treatment. The statutory deadline for promulgation of the GWR is May 2002, but the EPA intends to promulgate the rule by November, 2000.

   The EPA proposes to allow three years for compliance and to ensure simultaneous compliance by groundwater systems with the Stage 1 Disinfection By Products Rule (DBPR) and the GWR. Groundwater systems must begin the sampling under the Stage 1 DBPR in November, 2003. Under the GWR, the EPA is considering mandatory disinfection of groundwater systems. Latest information indicates that the EPA may include provisions for waivers from mandatory disinfection in the GWR, but the criteria is not known at this time. The GWR may require contact time prior to pumping to the distribution systems. This will require a change from the current practice of adding the disinfectant as the water is pumped to the distribution system.

2. Hydrogen Sulfide and Chlorine Treatment – It is recommended that the District continue with its current treatment for removal of hydrogen sulfide, which consists of oxidizing the hydrogen sulfide with chlorine. Past District experience indicates that the District receives complaints whenever there is a low or no chlorine residual in the distribution system. A prior study indicated that there may be iron bacteria in the distribution system. Chlorine is required to control the iron bacteria. The District has been chlorinating its system for so many years, that cessation of chlorination may result in positive coliform samples and, potentially, the required public notification that the MCL is exceeded. The Nassau County Commissioner of Health is against issuing waivers from mandatory chlorination and is of the opinion that all water systems should be chlorinated. Stopping and restarting chlorination may result in more consumer complaints than if chlorination was continuous. In any event, it is recommended that the District not do anything with its current chlorination treatment until the EPA promulgates the Groundwater Rule. The current treatment practice for removal of hydrogen sulfide is effective and the least costly method.

3. Iron Removal Treatment – It is recommended that the District continue to sequester the iron naturally present in the well water with a linear chain polyphosphate. Sequestering iron is the most cost effective method for treatment of the iron. The District should continue to monitor the concentration of iron present in its wells and consider iron removal treatment if the concentration of iron exceeds one milligram per liter. The excessive cost of iron removal treatment is not warranted since there will be little or no benefit.

4. Phosphate Treatment – It is recommended that the District continue to treat all the water produced by its wells with a linear chain polyphosphate to sequester

the iron in the well water and to inhibit corrosion of the distribution system (especially unlined cast iron mains) and customers plumbing systems. Even if the District provides treatment to remove the iron from the well water, it is recommended that the District continue to treat all well water with phosphates to inhibit corrosion of the unlined cast iron water mains. In addition, the phosphate treatment may be required to obtain optimal corrosion control treatment and should not be stopped without prior pilot testing.

5. pH Adjustment Treatment – It is recommended that the District continue to treat with Sodium hydroxide to raise the pH of the well water prior to pumping it to the distribution system. Adjusting pH with sodium hydroxide is the most cost effective method. The District has achieved optimal corrosion control treatment using sodium hydroxide for pH adjustment and phosphates.

6. Flushing of Distribution System – It is recommended that the District continue its current program of flushing water mains to remove sediment that may deposit in the mains.

7. Monitor Consumer Complaints – It is recommended that the District continue to monitor consumer complaints and consider improvements to the distribution system in high repetitive complaint areas.